

Rs. 10



JIMA

JOURNAL *of the* **INDIAN MEDICAL ASSOCIATION**

An Official Publication of the Indian Medical Association

Largest
Circulated
Medical Journal
in India

ISSN 0019-5847

97TH
YEAR OF
PUBLICATION

Volume 124 (JIMA)
Volume 70 (RNI)
Number 07
July 2026
KOLKATA

Visit us at
<https://onlinejima.com>



JAYPEE Jaypee Journals



Indexed in

Scopus[®]
Embase[®]

01



sanofi

Fast relief in allergies with nasal congestion*



Fast onset of action
30 minutes¹



Sustained effect
up to 12 hrs²



9.3% improvement
in work productivity³

Recommended by global
and Indian guidelines



Say yes to more

In chronic allergies with nasal congestion

Allegra-D[®]

Fexofenadine Hydrochloride and Pseudoephedrine
Hydrochloride ER Tablets U.S.P. 60mg/120mg

NRx

NON-DROWSY

Fexofenadine Hydrochloride and Pseudoephedrine
Hydrochloride ER Tablets U.S.P. **60mg/120mg**

Allegra-D[®]

50 TABLETS

12H

Image used for illustrative purpose only.

ARIA: Allergic Rhinitis and its Impact on Asthma. EUFORA: European Forum for Research and Education in Allergy and Airway Diseases. AOI: The Association of Otolaryngologists of India. JSA: Japanese Society of Allergy. BSACI: British Society for Allergy and Clinical Immunology.

Disclaimer: Guidelines suggest giving decongestant as an add on therapy to antihistamines, which can be monotherapy or in combination. In clinical studies with the fexofenadine/pseudoephedrine combination, nasal obstruction improvement was observed from ~30 minutes, with decongestant effects sustained for up to 12 hours with the ER component. Individual response may vary; see Prescribing Information.

*As per Allegra D[®] PI- please access: <https://www.sanofi.com/en/india/consumer-healthcare/for-healthcare-professionals/product-information>.

References: 1. Dhanya NB, et al. Comparative efficacy of levocetirizine, desloratadine and fexofenadine by histamine wheal suppression test. *Indian J Dermatol Venereol Leprol*. 2008;74(4):361-363. 2. Nakamura Y, et al. Effect of fexofenadine/pseudoephedrine combination tablet on nasal obstruction in patients with allergic rhinitis using rhinomanometry: A randomized controlled trial. *Asian Pac J Allergy Immunol*. 2024;42(2):147-53. 3. Sussman, et al. The efficacy and safety of fexofenadine HCl and pseudoephedrine, alone and in combination, in seasonal allergic rhinitis. *J Allergy Clin Immunol*. 1999;104(1):100-6. 4. Sousa-Pinto B, et al. Allergic Rhinitis and Its Impact on Asthma (ARIA)-EAAACI Guidelines- 2024-2025 Revision: Part I- Guidelines on Intranasal Treatments. *Allergy*. Published online December 1, 2025. 5. Hellings PW, et al. EUFORA treatment algorithm for allergic rhinitis. *Rhinology*. 2020;58(6):618-622. 6. Bhargava S, et al. Indian Guideline on Allergic Rhinitis, formulated by Association of Otolaryngologists of India -2021. Available from: <https://www.aoidelhi.org/picture/150224092818AOI-AR-Guidelines.pdf> 7. Okano M, et al. Executive summary: Japanese guidelines for allergic rhinitis 2020. *Allergol Int*. 2023;72(1):41-53. 8. Scadding GK, et al. BSACI guideline for the diagnosis and management of allergic and non-allergic rhinitis (Revised Edition 2017; First edition 2007). *Clin Exp Allergy*. 2017;47(7):856-889.

Please refer to the complete prescribing information (which contains all necessary safety information, contraindications, and usage guidelines before making prescribing decisions): <https://www.sanofi.com/en/india/consumer-healthcare/for-healthcare-professionals/product-information>

Sanofi Consumer Healthcare India Limited. Unit 1104, 11th Floor, Godrej Two, Pirojshanagar Eastern Express Highway, Vikhroli East, Mumbai - 400079, Maharashtra.

For the use only of a Registered Medical Practitioner or a Hospital or a Laboratory

MAT-IN-2501402 v1.0 12/25

In Fever & Pain, continue your trust

Rx

Dolo-650

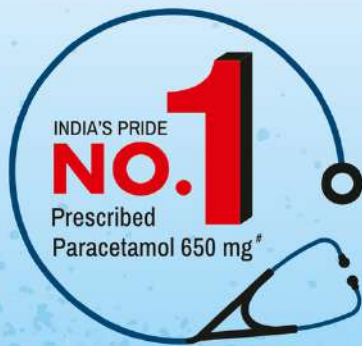
Paracetamol 650 mg Tablets

Extra Strength for Faster & Longer Action

TECHNOLOGY THAT MATTERS



Engineered for fast disintegration
with specialized disintegrant¹
“Sodium Starch Glycolate
(SSG)”¹



Born with... **FASTER
DISINTEGRATION***

**BETTER
ABSORPTION**

**FASTER
ACTION**

1. Shah U et al. Pharm Dev Technol. 2002;7(3):345-59.
#. IQVIA April'25 MAT. | *. Data on file (COA).



**MICRO LABS
LIMITED**

TEAM IMA (2025-26)



National President
Dr. Anilkumar J Nayak
Gujarat



Imm. Past National President
Dr. Dilip Bhanushali
Telangana



Hony. Secretary General
Dr. Sarbari Dutta
Bengal



Hony. Finance Secretary
Dr. Piyush Jain
Delhi

National Vice Presidents



Dr. Ramesh R.
Kerala



Dr. Sunil Chugh
Rajasthan



Dr. Dhanwantari Tiwary
Jharkhand



Dr. Yagnesh Popat
Gujarat

Honorary Joint Secretaries



Dr. Rajnesh Attam
Delhi



Dr. Vasant Ramraoji Lunge
Maharashtra



Dr. Anand Prakash
Uttar Pradesh



Dr. Sibabrata Banerjee
Bengal



Dr. Kamlesh sainsi
Gujarat

Honorary Assistant Secretary



Dr. Sandeep Datta
Delhi



Dr. Vinod Tiwari
Chhattisgarh



Dr. Anirban Dalui
Bengal, Stationed at JIMA, Kolkata



Dr. Rajendra Kumar Yadav
Telangana



Dr. Jyotirmoy Pal
Bengal

Honorary Jt. Finance Secretary

IMA COLLEGE OF GENERAL PRACTITIONERS

Dean, IMA-CGP



Dr. Shobha Ahuja
Maharashtra

Vice Dean



Dr. Braja Kishore Dash
Odisha

Honorary Secretary



Dr. Amutha Karunanidhi
Tamilnadu

The ideal 1st line of treatment in URTI & SSTI



^{Rx} **LYNX** [®]
Lincimycin Injection/Capsules/OD Tablets/Gel



Indian & Global Recommendation^{1,2,3,4,5}

Narrow Spectrum Antibiotics should be preferred as 1st line of treatment

NICE National Institute for
Health and Care Excellence

IDSA Infectious Diseases
Society of America



**National Centre for
Disease Control**

Scores over other antibiotics

Spectrum

- ❖ Gram positive aerobic and anaerobic bacteria especially *S. aureus*, *S. pneumoniae*

❖ Low MIC

Against most of the gram positive pathogens & anaerobes

Strengths

❖ High Penetration

High concentration in both vascular, avascular tissues, Necrotic tissue & pus

❖ Binding to PMN's (Polymorphonuclear leukocyte)

Ability to bind to PMN's enhancing efficacy in moderate to severe SSTIs

❖ Least Resistance

Unique mechanism of action - High susceptibility

Indications

- Abscess
- Cellulitis
- Infected wounds
- Boils
- Diabetic foot
- Bone & Joint infections
- Tonsillitis
- Sinusitis
- Otitis Media
- Laryngopharyngitis

1. NICE guideline. 2018-23

2. Clinical Infectious Diseases, Volume 53, Issue 7, 1 October 2011

3. WHO - <https://aware.essentialmeds.org/groups>

4. Antibiotic Stewardship Statement for Antibiotic Guidelines - CDC

5. <https://ncdc.mohfw.gov.in/>

6. Br J Surg. 1976 Dec;63(12):973-7

7. JAC 7 supplement A: 1981

NICE - National Institute for health & Care Excellence



IMA COLLEGE OF GENERAL PRACTITIONERS

Honorary Joint Secretaries, IMA - CGP



Dr. Aadhar Senthil Kumar
Tamilnadu



Dr. Ujwala Dahiphale
Maharashtra



Dr. Hemanga Baishya
Assam



Dr. Vanrajsinh A. Mahida
Gujarat



Dr. Vikas Sharma
Delhi



Dr. D. Kesavan
Tamilnadu

IMA ACADEMY OF MEDICAL SPECIALITIES



Chairperson
Dr. M. Venkatchalapathy
Karnataka



Vice Chairman
Dr. V. Amuthan
Tamilnadu



Honorary Secretary
Dr. C. Sai Ram
Telangana

Honorary Joint Secretaries



Dr. Santosh Kadam
Maharashtra



Dr. Asha Satish Khivsara
Telangana

Honorary Editor



Dr. R. K. Nema
Madhya Pradesh

Honorary Executive Editor



Dr. Sandeep Bhaskar Naik
Goa

IMA AKN SINHA INSTITUTE OF CONTINUING MEDICAL AND HEALTH EDUCATION & RESEARCH



Honorary Director
Dr. Anil S. Pachnekar
Maharashtra



Honorary Exe. Secretary
Dr. Sunil Kumar
Bihar



Honorary Jt. Secretary
Dr. D. S. Singh
Bihar



Honorary Jt. Secretary
Dr. Dilip B. Gadhave
Gujarat

JOURNAL OF IMA



Honorary Editor
Dr. Ranjan Bhattacharyya
Bengal



Honorary Secretary
Dr. Prasanta Kr. Bhattacharyya
Bengal



Honorary Associate Editor
Dr. Asok Kumar Nandi
Bengal



Honorary Associate Editor
Dr. Suman Biswas
Bengal



The All Season Expert for Allergic Rhinitis

For multi-symptom relief,

Montina[®]-L

Montelukast Sodium + Levocetirizine Hydrochloride

Tablets / Syrup

The Synergy that Calms Allergy!



Can be taken
with or without
food unlike other
antihistamines



YOUR HEALTH OF IMA



Honorary Editor
Dr. Khwaja Alim Ahmed
Bengal



Honorary Associate Editor
Dr. Abul Kasem Molla
Bengal



Honorary Associate Editor
Dr. Shailendra Kumar Singh
Uttar Pradesh



Honorary Secretary
Dr. Sankar Sengupta
Bengal

APKA SWASTHYA



Honorary Editor
Dr. Ritu Garg
Uttar Pradesh



Honorary Associate Editor
Dr. Chandra Prakash Singh
Uttar Pradesh



Honorary Associate Editor
Dr. Arvind Sharma
Uttaranchal



Honorary Secretary
Dr. Arun Kumar Tripathi
Uttar Pradesh

IMA HOSPITAL BOARD OF INDIA



Chairman
Dr. K.M. Abul Hasan
Tamilnadu



Honorary Secretary
Dr. Sanjay Dattaraya Patil
Maharashtra



Treasurer
Dr. Anilkumar Bhaskar Patil
Maharashtra

JIMA COMMITTEE - 2026



Dr. Anilkumar J. Nayak
National President, IMA



Dr. Dilip Bhanushali
Imm. Past National President, IMA



Dr. Sarbari Datta
Hony Secretary General, IMA



Dr. Sibabrata Banerjee
Hony. Joint Secretary, Hqs



Dr. Jyotirmoy Pal
Hony. Jt. Finance Secretary, Hqs



Dr. Ranjan Bhattacharyya
Hony. Editor,
JIMA



Dr. Asok Kumar Nandi
Hony. Associate Editor,
JIMA



Dr. Suman Biswas
Hony. Associate Editor,
JIMA



Dr. Prasanta Kumar
Bhattacharyya
Hony. Secretary, JIMA



Dr. Anirban Dalui
Hony. Assistant Secretary,
JIMA



Dr. Sanjoy Banerjee
Member,
JIMA Committee



Dr. Sujoy Ghosh
Member,
JIMA Committee



Dr. Sekhar Chakraborty
Member,
JIMA Committee



Dr. Samarendra Kumar Basu
Member,
JIMA Committee



Dr. Pritam Roy
Member,
JIMA Committee



Dr. Abhijit Chaudhuri
Member,
JIMA Committee



Dr. Debduddha Haldar
Sub Editor, JIMA



SUN PHARMA SCIENCE FOUNDATION CLINICAL RESEARCH FELLOWSHIP 2026

EMPOWERING CLINICIANS TO CARRY OUT INDEPENDENT CLINICAL RESEARCH

We invite Young Physician to avail the “Sun Pharma Science Foundation Clinical Research Fellowship 2026”. This Fellowship is meant to support the brilliant and upcoming early career clinicians working in India. **An Assistant Professor employed in any Medical College in India** will be eligible to be considered for this Research Fellowship. The candidate must have obtained the first academic appointment within three years prior to the date of announcement of the Fellowship. The research proposed to be carried out under this Fellowship should be an independent project of the applicant and must not be a part of a group or departmental research project. The research has to be done on a specific project under the supervision of a renowned researcher of in an institution within India (Desirable : in case of external mentor, the research should be carried out by the selected fellow in the Mentor's Institution). The aim is to enable clinicians for carrying out independent clinical research..

The Sun Pharma Science Foundation Clinical Research Fellowship 2026

Fellowship will be for a duration of six months, which may be availed by an applicant in one or more (not exceeding three) disjoint period of time within three years from the award of the Fellowship. Fellow will receive (a) a maximum of Rs. 9 lakhs as stipend for the approved research project, an amount at par with the selected Fellow's current salary, if the Fellow's employer does not provide any salary support during the period of internship for conducting research elsewhere, (b) travel, Institutional boarding & lodging, if required for carrying research in other labs, (c) a maximum amount upto Rs 12 Lakh will be paid directly as Bench Fee to the training institution, however the amount to be paid will be decided on the basis of the nature of the proposed Project, all subject to submission of Utilization Certificate.

Eligibility

- ❖ A Physician employed as Assistant Professor in any Medical College in India will be eligible to be considered for this Research Fellowship.
- ❖ The research proposed to be carried out under this Fellowship should be an independent project of the applicant, and must not be a part of a group or departmental research project.

How to apply

The applicants should submit their nominations online using the link:-

<https://www.sunpharmasciencefoundation.net/>

Applications will be live from **July 15 2026 to September 15, 2026. Please visit our website and apply.**

A copy of the filled application form with all supporting documents should reach in print to the office of the Foundation within 15 days of submission.

OFFICE OF SUN PHARMA SCIENCE FOUNDATION

8C, 8th Floor, Hansalaya Building, 15-Barakhamba Road, Connaught Place,
New Delhi : 110 001 (India) Tel. (91-11) 23721414/ 23721415
e-mail : sunpharma.sciencefoundation@sunpharma.com
website : www.sunpharmasciencefoundation.net



LAUNCHING SUPERSPECIALITY HOSPITAL

The future of affordable healthcare is at New Town, Kolkata, West Bengal

Disha, the largest eyecare provider in Eastern India, has been dedicated to serving the patients of Eastern India for the past 28 years. We are now embarking on a new venture with the upcoming Disha Superspeciality Hospital, focusing on healthcare that's affordable for all.

Built on 3-acre land | A huge 5 lakh sq. ft. structure | B+G+5 floors | 650-beds

We invite collaboration with experienced doctors who can bring their expertise to individual subspecialties and contribute to the hospital's development with enthusiasm and accountability.

Come, let's together redefine our healthcare standards in this greenfield initiative.

To know more

 **89810 08949**

 **dishamulti@outlook.com**

Kolaz.in



JOURNAL Of the INDIAN MEDICAL ASSOCIATION

Volume 124 (JIMA)
Number 07
July 2026
KOLKATA
ISSN 0019-5847

13 Editorial

Yoga for Healthy Aging: Evidence and Trend — *Ranjan Bhattacharyya*

Original Articles

- Comparative Study on the Caregiver Burden of Patients with Autism Spectrum Disorder and Attention Deficit and Hyperactivity Disorder Attending the Child Psychiatry Clinic of a Tertiary Care Hospital in Kolkata — *Arnab Biswas,*
17 *Ashis Debnath, Shuvankar Mukherjee, SK Kamal Hassan, Asish Mukhopadhyay*

- Change in Transfusion Index Following Splenectomy in Patients with Thalassemia Major: A Retrospective Study Based on Two Teaching Hospitals — *Ritankar Sengupta,*
22 *Sandeep Saha, Subhadeep Datta, Tapas Bandyopadhyay*

- A Comparative Study between the Functional Outcome of Proximal Femoral Nailing and Proximal Femoral Nailing A2 in the Treatment of Intertrochanteric Fractures —
27 *Vignesh Ilangoan, Shebin Christin I, Meenakshi Sundaram K*

- Emotional Intelligence and Parenting Styles: An Observational Study on Adolescent Students and Their Parents in a South Indian School — *Karthikraj T, Sri Andaal,*
33 *Saravanan Muthuarumugam*

- Usefulness of Antenatal Ultrasonographic Measurements in Prediction of Birth Weight and Its Correlation with Early Neonatal Outcome — *Chalasani Vasanth Krishna,*
38 *Chandru Bhaskar V, S Deepa, Shri Ram T, Mathivanan Malaisamy, Vajrapu Keerthana*

- Expression of p16 in Cases of Oral Squamous Cell Carcinoma: A Study of 100 Cases — *Prachi Chouhan, Sushama Gurwale, Charusheela Gore,*
42 *Gayatri Bhuibhar, Pranjali Nibe*

Systemic Review

- Impact Evaluation of Errors in Documentation on the Healthcare System: A Systematic Review — *Subhasish Chatterjee, Amrita Ghosh, Ranabir Pal,*
47 *Kaushik Bhattacharya*

Case Series

- Surgeon's Approach to Spontaneous Small Bowel Intramural Hematoma: A Case Series of Three Cases — *Jyoti Bansal, Vijayendra Kedage, Kallya Rajgopal Shenoy,*
54 *Asish Kishore, Manasa U*

- Sjögren's Syndrome Unveiled—Hypokalemia and Distal Renal Tubular Acidosis as Diagnostic Precursors: A Case Series — *Varun A, Pravin Selvam S,*
59 *Kirubhakaran K, Ranga Bashyam SR*

Case Report

- From Puncture to Pathology—Chronic Hand Swelling Unmasked as Atypical Mycobacterial Tenosynovitis: A Case Report — *Gaurab Ranjan Chaudhuri,*
63 *Akhilesh Humnekar, Rudrakshi Mahaldar, Sourabh Shankar Chakraborty, Saurabh Raj, Shrimoyee Roy, Mainak Mallik*

Contents

- 68 LipStaT: A Smile-transformational Surgery — *Aditi Chaturvedi, Amit Bhardwaj*

Letter To The Editor

- The Use of 3D Printing in Anatomy: Advancements, Applications, and
73 Future Directions — *Preeti Sonje*

Contents

Yoga for Healthy Aging: Evidence and Trend

Ranjan Bhattacharyya

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0037

Yoga has gained recognition as a multifaceted practice that not only enriches physical health but also enhances psychological well-being. This ancient discipline incorporates a variety of techniques, including postures (asanas) and breathing exercises (pranayama), which serve to improve flexibility, strength, and balance while simultaneously diminishing stress and anxiety levels. Research indicates that yoga is effective in addressing a range of health issues, spanning psychiatric disorders, cardiovascular conditions, and autoimmune ailments, ultimately promoting a higher quality of life for practitioners. Moreover, the emerging field of medical yoga therapy merges traditional practices with modern medical insights, targeting individualized health needs and fostering a holistic approach to wellness.¹ This essay explores the diverse applications of yoga in health, aiming to elucidate its mechanisms and effectiveness compared to other therapeutic modalities.

OVERVIEW OF YOGA AND ITS HISTORICAL SIGNIFICANCE IN HEALTH

Yoga, with its roots tracing back to the ancient Indus Valley Civilization, reflects a profound historical significance in promoting health across physical, mental, and spiritual dimensions. Traditionally, yoga was understood not merely as a series of physical postures, but rather as a holistic approach to achieving higher states of consciousness, emphasizing the cultivation of inner peace and self-awareness. This ancient practice has evolved over centuries, leading to a contemporary understanding that often prioritizes the physical aspects, particularly in Western cultures. However, the therapeutic applications of yoga are gaining recognition as effective interventions for various health issues, making it increasingly relevant in today's health paradigms. By bridging historical philosophy and modern health practices, yoga continues to play a vital role in holistic wellness, offering individuals pathways to improved health and mindfulness.

Physical Health Benefits of Yoga

The practice of yoga has gained considerable attention for its extensive physical health benefits, which are particularly relevant in today's fast-paced society. Engaging in yoga enhances flexibility, muscular strength, and coordination, reducing the likelihood of injuries and contributing to overall physical fitness. Moreover, its emphasis on alignment and posture can mitigate chronic pain conditions, particularly in the back and joints. Notably, a structured yoga program has been shown to yield significant improvements in physical well-being, as evidenced by a recent study utilizing the PROMIS Global Health Questionnaire, which highlighted the beneficial effects of daily yoga on students' health amidst rising

Journal of Indian Medical Association (JIMA, 2025–2026); Honorary Secretary, East Zone, Indian Psychiatric Society (EZ-IPS 1–3)

Corresponding Author: Ranjan Bhattacharyya, *Journal of Indian Medical Association* (JIMA, 2025–2026); Honorary Secretary, East Zone, Indian Psychiatric Society (EZ-IPS 1–4)

How to cite this article: Bhattacharyya R. Yoga for Healthy Aging: Evidence and Trend. *J Indian Med Assoc* 2026;124(7):13–16.

Source of support: Nil

Conflict of interest: None

academic stress. Additionally, yoga encourages better respiratory function through regulated breathing techniques, which can lead to improved cardiovascular health. Ultimately, the multifaceted advantages of yoga establish it as an essential component of holistic health strategies, fostering both physical resilience and a foundation for overall well-being.²

Improvement in Flexibility, Strength, and Cardiovascular Health

The practice of yoga significantly enhances flexibility, strength, and cardiovascular health, making it a vital component of holistic wellness. Through a diverse range of postures (asanas), yoga stretches and strengthens various muscle groups, ultimately improving flexibility and promoting better posture. Additionally, the incorporation of controlled breathing (pranayama) not only elevates lung capacity but also facilitates cardiovascular endurance, benefiting overall heart health. Research highlights yoga's effectiveness in managing chronic conditions such as hypertension and diabetes, underlining its capacity to support cardiovascular function. Thus, by integrating physical and mental conditioning, yoga emerges as a multifaceted approach to improving flexibility, strength, and cardiovascular health.³

MENTAL HEALTH BENEFITS OF YOGA

The mental health benefits of yoga extend beyond mere relaxation techniques; they embody a holistic approach to well-being that intertwines mind, body, and spirit. Yoga serves as an accessible and effective practice for alleviating stress, thereby promoting overall mental health. The practice not only focuses on physical fitness but also emphasizes mental clarity and emotional resilience. Moreover, highlights that yoga's therapeutic applications are substantiated by evidence demonstrating its efficacy in treating mental disorders such as anxiety and depression. Through the unification of breath, movement, and mindfulness, yoga fosters a supportive environment that enhances self-awareness and

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is included, and any changes are indicated.

encourages coping strategies, making it a vital component in the application of holistic health practices.

Reduction of Stress, Anxiety, and Enhancement of Mental Well-being

The practice of yoga has garnered significant attention for its potential to reduce stress and anxiety while enhancing mental well-being. By promoting emotional regulation and mindfulness, yoga facilitates a state of relaxation that counteracts the physiological impacts of stress. Scientific research indicates that engaging in yoga can improve brain function related to emotional processing, thereby fostering resilience against anxiety and enhancing mood stability. Moreover, systematic reviews highlight the efficacy of Ashtanga yoga, specifically, in lowering perceived stress levels and bolstering subjective well-being. As practitioners immerse themselves in the structured routine of yoga poses and controlled breathing, they not only cultivate a deeper connection to their bodies but also develop essential coping mechanisms that contribute to long-term mental health and emotional balance.⁴

Extensive research indicates that yoga not only improves physical aspects such as flexibility and strength but also addresses psychological concerns, including stress reduction and anxiety management, thereby fostering a holistic state of health and wellness. As supported by the incorporation of Hatha yoga practices, yoga facilitates both mental and physical health benefits while emphasizing its role as a science that intertwines philosophy, psychology, and practical methods for conscious evolution. By integrating yoga into health care, practitioners can leverage these findings to promote better health outcomes and enrich the quality of life for diverse populations. Its potential applications in managing chronic conditions—such as hypertension, diabetes, and anxiety—highlight yoga's role as a complementary therapy alongside conventional medical treatments. The integration of yoga postures, breathing exercises, and mindfulness creates a comprehensive approach that addresses physical, emotional, and mental health dimensions. As studies continue to affirm the efficacy of yoga in different health contexts, future applications could expand into preventive health care models, promoting wellness in various populations. This trajectory not only affirms yoga's significance in contemporary health discourse but also encourages its adoption as a proactive strategy for holistic health management (Table 1).

THE NEUROBIOLOGY OF YOGA: DECODING THE MIND–BODY CONNECTION

Yoga, an ancient practice originating in India, has transcended its spiritual roots to become a globally recognized approach to holistic well-being. While traditionally described in terms of energy centers (chakras) and vital life force (prana), modern science, particularly neuroscience, is increasingly offering a fascinating, evidence-based understanding of how and why yoga works. The neurobiology of yoga reveals a profound interplay between movement, breath, and the central nervous system, explaining its widespread benefits for mental and physical health.

The Autonomic Nervous System: Finding the Balance

A central tenet of the neurobiology of yoga is its impact on the autonomic nervous system (ANS), which regulates involuntary physiological processes. The ANS has two primary branches:

Table 1: How yoga helps mental health

Stress reduction: Gentle movement, breathwork, and relaxation lower cortisol and calm the autonomic nervous system, easing tension and rumination	Anxiety relief: Slow, diaphragmatic breathing (like box breathing) activates the parasympathetic “rest-and-digest” response, reducing physical symptoms of anxiety
Depression support: Regular practice can improve mood and energy via endorphins, vagal tone, and better sleep; mindful movement also counters withdrawal and inertia	Improved sleep: Evening practices with forward folds, longer exhales, and guided relaxation can shorten sleep onset and improve sleep quality
Emotion regulation: Mindfulness in poses builds interoceptive awareness—recognizing body signals—supporting resilience and less reactivity	Trauma sensitivity: Grounding, choice-based practices and slower pacing can help with safety and agency; look for “trauma-informed yoga” if this is relevant

The Sympathetic Nervous System (SNS)

This is the “fight or flight” system. It mobilizes the body for action, increasing heart rate and blood pressure, and releasing stress hormones such as cortisol and adrenaline. While essential for survival, chronic activation due to modern stressors leads to wear and tear on the body.

The Parasympathetic Nervous System (PNS)

This is the “rest and digest” system. It promotes relaxation, slows the heart rate, enhances digestion, and facilitates cellular repair.

Many individuals in contemporary society operate in a state of chronic sympathetic dominance. Yoga interventions, particularly the combination of physical postures (asanas) and controlled breathing (pranayama), are highly effective at shifting this balance.

The Role of the Vagus Nerve

The vagus nerve is the primary component of the parasympathetic nervous system, wandering from the brainstem down through the chest and into the abdomen, interacting with major organs. Yoga practices are believed to increase “vagal tone”—a measure of cardiovascular function that facilitates an adaptive response to environmental challenges.

Higher vagal tone is associated with better emotional regulation, resilience to stress, and a lower resting heart rate. By consciously slowing the breath, particularly extending the exhalation during yoga practice, practitioners actively stimulate the vagus nerve, signaling to the brain that the body is safe and initiating the relaxation response.

PRANAYAMA: THE BREATH–BRAIN CONNECTION

Pranayama, or breath control, is perhaps the most direct physiological bridge between the body and the mind in yoga.

The way we breathe directly influences brain activity. Rapid, shallow breathing (often associated with stress) triggers sympathetic activation. Conversely, slow, deep, diaphragmatic breathing activates the parasympathetic nervous system.

Research suggests that controlled breathing exercises can alter activity in specific brain regions:

- *The amygdala:* The brain's emotional processing center, heavily involved in the fear response. Yoga and deep breathing have

been shown to decrease amygdala activation, reducing feelings of anxiety and hyperarousal.

- *The prefrontal cortex (PFC)*: Responsible for higher-order executive functions such as decision-making, attention, and regulating emotions. Pranayama and meditation enhance activity and connectivity in the PFC, allowing for better “top-down” control over the emotional responses generated by the amygdala.

ASANA: MOVEMENT, PROPRIOCEPTION, AND INTEROCEPTION

- The physical postures of yoga, or asanas, are more than just stretching; they are complex neuromuscular exercises.

Proprioception

This is the body’s ability to sense its position in space. Yoga requires intense focus on body alignment and balance, actively engaging and refining the proprioceptive system. This continuous feedback loop between the muscles, joints, and the brain enhances motor control and spatial awareness.

Interoception

This refers to the ability to perceive internal bodily sensations (e.g., heartbeat, respiration, muscle tension). Yoga strongly cultivates interoceptive awareness. By learning to tune into subtle physical sensations without immediate judgment or reaction, practitioners develop better emotional regulation. They learn to recognize the early physical signs of stress (like a tightening jaw) and deploy relaxation techniques before the stress response escalates.

Neuroplasticity

Regular yoga practice has been associated with structural and functional brain changes, including increased gray matter volume in areas related to attention, emotional regulation, and sensory processing (e.g., prefrontal cortex, hippocampus, insula).

Neurotransmitter modulation

Yoga can influence levels of neurotransmitters such as gamma-aminobutyric acid (GABA), serotonin, dopamine, and endorphins, which contribute to mood stabilization, anxiety reduction, and a sense of well-being.

Hypothalamic-Pituitary-Adrenal (HPA) Axis

Yoga may downregulate the HPA axis, reducing cortisol levels and mitigating the physiological effects of chronic stress.

Brainwave Activity

Practices like meditation and deep breathing during yoga can alter brainwave patterns, increasing alpha and theta waves associated with relaxation, creativity, and focused attention.

Sensory and Motor Integration

Asanas (postures) engage proprioceptive and vestibular systems, enhancing body awareness and coordination through neural circuits involving the cerebellum and somatosensory cortex.

Inflammatory and Immune Modulation

Yoga’s impact on the nervous system also extends to neuroimmune pathways, potentially reducing neuroinflammation via vagal nerve stimulation.

THE NEUROCHEMISTRY OF YOGA: HORMONES AND NEUROTRANSMITTERS

Yoga practice induces measurable changes in the brain’s chemical messenger system.

Gamma-aminobutyric Acid (GABA)

Gamma-aminobutyric acid is the primary inhibitory neurotransmitter in the brain; it essentially acts as the brain’s “brake pedal,” calming nervous activity and reducing anxiety. Low levels of GABA are linked to depression and anxiety disorders. Studies, such as those conducted by researchers at Boston University School of Medicine, have shown that participating in a yoga session can significantly increase brain GABA levels compared to other forms of exercise like walking. This surge in GABA is a key biological mechanism behind the mood-elevating and anxiety-reducing effects of yoga.

Cortisol

Cortisol is the primary stress hormone. While necessary in short bursts, chronic elevation is detrimental to health, impairing cognitive function and weakening the immune system. Regular yoga practice has been consistently shown to lower baseline cortisol levels and blunt the cortisol response to acute stressors.

Endorphins and Serotonin

Like other forms of exercise, the physical exertion of yoga can trigger the release of endorphins, the body’s natural painkillers and mood elevators. Additionally, the meditative and rhythmic aspects of yoga may influence serotonin levels, a neurotransmitter crucial for mood regulation and feelings of well-being.

Neuroimaging studies (such as MRI) comparing experienced yoga practitioners with nonpractitioners have revealed structural differences:

- *Increased gray matter volume*: Experienced yogis often show increased gray matter volume in several brain regions, including the hippocampus (crucial for memory and learning) and the prefrontal cortex. This is significant because gray matter naturally tends to decrease with age; yoga may help preserve brain health and cognitive function over time.
- *Thicker somatosensory cortex*: The area of the brain responsible for processing bodily sensations often shows increased thickness in yoga practitioners, correlating with their enhanced interoceptive and proprioceptive abilities.
- *Default mode network (DMN) modulation*: The DMN is a network of interacting brain regions that is active when the mind is wandering or engaged in self-referential thought (often associated with rumination and anxiety). Meditation and the mindful aspects of yoga have been shown to decrease activity in the DMN, promoting a state of present-moment awareness and reducing mental chatter.⁵

There are different types of yoga practices as described in Table 2.

Table 2: Types of yoga practices

Gentle Hatha or Iyengar: Slow, alignment-focused—good for beginners, anxiety, and recovery days	Restorative or Yin: Long, supported holds to downshift the nervous system; excellent for stress and sleep
Vinyasa (slow flow): Mindful, rhythmic movement; mood-lifting and helps focus	Pranayama and meditation: Breath and awareness practices directly target anxiety, attention, and mood

CONCLUSION

The neurobiology of yoga provides a compelling, scientific framework for understanding an ancient tradition. By integrating physical movement, breath regulation, and focused attention, yoga acts as a sophisticated “bottom-up” and “top-down” intervention for the nervous system. It downregulates the stress response, enhances mood-regulating neurotransmitters, improves brain connectivity, and even alters brain structure to promote resilience and cognitive health. As research continues to unfold, yoga is increasingly recognized not merely as an alternative therapy, but as a potent, evidence-based strategy for optimizing brain function and achieving holistic well-being.

REFERENCES

1. Lai YT, Huang HL, Hsieh CC, et al. The effects of yoga exercise on blood pressure and hand grip strength in chronic stroke patients: a pilot controlled study. *Int J Environ Res Public Health* 2023;20(2):1108. DOI: 10.3390/ijerph20021108
2. Birdee GS, Ayala SG, Wallston KA. Cross-sectional analysis of health-related quality of life and elements of yoga practice. *BMC Complement Altern Med* 2017;17(1):83. DOI: 10.1186/s12906-017-1599-1
3. Kelley KK, Aaron D, Hynds K, et al. The effects of a therapeutic yoga program on postural control, mobility, and gait speed in community-dwelling older adults. *J Altern Complement Med* 2014;20(12):949–954. DOI: 10.1089/acm.2014.0156
4. Cheshire A, Richards R, Cartwright T. ‘Joining a group was inspiring’: a qualitative study of service users’ experiences of yoga on social prescription. *BMC Complement Med Ther* 2022;22(1):67. DOI: 10.1186/s12906-022-03514-3
5. Marshall M, McClanahan M, McArthur Warren S, et al. A comparison of the acute effects of different forms of yoga on physiological and psychological stress: a pilot study. *Int J Environ Res Public Health* 2020;17(17):6090. DOI: 10.3390/ijerph17176090

Comparative Study on the Caregiver Burden of Patients with Autism Spectrum Disorder and Attention Deficit and Hyperactivity Disorder Attending the Child Psychiatry Clinic of a Tertiary Care Hospital in Kolkata

Arnab Biswas¹, Ashis Debnath², Shuvankar Mukherjee³, SK Kamal Hassan⁴, Asish Mukhopadhyay⁵

Received on: 04 December 2025; Accepted on: 02 January 2026; Published on: 10 July 2026

ABSTRACT

Background: Studies show that autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) place a significant burden and stigma on caregivers, economically as well as socially, psychologically, and emotionally (Gabra and Hashem, 2021). This study aims to evaluate various psychological aspects of the caregivers, the caregiver burden of the children with these disorders, and compare the findings of the same. A cross-sectional, analytical study was designed including 120 caregivers (60 caregivers of autism vs 60 caregivers of ADHD); all of them were assessed for (1) anxiety; (2) depression; and (3) caregiver burden.

Results: The results of the study show that the anxiety and depression among the caregivers with children with ASD and ADHD are very high. The level of caregiver burden is high among the caregivers of children with ASD.

Conclusion: This study supports the notion that both ADHD and ASD pose a great challenge for their caregivers, which is higher in ASD than ADHD caregivers.

Keywords: Attention deficit and hyperactivity disorder, Autism spectrum disorder, Caregiver burden.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0030

BACKGROUND

Autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) are two of the most prevalent neurodevelopmental disorders of childhood, both associated with significant functional and behavioral impairments that extend their impact beyond the affected child to the entire family system.^{1,2} ASD is characterized by deficits in social communication and restricted, repetitive behaviors, while ADHD involves inattention, hyperactivity, and impulsivity that interfere with academic and social functioning.^{2,3}

Caring for children with these disorders often places a considerable psychological and emotional burden on caregivers. Several studies have demonstrated that caregivers of children with ASD report higher levels of stress, anxiety, depression, and overall caregiving burden compared to caregivers of typically developing children.^{4,5} Similarly, caregivers of children with ADHD also experience increased psychological distress, though the extent of burden appears to vary between the two groups.⁶

Comparative studies suggest that caregivers of children with ASD generally experience greater levels of stress and depression than those caring for children with ADHD, possibly due to the more pervasive nature of ASD symptoms and greater caregiving demands.^{7,8} However, such comparative research remains limited, particularly in the Indian context.

The present cross-sectional, analytical study aims to assess and compare levels of anxiety, depression, and caregiver burden

^{1,2,4,5}Department of Psychiatry, Nil Ratan Sircar Medical College & Hospital, Kolkata, West Bengal, India

³Department of Community Medicine, Calcutta National Medical College and Hospital, Kolkata, West Bengal, India

Corresponding Author: Arnab Biswas, Department of Psychiatry, Nil Ratan Sircar Medical College & Hospital, Kolkata, West Bengal, India, Phone: +91 7439873427, e-mail: biswasarnab2398@gmail.com

How to cite this article: Biswas A, Debnath A, Mukherjee S, *et al.* Comparative Study on the Caregiver Burden of Patients with Autism Spectrum Disorder and Attention Deficit and Hyperactivity Disorder Attending the Child Psychiatry Clinic of a Tertiary Care Hospital in Kolkata. *J Indian Med Assoc* 2026;124(7):17–21.

Source of support: Nil

Conflict of interest: None

among caregivers of children with ASD and ADHD attending the Child Clinic of the Department of Psychiatry, NRS Medical College and Hospital, Kolkata.

Study Objectives

This cross-sectional, analytical study was conducted to assess psychiatric symptoms, specifically anxiety, depression, and caregiver burden among caregivers of children diagnosed with ASD and ADHD. The study also aimed to compare the severity of caregiver burden between the two groups in order to identify differential patterns of psychological distress associated with each disorder.

METHODS

Participants

The study included a total of 120 participants, comprising 60 children diagnosed with ASD and 60 with ADHD. All participants were recruited from the Child Clinic of the Department of Psychiatry, NRS Medical College and Hospital. The study was conducted over a 6-month period, from December 2024 to May 2025.

Participants were selected randomly following confirmed diagnoses of ASD and ADHD based on the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria.

Caregivers of children with ASD and ADHD who were willing to participate in the study were included in the study, and caregivers of children with comorbid intellectual disability or sensory impairments were excluded from the study. After diagnostic confirmation and fulfillment of the inclusion and exclusion criteria, eligible participants and their primary caregivers were invited to participate, and informed consent was obtained prior to data collection. The primary caregivers were subsequently assessed for anxiety using the Hamilton Anxiety Rating Scale (HAM-A), for depression using the Hamilton Depression Rating Scale (HAM-D), and for caregiver burden using the 22-item Zarit Burden Interview (ZBI).

Study Tools

- Diagnostic and Statistical Manual–V (fifth edition).
- Zarit Burden Interview Scale.
- Hamilton Anxiety Rating Scale.
- Hamilton Depression Rating Scale.
- Modified BG Prasad Scale for socioeconomic status.

Statistical Analysis

Data were analyzed using nonparametric statistical methods, as the distribution of caregiver burden, anxiety (HAM-A), and depression (HAM-D) scores did not meet assumptions of normality. Descriptive statistics were used to summarize sociodemographic variables. The Mann–Whitney *U* test was applied to compare continuous outcome variables between the two independent diagnostic groups (ASD vs ADHD). For variables with more than two categorical levels—such as caregiver age-groups and socioeconomic status—the Kruskal–Wallis *H* test was employed to examine differences in burden scores across categories. Categorical variables were compared using frequencies and percentages. Statistical significance was set at $p < 0.05$ for all analyses. Results are presented as mean rank scores along with corresponding *p*-values to reflect group-wise differences in psychological outcomes.

Ethics Approval and Consent to Participate

Prior to the commencement of data collection, ethical approval to conduct the study was obtained from the Institutional Ethics Committee of NRS Medical College and Hospital. Written informed consent was obtained from all participants before the interviews. Participant confidentiality was strictly maintained by using anonymous questionnaires, conducting interviews individually in a private setting, and securely storing all data in password-protected files accessible only to the research team.

DISCUSSION

The present study examined and compared caregiver burden, anxiety, and depression among caregivers of children diagnosed with ASD and ADHD. Across all psychological domains assessed, caregivers

of children with ASD experienced significantly higher distress than those caring for children with ADHD. This pattern aligns with existing international and regional literature, which consistently reports that ASD imposes a more pervasive and enduring caregiving demand due to its broader deficits in social communication, behavioral rigidity, and need for intensive supervision. Previous studies from Egypt and South Africa similarly noted markedly greater burden and stigma among ASD caregivers (mean burden score rank: 75.64) (Table 1) compared to caregivers of children with ADHD (mean burden score rank: 45.36) (Table 1) or other developmental disorders, supporting the findings of the current study.^{1,9}

In the present sample, caregiver burden was strongly influenced by demographic factors, with older caregivers, female caregivers, and those from lower socioeconomic strata reporting significantly higher burden. These associations mirror the findings of Carter et al. and Lloyd & Hastings, who observed that maternal stress, financial strain, and limited social support were key determinants of caregiver distress in neurodevelopmental disorders.^{6,7} In particular, the higher burden among females in our study reflects the gendered distribution of caregiving responsibilities within many families, a trend also noted in earlier research where mothers of children with ASD and ADHD consistently reported poorer psychological well-being than fathers.⁴

The heightened anxiety and depressive symptoms observed among ASD caregivers (mean HAM-A rank: 72.29, mean HAM-D rank: 72.62) (Tables 2 and 3) in this study are consistent with the findings of Giallo et al., who reported that caregivers of children with ASD experience profound fatigue, lower self-efficacy, and increased emotional exhaustion compared to caregivers of children with other developmental conditions.⁸ The chronicity of ASD symptoms, coupled with behavioral challenges and concerns about long-term prognosis, likely contributes to the elevated distress levels. In contrast, while caregivers of children with ADHD also demonstrated significant anxiety and depression (mean HAM-A rank: 48.71, mean HAM-D rank: 48.38) (Tables 2 and 3), their psychological strain was comparatively lower. A trend supported by global data

Table 1: Comparison of caregiver burden scores between ADHD and ASD groups

	Category	N	Mean rank	p-value
Burden score of the caregivers	ADHD	60	45.36	0.000
	ASD	60	75.64	

Table 2: Comparison of caregiver anxiety (HAM-A) scores between ADHD and ASD groups

	Category	N	Mean rank	p-value
HAM-A score of the caregivers	ADHD	60	48.71	0.000
	ASD	60	72.29	

Table 3: Comparison of caregiver depression (HAM-D) scores between ADHD and ASD groups

	Category	N	Mean rank	p-value
HAM-D score of the caregivers	ADHD	60	48.38	0.000
	ASD	60	72.62	

Table 4: Association between caregiver age, caregiver sex, patient sex, patient age, socioeconomic status of the family, and burden scores

		<i>N</i>	<i>Mean rank</i>	<i>p-value</i>
Burden score	Age of the caregivers			0.002
	≤40 years	59	52.60	
	41–59 years	40	59.90	
	≥60 years	21	83.83	
	Sex of the caregivers			0.000
	Male	38	33.92	
	Female	82	72.82	
	Sex of the patient			0.731
	Male	93	59.91	
	Female	27	62.52	
	Age of the patient			0.335
	≤9 years	53	57.08	
	≥9 years	67	63.21	
	Socioeconomic status of the family			0.000
	Lower class	12	76.63	
	Lower middle class	40	77.78	
	Middle class	44	51.65	
	Upper middle class	19	40.92	
	Upper class	5	35.90	

Table 5: Distribution of caregiver and patient sociodemographic characteristics across ADHD and ASD groups

<i>Variable</i>	<i>Category</i>	<i>ADHD (n = 60)</i>	<i>ASD (n = 60)</i>	<i>Total (N = 120)</i>
Caregiver sex	Male	19 (31.7%)	19 (31.7%)	38 (31.7%)
	Female	41 (68.3%)	41 (68.3%)	82 (68.3%)
Patient sex	Male	48 (80.0%)	45 (75.0%)	93 (77.5%)
	Female	12 (20.0%)	15 (25.0%)	27 (22.5%)
Socioeconomic status (BG Prasad scale)	Lower class	7 (11.7%)	5 (8.3%)	12 (10.0%)
	Lower middle class	15 (25.0%)	25 (41.7%)	40 (33.3%)
	Middle class	22 (36.7%)	22 (36.7%)	44 (36.7%)
	Upper middle class	11 (18.3%)	8 (13.3%)	19 (15.8%)
	Upper class	5 (8.3%)	0 (0%)	5 (4.2%)
Place of residence	Urban	31 (51.7%)	24 (40.0%)	55 (45.8%)
	Rural	29 (48.3%)	36 (60.0%)	65 (54.2%)

shows that ADHD-related behaviors, though disruptive, are often more manageable with structured behavioral interventions and pharmacotherapy.^{1,5}

An important contextual factor in the Indian setting is the role of socioeconomic disadvantage. Lower- and lower-middle-class caregivers in the current study had substantially higher burden scores (mean rank lower class: 76.63, mean rank lower middle class: 77.78) (Table 4) compared to caregivers from higher socioeconomic groups (mean rank upper middle class: 40.92, mean rank upper class:

35.90) (Table 4). Limited access to therapeutic services, financial constraints, and inadequate community resources likely exacerbate emotional and practical strain. Similar socioeconomic gradients in caregiver burden have been reported in other low- to middle-income countries, highlighting the structural inequities that shape caregiving experiences.³

Interestingly, caregiver burden in the present study was not significantly associated with the child's age or sex, suggesting that caregiving challenges arising from ASD and ADHD are relatively

stable across developmental stages and independent of gendered behavioral expectations. This finding echoes previous research indicating that the intensity of caregiving demands in ASD, in particular, remains consistent as the child grows, given the lifelong nature of the disorder (Table 5).⁸

Overall, the current study adds to the growing body of evidence showing that caregivers, especially those supporting children with ASD, face considerable psychological strain. The high levels of anxiety, depression, and burden identified across the sample underscore the need for caregiver-focused interventions, accessible mental health support, and policy frameworks that recognize caregiver well-being as a critical component of child developmental care. Future research would benefit from exploring longitudinal patterns of caregiver distress, as well as the impact of social support networks, therapeutic engagement, and family functioning on caregiver outcomes.

RESULTS

A total of 120 caregivers were assessed, with equal representation from the ASD and ADHD groups, and most caregivers were female while the majority of children were male. Caregiver burden showed significant variation across demographic factors, with higher burden observed among older caregivers, females, and those from lower socioeconomic backgrounds ($p < 0.05$), while the child's age and sex were not associated with burden. When comparing diagnostic groups, caregivers of children with ASD reported significantly higher burden scores than those of children with ADHD ($p < 0.001$), and this pattern extended to psychological outcomes, with ASD caregivers exhibiting markedly elevated anxiety (HAM-A) and depression (HAM-D) scores ($p < 0.001$ for both). Overall, the results indicate that caregiving demands are substantially greater in ASD, and caregiver vulnerability is further shaped by socioeconomic disadvantage, older age, and female sex.

CONCLUSION

This study demonstrates that caregiving for children with ASD and ADHD is associated with considerable emotional and psychological strain, with caregivers of children with ASD experiencing particularly elevated levels of burden, anxiety, and depression. The findings underscore that caregiver well-being is shaped not only by the child's diagnosis but also by broader contextual factors such as socioeconomic disadvantage, older caregiver age, and female gender. Although both groups of caregivers face meaningful challenges, the consistently higher distress observed in the ASD group highlights the need for targeted support and greater clinical attention. By recognizing caregiver mental health as an integral part of child neurodevelopmental care, healthcare systems can move toward more comprehensive and family-centered approaches that ultimately benefit both children and their caregivers.

RECOMMENDATIONS

The study highlights the need for structured psychosocial support for caregivers of children with ASD and ADHD, with particular emphasis on those caring for children with ASD, who demonstrated significantly higher levels of burden, anxiety, and depression. Routine screening of caregiver mental health in child psychiatry settings should be incorporated into clinical practice, using brief, validated tools to identify those at risk

early. Psychoeducation, caregiver skill-building programs, and accessible counseling services may help mitigate stress and enhance coping. Special attention should be directed toward caregivers from lower socioeconomic groups, older caregivers, and female caregivers, as they were found to be more vulnerable to heightened burden. Strengthening community-based resources and establishing caregiver support groups may further reduce isolation and improve long-term resilience. Finally, future policies and clinical guidelines in neurodevelopmental care should explicitly integrate caregiver well-being as a core component of comprehensive child management.

STUDY LIMITATIONS

This study has certain limitations that should be acknowledged. First, its cross-sectional design restricts the ability to infer causal relationships between caregiving demands and psychological outcomes. Second, the sample was drawn from a single tertiary care hospital, which may limit the generalizability of the findings to broader community settings. Third, reliance on self-reported measures introduces the possibility of response bias, especially given the social stigma surrounding mental health in caregivers. Additionally, factors such as family dynamics, severity of the child's symptoms, availability of social support, and caregiver coping styles were not assessed, though they may significantly influence caregiver burden. Longitudinal, multicenter studies incorporating these additional variables would provide a more comprehensive understanding of caregiver experiences across diverse contexts.

ETHICS APPROVAL

Ethics approval was obtained from the Institutional Ethics Committee of Nil Ratan Sircar Medical College (Approval No. NRSMC/IEC/288/2024; dated 12 November 2024).

INFORMED CONSENT

Written informed consent was obtained from all participants prior to enrolment.

CLINICAL TRIAL REGISTRATION

Clinical trial registration was not required for this study.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

AUTHOR CONTRIBUTIONS

Conceptualization: Dr Arnab Biswas; Methodology: Dr Ashis Debnath; Data collection: Dr Shuvankar Mukherjee; Writing – original draft: Dr Arnab Biswas; Writing – review & editing: Dr SK Kamal Hassan, Prof. (Dr) Asish Mukhopadhyay.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to all those who contributed to the successful completion of this article. They are especially thankful to the patients and their family members for their cooperation, patience, trust, and willingness to share their experiences. The authors also extend their heartfelt thanks

to their teachers, mentors, and colleagues for their guidance, insights, encouragement, and constructive feedback, which greatly contributed to the clarity and quality of this manuscript.

AI USE DECLARATION

The authors confirm that no artificial intelligence (AI)-assisted technology was used in the writing or editing of this manuscript, and no images were generated or manipulated using AI.

REFERENCES

1. Wolraich ML, Hagan JF Jr, Allan C, et al. Clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics* 2019;144(4):e20192528. DOI: 10.1542/peds.2019-2528
2. Pope K, Doll J, Kyvelidou A, et al. Clinician, caregiver and patient perspectives of the continuum of care for autism. *J Interprof Educ Pract* 2020;9:100335. DOI: 10.1016/j.xjep.2020.100335
3. Niekerk K, Stancheva V, Smith C. Caregiver burden among caregivers of children with autism spectrum disorder. *S Afr J Psychiatr* 2023;29:2079. DOI: 10.4102/sajpspsychiatry.v29i0.2079
4. Fuermaier AB, Tucha L, Evans BL, et al. Driving and attention deficit hyperactivity disorder. *J Neural Transm* 2017;124(1):55–67. DOI: 10.1007/s00702-016-1600-4
5. Liu TL, Hsiao RC, Chou WJ, et al. Hopelessness in caregivers of children with attention-deficit/hyperactivity disorder: associations with depression and anxiety and multidimensionally related factors. *J Formos Med Assoc* 2023;122(11):1158–1164. DOI: 10.1016/j.jfma.2023.07.014
6. Carter AS, Martínez-Pedraza F de L, Gray SA. Stability and individual change in depressive symptoms among mothers raising young children with ASD: maternal and child correlates. *J Clin Psychol* 2009;65(12):1270–1280. DOI: 10.1002/jclp.20634
7. Lloyd T, Hastings RP. Psychological variables as correlates of adjustment in mothers of children with intellectual disabilities: cross-sectional and longitudinal relationships. *J Intellect Disabil Res* 2008;52(1):37–48. DOI: 10.1111/j.1365-2788.2007.01004.x
8. Giallo R, Wood CE, Jellett R, et al. Fatigue, wellbeing and parental self-efficacy in mothers of children with an autism spectrum disorder. *Autism* 2013;17(4):465–480. DOI: 10.1177/1362361311416830
9. Gabra RH, Hashem DF. Comparison of caregivers' characteristics, stigma, and disease burden of children with autism spectrum disorder and attention-deficit disorder in Egypt. *Middle East Curr Psychiatry* 2021;28:83. DOI: 10.1186/s43045-021-00163-9

Change in Transfusion Index Following Splenectomy in Patients with Thalassemia Major: A Retrospective Study Based on Two Teaching Hospitals

Ritankar Sengupta¹, Sandeep Saha², Subhadeep Datta³, Tapas Bandyopadhyay⁴, Malay Kumar Ghosh⁵

Received on: 29 July 2024; Accepted on: 03 December 2024; Published on: 10 July 2026

ABSTRACT

Background: Thalassemia is a heterogeneous group of inherited diseases in which there is a lack or reduced production of the hemoglobin beta chain, leading to increased destruction of defective red blood cells (RBCs) in reticuloendothelial system, especially in the spleen, followed by excessive extramedullary hematopoiesis, resulting in splenomegaly. This enlarged spleen causes ongoing destruction of RBCs with further worsening of anemia and further increase in transfusion requirement. Consequently, splenectomy is often performed to avoid this complication and to reduce the transfusion index. With this background, we hypothesized that properly performed splenectomy would reduce transfusion requirement, minimize transfusion-related complications, and ameliorate the transfusion-free interval.

Materials and methods: We conducted a retrospective study in which 30 confirmed cases of thalassemia who had undergone splenectomy were included in the study to evaluate the role of splenectomy in reducing transfusion frequency.

Results: Our study shows a statistically significant reduction in mean blood transfusion volume and a decrease in blood transfusion frequency. We also observed a statistically significant increase in platelet level and a nonsignificant increase in serum ferritin levels following splenectomy.

Conclusion: Splenectomy in properly selected patients with thalassemia major results in a significant decrease in the transfusion index.

Keywords: Splenectomy, Thalassemia major, Transfusion index.

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0029

INTRODUCTION

Thalassemia represents a heterogeneous group of inherited diseases characterized by a lack or reduced production of the beta chain, leading to increased destruction of defective red blood cells (RBCs) in the reticuloendothelial system, especially in the spleen, followed by excessive extramedullary hematopoiesis, resulting in splenomegaly. This enlarged spleen causes ongoing destruction of RBCs with further worsening of anemia and ongoing increase in transfusion requirement. With repeated transfusions, many of them develop transfusion-related complications. Besides this, there is also deposition of iron in different organs in the body due to excessive destruction of RBCs, with liberation of iron from destroyed RBCs, with its deposition in viscera and its sequel.¹ Some of these patients also present with cardiorespiratory embarrassment due to massive splenomegaly. Though blood transfusion and iron chelation remain the mainstay of treatment of thalassemia, splenectomy is often required to overcome the situation and to reduce the transfusion index.¹

Splenectomy, being performed laparoscopically or by open method, has got its own complications, such as hemorrhage, thrombocytosis, atelectasis, gastric dilatation, and overwhelming postsplenectomy infection.² Consequently, splenectomy should be performed only in properly selected patients of thalassemia major where the predictable advantage of this operation clearly outweighs its possible complications. Annual transfusion volume exceeding 225–250 mL/kg with packed red cells (hematocrit 75%) may indicate the presence of hypersplenism. Splenectomy in

^{1,3}Department of Surgery, Deben Mahata Government Medical College and Hospital, Purulia, West Bengal, India

²Department of Hematology, NRS Medical College, Kolkata, West Bengal, India

⁴Department of Internal Medicine, Medica Superspecialty Hospital, Kolkata, West Bengal, India

⁵Ex-HOD, NRS Medical College & Hospital, Kolkata, West Bengal, India

Corresponding Author: Sandeep Saha, Department of Hematology, NRS Medical College, Kolkata, West Bengal, India, Phone: +91 9830268507, e-mail: drsandeep_2007@yahoo.co.in

How to cite this article: Sengupta R, Saha S, Datta S, *et al.* Change in Transfusion Index Following Splenectomy in Patients with Thalassemia Major: A Retrospective Study Based on Two Teaching Hospitals. *J Indian Med Assoc* 2026;124(7):22–26.

Source of support: Nil

Conflict of interest: None

the presence of hypersplenism leads to significant improvement in anemia, thrombocytopenia, and serum ferritin levels, with a reduction in transfusion requirements. However, splenectomy should be avoided unless there is an inability to maintain iron balance with optimal chelation or if there are clinically significant complications such as pancytopenia and marked enlargement. Currently, the indications for splenectomy in thalassemia are increased blood transfusion requirement (200–220 mL/kg/year),

hypersplenism as evidenced by pancytopenia and symptomatic splenomegaly.³

Thalassemia remains a critical problem of health throughout the world, particularly in India, where premarital genetic screening is still lacking. India has almost 150,000 thalassemia children, the largest worldwide, with the addition of 10,000–15,000 new cases every year.⁴ Consequently, the hospitals of India treat a significant number of patients with thalassemia major who mostly survive on regular blood transfusions and iron chelation. However, splenectomy is also done in properly selected cases to reduce the transfusion index. With this background, we conducted this study to evaluate the role of splenectomy for the reduction of transfusion index in patients with thalassemia major.

MATERIALS AND METHODS

We conducted a retrospective descriptive study in two teaching hospitals, namely the Department of General Surgery and the Department of Hematology, over a period of 2 years, from October 2020 to September 2022. During this period, a total of 34 cases of thalassemia patients, proved by hemoglobin electrophoresis, were recruited for study who presented with features of increased transfusion requirement (>200 – 220 mL/kg/year) and/or features of hypersplenism (symptomatic splenomegaly with pancytopenia). Nontransfusion-dependent thalassemic patients and cases of portal hypertension and severe hemosiderosis were excluded from the study. However, four patients were lost in follow-up, and finally, 30 patients were included in the study. Detailed history regarding previous hospitalization, transfusion, blood parameters including hemoglobin and platelet count, infection, and chelation therapy were recorded. All of them were vaccinated against *meningococcus*, *pneumococcus*, and *Haemophilus influenzae* at least 14 days before surgery if not vaccinated earlier. All of them were evaluated for splenunculi and features of portal hypertension and liver and spleen size by ultrasonography before surgery. All these patients underwent open splenectomy through a midline incision after proper preoperative assessment and workup and were followed up for 1 year to evaluate postoperative complications, transfusion requirements, hemoglobin (Hb), RBC count, platelet count, and

serum ferritin levels. All patients received oral deferasirox at 20–40 mg/kg body weight (BW) as a chelating agent both before and after splenectomy.

Data obtained from each subject included medical history, age, sex, BW, nutrition status, liver size, preoperation spleen size, transfusion frequency, volumes of blood transfusion before and after splenectomy, and blood counts before and after splenectomy and operation report. The data were analyzed using SPSS, the Wilcoxon test, and paired-sample t-test to compare blood parameter outcomes in thalassemia patients, and all values were considered significant if $p < 0.05$.

RESULTS

We conducted the study with 30 patients; the mean age of the patients was 23 years, with a range of 15–38. Of these 30 patients, 8 (26.66%) were below 20 years, 19 (63.33%) were between 20 and 30 years, and 3 (10%) patients were above 30 years of age. There were 22 male (73.33%) and 8 female (26.66%) patients in this study (Table 1). The mean BW of the patient was 40.6 kg with a range of 28–52 kg. All the patients had liver enlargement with a range of 3–10 cm; similarly, all patients also had splenic enlargement with a range of 5–9 Schuffner grade (Table 1). The most common indication for splenectomy was increased transfusion requirement (70%), followed by hypersplenism (20%) and massive symptomatic splenomegaly (10%). In our study, all patients received prophylactic vaccination against *Haemophilus influenzae*, *pneumococcus*, and *meningococcus*, either before being incorporated into the study or before elective splenectomy.

The annual transfusion frequency to maintain a target hemoglobin of 9 gm/dL was 16.3 times per year with a standard deviation of 3.48 before splenectomy, which was statistically reduced significantly to 8.9 times per year with a standard deviation of 3.3 ($p < 0.0001$) (Table 2).

The total volume of annual blood transfusion requirement before splenectomy was 5022.09 mL/year, which was reduced significantly to 1589.29 mL/year following splenectomy ($p < 0.0001$), and the mean annual blood transfusion requirement presurgery was 299.86 mL/kg body wt/year, which also decreased significantly to 169.15 mL/kg body wt/year ($p < 0.0001$) (Table 3).

Table 1: Subject demographics

Parameter	Patients (n = 30)		
Age	<20 years	8 (26.66%)	Mean $\pm$ SD = 23 $\pm$ 6.09
	20–30 years	19 (63.33%)	
	>30 years	3 (10%)	
Sex	Male	22 (73.33%)	8 (26.66%)
	Female	8 (26.66%)	
Liver size (cm below right subcostal margin at midclavicular line)	3	1 (3.33%)	11 (36.66%)
	4	11 (36.66%)	
	5	5 (16.66%)	
	6	8 (26.66%)	
	7	1 (3.33%)	
	8	1 (3.33%)	
	9	2 (6.66%)	
	10	1 (3.33%)	
Spleen size (Schuffner grade)	5–6	17 (56.66%)	12 (40%)
	7–8	12 (40%)	
	9 or more	1 (3.33%)	

Table 2: Pre- and postsplenectomy blood transfusion frequency

Frequency of blood transfusion (times/year)	Number	Percentage	Mean (SD)	p-value
Presplenectomy				
<10	1	3.33	16.3 (3.48)	<0.0001
10–15	12	40		
16–20	14	46.66		
>20	3	10		
Postsplenectomy				
<5	2	6.66	8.9 (3.3)	
5–10	22	73.33		
11–15	4	13.33		
>15	2	6.66		

Table 3: Pre- and postsplenectomy effect on blood transfusion

Blood transfusion	Presplenectomy mean (min–max)	Postsplenectomy mean (min–max)	p-value
Total volume/year (mL)	5022 (2079–9360)	1589.29 (379.2–4640)	<0.0001
Total volume/kg/year (mL)	299.86 (231–390)	169.15 (108–232)	<0.0001

Table 4: Pre- and postsplenectomy effects on blood counts and blood parameters

Parameter	Presplenectomy mean (min–max)	Postsplenectomy mean (min–max)	p-value
Hemoglobin (gm/dL)	6.61 (5.6–7.8) SD: 0.51	8.46 (7.0–11.0) SD: 0.82	<0.0001
Platelets (cells/mm ³)	2,23,330 (70,000–3,50,000) SD: 79,270	3,36,660 (1,80,000–5,10,000) SD: 87,500	<0.0001
Ferritin (ng/mL)	915 (415–1560) SD: 249.18	988 (365–1800) SD: 287.46	0.2976

The presplenectomy hemoglobin level ranged from 5.6 to 7.8 gm/dL with a mean of 6.61 gm/dL and standard deviation of 0.51, which also increased significantly to a mean of 8.46 gm/dL with a standard deviation of 0.82 and ranged from 7 to 11 gm/dL ($p < 0.0001$) (Table 4).

The presplenectomy platelet count ranged from 70,000 to 3,50,000 cells/mm³, with a mean of 2,23,330 cells/mm³ and a standard deviation of 79,270 cells/mm³. 24 hours postsplenectomy, there was a significant increase in platelet count, which ranged from 1,80,000–5,10,000 cells/mm³, with a mean value of 3,36,660 cells/mm³ and a standard deviation of 87,500 ($p < 0.0001$). In spite of this sudden rise in platelet count in the immediate postsplenectomy period, none of the patients developed thrombotic complications, and for any of them, aspirin prophylaxis was not required (Table 4).

The presplenectomy ferritin level ranged from 415 to 1560 ng/mL with a mean value of 915 ng/mL and a standard deviation of 249.18. The postsplenectomy ferritin levels ranged from 365 to 1800 ng/mL, with a mean of 988 ng/mL and a standard deviation of 287.46 ng/mL. However, this increase in ferritin level was not statistically significant ($p = 0.2976$) (Table 4).

DISCUSSION

In thalassemia, there is a lack or reduced production of the hemoglobin beta chain, leading to increased destruction of defective RBCs in reticuloendothelial system, especially in the spleen, followed by excessive extramedullary hematopoiesis, resulting in splenomegaly. This enlarged spleen causes ongoing destruction of RBCs with further worsening of anemia and ongoing increase in transfusion requirement.

Updated and advanced management of thalassemia includes bone marrow transplantation, peripheral blood stem cells

transplantation, cord blood stem cells transfusion, gene therapy, and stimulation of fetal hemoglobin.³ However, these cutting-edge infrastructures are not commonly available in most of the hospitals of India, including ours, and most of the thalassemia patients we deal with cannot afford the cost of such advanced management. Consequently, in properly selected cases, splenectomy is still a valid and good option to reduce transfusion requirements as the removal of the spleen increases RBC survival.⁵

Isa et al. conducted a retrospective cross-sectional descriptive study in Indonesia over a period from 1993 to 2009 with 34 transfusion-dependent thalassemia patients who underwent splenectomy to reduce transfusion requirement. Statistical analysis showed significant decrease of mean blood transfusion volume from 4691.4 cc per year to 3764.2 cc per year ($p = 0.048$), decreased mean blood transfusion volume from 219.6 cc per kg BW per year to 125.5 cc per kg BW per year ($p < 0.001$) and decreased of blood transfusion frequency from 12 to 14 times per year to 6–8 times per year ($p < 0.001$). They concluded that splenectomy has promising results to reduce blood transfusion frequency and improve overall blood profile.⁶

Merchant et al. conducted a retrospective cross-sectional descriptive study with 40 transfusion-dependent thalassemia patients who underwent splenectomy to assess the efficacy of splenectomy to reduce transfusion requirements. The annual blood transfusion requirement before surgery was 294.85 ± 226 mL/kg/year, which was significantly reduced to 138.41 ± 90.38 mL/kg/year in 1st year and to 116 ± 41.44 mL/kg/year in 5th year postsplenectomy ($p < 0.001$). There was also a significant rise in platelet counts within 24 hours following splenectomy, with a mean rise of 4,51,000/mm³ ($p < 0.001$). They concluded that a significant and sustained fall in annual blood transfusion requirement and a rise in platelet counts occurred following splenectomy in transfusion-dependent thalassemia patients.⁷

Akhtar et al. conducted an observational descriptive study with 50 patients of thalassemia major to assess the effectiveness of splenectomy to reduce transfusion requirement. They observed that the average blood transfusion requirement was 250 mL/kg/year, interval of transfusion was 2 weeks and a mean of 25 transfusions per year was required before splenectomy, which was reduced significantly to 125 mL/kg/year, the transfusion interval increased to 1 month, and frequency was reduced to 12 per year.⁸

In our study, we also observed a statistically significant fall in transfusion requirement, mean transfusion volume, and a significant rise in platelet counts after splenectomy in transfusion-dependent patients with thalassemia. Following splenectomy, all the patients maintained adequate hemoglobin levels with a limited number of transfusions, which were significantly lower when compared with the presplenectomy period.

A number of studies have shown a long-term effect of splenectomy in reducing transfusion requirements; consequently, any rise in annual blood transfusion requirements should be recognized and investigated early to find out the cause. From a surgical point of view, the presence of accessory splenic tissue is a leading cause of recurrence of anemia and an increase in transfusion index in splenectomized thalassemic patients.⁷

Accessory splenic tissue or splenunculi are usually found near the hilum of the spleen in 10–30% of the population. They should be looked for very carefully by ultrasonography before operation, and also should be searched per-operatively, and if found, should be removed during splenectomy, as these splenunculi have the same structure and functions as the primary orthotopic spleen, and their presence in the postoperative period would result in hypersplenism and increased transfusion demand.⁹ In our study, we did not find any accessory splenic tissue either preoperatively by ultrasonography or during splenectomy.

Splenectomy results in a hypercoagulable state due to the presence of a larger number of red cells with thrombogenic, altered asymmetrical membrane phospholipid in the circulation, along with thrombocytosis.¹⁰ Thrombocytosis develops in 75% of splenectomized patients, platelet levels typically peak in 1 week to 4 months after splenectomy, and in 15% patients may reach up to 10,00,000 cells/mm³ or even more.¹¹

This hypercoagulable state predisposes splenectomized individuals to increased risk of thrombotic complications.¹⁰ A study has demonstrated that thromboembolic events occurred in 1.65% of 8,860 thalassemic patients with a predilection for splenectomized patients.¹² However, there is no comprehensive evidence and no recommendation for the use of any antiplatelet or antithrombotic therapy for splenectomized patients with asymptomatic thrombocytosis.¹³ In our study, there was a significant increase in platelet count following splenectomy in all 30 patients, but only 3 (10%) of them had thrombocytosis, and the maximum platelet count was 5,10,000 cells/mm³. All of them were asymptomatic, and none of them developed any thromboembolic event.

The effect of splenectomy on iron overload is dubious. In our study, there was a nonsignificant increase in ferritin level ($p = 0.2976$) following splenectomy. This increase could be due to the fact that the spleen acts as a safe reservoir for the transfused iron, and following splenectomy, there could be massive accumulation of iron in the liver,¹⁴ though the iron content of spleen at splenectomy is relatively low, amounting to only one-fifth to one-tenth of the iron content of liver.¹⁵

CONCLUSION

Splenectomy is a good and valid option for thalassemia patients with increased transfusion requirement, hypersplenism, and symptomatic huge splenomegaly despite its own complications of splenectomy. With the adoption of new surgical techniques and better postoperative care, these complications have reduced significantly. This present study attempts to highlight the benefits of splenectomy in terms of reduction of transfusion requirement in thalassemia patients. We conclude that splenectomy, though not the treatment of choice, is of utmost importance to reduce transfusion index in thalassemia patients with a nonsignificant increase in ferritin level following splenectomy, especially in our country, where most of the thalassemic patients cannot afford the cutting-edge newer treatment of thalassemia.

LIMITATIONS

The present study has a few limitations as well. Firstly, the present study was a retrospective observational study conducted in only two medical colleges of the state, and therefore, the results cannot be generalized to all thalassemia patients. More studies, preferably multicenter with allotment of more cases and prolonged follow-up, are required.

DECLARATIONS

Ethical Approval

Ethics approval was obtained from the Institutional Ethics Committee of Deben Mahata Government Medical College & Hospital (Approval No. IEC/DMGMCH/2022/05; Date: 30 December 2022).

Consent to Publish

The authors give consent that this manuscript can be published in print and online forms.

Data Availability Statement

The data collected and analyzed during this study are available and can be shared on request. But associated files can be available only after seeking permission from higher authorities, as this work was done in Government hospitals.

Informed Consent

Written informed consent was obtained from all participants prior to enrolment.

Clinical Trial Registration

Not applicable.

Acknowledgments

The authors thank Prof. (Dr) Malay Kumar Ghosh, Founder of the Department of Haematology, NRS Medical College, and the Department of Surgery, Deben Mahata Government Medical College & Hospital, for their technical support.

Author Contributions

Conceptualization: Sandeep Saha (SS), Ritankar Sengupta (RS); Methodology: Sandeep Saha (SS), Ritankar Sengupta (RS); Data collection: Ritankar Sengupta (RS), Sandeep Saha (SS), Subhadeep Datta (SD); Writing – original draft: Ritankar Sengupta (RS), Sandeep Saha (SS); Writing – review & editing: Sandeep Saha (SS), Ritankar Sengupta (RS), Tapas Bandyopadhyay (TB).

AI Use Declaration Statement

No AI tools were used in the preparation of this manuscript. All intellectual content was developed by the authors.

REFERENCES

1. Weatherall DJ. The inherited disease of hemoglobin is an emerging global health burden. *Blood* 2010;115:4331. DOI: 10.1182/blood-2010-01-251348
2. Shatney CH. Complications of splenectomy. *Acta Anaesthesiol Belg* 1987;38(4):333–339. PMID: 3327338.
3. Piga A, Serra M, Longo F, et al. Changing patterns of splenectomy in transfusion dependent thalassemia patients. *Am J Hematol* 2011;86:808–810. DOI: 10.1002/ajh.22102
4. Ministry of Health and Family Welfare. (2016). National Health Mission: Guidelines on Hemoglobinopathies in India: prevention and control of hemoglobinopathies in India. [online] Available from: <https://nhm.gov.in/images/pdf/programmes/RBSK/Resource Documents/Guidelines on Hemoglobinopathies in India.pdf> [Last accessed June, 2026].
5. Cappellini MD, Cohen A, Eleftheriou A, et al. Guidelines for the management of transfusion-dependent thalassemia, 3rd edition. Nicosia: Thalassemia International Federation; 2014. pp. 126–132.
6. Isa MM, Thayeb A, Yani A, et al. Post-total splenectomy outcome in thalassemia patients. *Bali Med J* 2019;8(3):947–950. DOI: 10.15562/bmj.v8i3.1655
7. Merchant RH, Shah AR, Ahmad J, et al. Post splenectomy outcome in beta thalassemia. *Indian J Pediatr* 2015;82(12):1097–1100. DOI: 10.1007/s12098-015-1792-5
8. Akhtar IK, Ashraf M, Khalid IU, et al. Surgical outcome of splenectomy in thalassemia major in children. *Pak J Med Sci* 2016;32(2):305–308. DOI: 10.12669/pjms.322.8815
9. Mohan H, Amanjit B, Bhardwaj S, et al. Splenunculi: report of three cases. *J Anat Soc India* 2002;51:70–71.
10. Hassan MN, Tahereb GM, Ahmad T, et al. Correlation of splenectomy with portal vein thrombosis in beta-thalassemia major. *J Pak Med Assoc* 2011;61:760–762. PMID: 22355997.
11. Hathirat P, Mahaphan W, Chuansumrit A, et al. Platelet counts in thalassemic children before and after splenectomy. *Southeast Asian J Trop Med Public Health* 1993;24:213–215. PMID: 7886578.
12. Taher AT, Isma'eel H, Mehio G, et al. Prevalence of thromboembolic events among 8,860 patients with thalassemia major and intermedia in the Mediterranean area and Iran. *Thromb Haemost* 2006;96:488–491. PMID: 17003927.
13. Buzel   R, Barbier L, Sauvanet A, et al. Medical complications following splenectomy. *J Visc Surg* 2016;153(4):277–286. DOI: 10.1016/j.jviscsurg.2016.04.013
14. Casale M, Cinque P, Ricchi P, et al. Effect of splenectomy on iron balance in patients with β -thalassemia major: a long-term follow-up. *Eur J Haematol* 2013;91:69–73. DOI: 10.1111/ejh.12121
15. Memon AS, Memon R, Muhammad AT, et al. Does it help in patients with thalassemia major. *J Liaquat Uni Med Health* 2017;16:1–12. DOI: 10.22442/jlumhs.171610500

A Comparative Study between the Functional Outcome of Proximal Femoral Nailing and Proximal Femoral Nailing A2 in the Treatment of Intertrochanteric Fractures

Vignesh Ilangoan¹, Shebin Christin I², Meenakshi Sundaram K³

Received on: 24 April 2024; Accepted on: 27 May 2024; Published on: 10 July 2026

ABSTRACT

Background: The intertrochanteric area is a complex system where muscles join, and forces are transferred. It establishes the biomechanics by determining how the hip's lever arm functions. Fractures in these zones can occur in a range of extremes, from low energy in older people with osteoporotic bones to high energy in young, healthy femurs. Numerous treatment approaches have been used in the past, and high-quality research is being done to enhance the quality of life and healing of patients following a fracture.

Aims and objectives: (1) To determine the time of recovery of patients postsurgery. (2) To compare the functional outcome of patients with intertrochanteric fractures treated with proximal femoral nailing (PFN) and proximal femoral nailing antirotation 2 (PFNA2).

Materials and methods: This study is a prospective comparative study. All patients who met our inclusion and exclusion criteria during the study period were selected. A total of 30 study participants were selected as per the simple random sampling technique in our study. Then the participants were divided into two groups (group A and group B) using single-blinding. Group A is intertrochanteric fracture treated with PFN, and group B is intertrochanteric fracture treated with PFNA2.

Results: The most common Boyd and Griffin type of fracture was observed in our study. A majority of about 47% of participants had type II fracture, and the least, about 3%, had type IV fracture among our study participants. Among the study participants who had PFN, most of the patients in the age-group 51–60 had fair and poor outcomes. Among the PFNA2 group, most of the patients in the age-group 51–60 had excellent outcomes, which is better than PFN. The mean operative time for group A was calculated to be 73.25 minutes. The same was calculated to be 43.07 minutes for group B. The patients fixed with PFN in group A averaged at 2.35%, and the PFNA2 patients in group B had an average of 0.98% (Average reduction in Hb (%)).

Conclusion: From our study, it is concluded that the functional outcome of fracture union remains the same irrespective of the implant used. However, it is significant to note that PFNA2 reduces the operative time and the intraoperative blood loss. Also, it prevents complications such as the 'Z' effect and superior cut-out, which are common in conventional PFN.

Keywords: Inter trochanteric fractures, Proximal femoral nailing, Proximal femoral nailing anti rotation 2.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0040

INTRODUCTION

Elderly osteoporotic people frequently suffer from femur intertrochanteric fractures. Elderly individuals' death has been linked to recumbency following hip fractures. For such fractures, surgical intervention is necessary in order to achieve a reduction that is deemed acceptable and to facilitate the patients' early recovery.¹ The dynamic hip screw (DHS) implant, which was formerly thought to be the gold standard for treating stable intertrochanteric fractures, was found to be insufficient for stabilizing unstable fractures.² A dynamic femoral head/neck stabilization implant combined with intramedullary nailing is now seen to be the best option for treating the unstable variant.³ For the treatment of intertrochanteric fractures, many nail designs that include a single compression screw or a compression screw combined with an antirotation screw—like the proximal femoral nail (PFN)—are becoming more and more common. Screw cut-out, Z effect, reverse Z effect, and varus collapse accounted for 31% of the postoperative problems, despite PFN's superiority over extramedullary devices for unstable intertrochanteric fractures.⁴ The proximal femoral nail antirotation (PFN-A) design

^{1–3}Department of Orthopedics, Vinayaka Missions Kirupananda Variyar Medical College, Salem, Tamil Nadu, India

Corresponding Author: Vignesh Ilangoan, Department of Orthopedics, Vinayaka Missions Kirupananda Variyar Medical College, Salem, Tamil Nadu, India, Phone: +91 8344663771, e-mail: vignesh.1696@gmail.com

How to cite this article: Ilangoan V, I SC, K MS. A Comparative Study between the Functional Outcome of Proximal Femoral Nailing and Proximal Femoral Nailing A2 in the Treatment of Intertrochanteric Fractures. *J Indian Med Assoc* 2026;124(7):27–32.

Source of support: Nil

Conflict of interest: None

succeeded in compacting the cancellous bone and increasing the bone-implant contact, providing superior fixation stability going forward.⁵ The insertion of the helical blade, which avoids reaming out the bone from the head/neck fragment, offers extra anchoring, particularly for patients in the age-group affected by osteoporosis. According to some research, helical blades

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is included, and any changes are indicated.

offer superior resistance against rotation and varus collapse because they compress the surrounding cancellous bone.⁶ A cephalomedullary nail designed for osteoporotic bones with goal to achieve better functional outcomes under less intraoperative time and blood loss, all while overcoming the common difficulties of its predecessor. In the study, we aimed to compare the functional outcome of PFN and the PFNA2 in various aspects of treating Intertrochanteric fractures.

AIMS AND OBJECTIVES

Aims

To compare the functional outcome of Intertrochanteric fractures treated with PFN and PFNA2.

Objectives

- To determine the time of recovery of patients postsurgery.
- To compare the functional outcome of patients with intertrochanteric fractures treated with PFN and PFNA2.

MATERIALS AND METHODS

This study is a prospective comparative study. All the patients, as per our inclusion and exclusion criteria during the study period, were selected. A total of 30 study participants were selected as per the simple random sampling technique in our study. Then the participants were divided into two groups (groups A and B) using single blinding. Group A is Intertrochanteric fracture treated with PFN, and group B is intertrochanteric fracture treated with PFNA2.

The study period was from November 2020 to October 2022. The study was conducted at the Department of Orthopedics, Vinayaka Missions Kirupananda Variyar Medical College and Hospital, Salem.

Inclusion Criteria

- Patients older than 18 years.
- Acute isolated fracture involving the intertrochanteric region of the femur.
- Closed fractures and Gustilo-Anderson grade I or II open fractures.
- Boyd and Griffin classification grades I, II, and IV.

Exclusion Criteria

- Patients younger than 18 years.
- Gustilo-Anderson grade III open fractures.
- Associated head injury.
- Associated fractures in any of the four limbs.
- Pathological fractures, fracture nonunion, and delayed union.
- Patients unwilling or medically unfit for surgery.

Methodology

All patients were admitted from the OPD or the ER and were evaluated based on the institutional protocol with all necessary investigations and opinions from General Physicians and Anesthetists. During this period, the fracture was immobilized using Buck's skin traction or derotation boot based accordingly. They were counseled, and recommended consents obtained. Patients and care takers were also given preoperative rehabilitation training to promote early recovery and prevent gross muscle wasting.

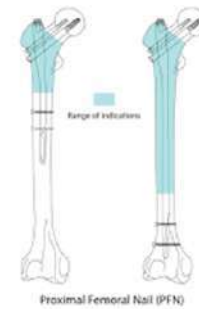


Fig. 1: Proximal Femoral Nailing

Operative Procedures

Group A: Proximal Femoral Nailing

Patient under spinal anesthesia, affected limb in traction and opposite limb in lithotomy. Reduction checked under C-arm. Closed manipulation done as necessary. Parts painted and draped. Under strict aseptic precautions, an incision was made over the GT. Skin and fascia were cut and retracted. Bone awl entry was made at the tip of the GT or medial to the GT. A guide-wire was passed across the fracture site. Sequential reaming was done. Proximal reaming was done. Nails of appropriate size and angle 130°/135° were introduced using the jig. 8.0-mm compression screw and a 6.4-mm derotation screw were placed using the jig and the guide-wires. The derotation screw was at least 15 mm less than the length of the compression screw. Tip apex distance was maintained at 25 mm. Distal locking was done with appropriate bolts. After thorough wound wash, the wound was closed in layers. A drain was used if indicated (Fig. 1).

Group B: Proximal Femoral Nailing Antirotation 2

Patient under spinal anesthesia, affected limb in traction and opposite limb in lithotomy. Reduction checked under C-arm. Closed manipulation done as necessary. Parts painted and draped. Under strict aseptic precautions, an incision was made over the GT. Skin and fascia were cut and retracted. Bone awl entry was made at the tip of the GT or medial to the GT. A guide-wire was passed across the fracture site. Sequential reaming was done. Proximal reaming was done. Nails of appropriate size and angle 130°/135° were introduced using the jig. A guide-wire was passed into the center-center of the neck of the femur. Length of the Helical blade was measured with account of the Tip apex distance. Appropriate reaming was done. A 11 mm Helical blade of the same size was introduced using the same jig and guide-wires by gentle tapping. Further compression was achieved using the on-table compression device of the helical blade screw. Further, the distal locking was done for the nail using the jig. The jig is removed and a thorough wound wash given. The nail cap, also functioning as a lock for the helical blade, is fitted and the wound is closed in layers. Sterile dressing done (Fig. 2).

Postoperative Protocol

Patients were recommended bed rest till the spinal effects wore off. Blood transfusions were carried out based on the preexisting anemia and intraoperative blood loss. High sitting with ankle pumps

was initiated immediately after. DVT prophylaxis was initiated on the same day with low-molecular-weight heparin if not contraindicated. All patients were trained to do static quadriceps exercises. On day 2, patients were given walking support and gait training was initiated. Wound care and dressing were done on recommended days, either as inpatient or outpatient, on an individual basis. Harris hip score was used to assess the functional improvement of the affected limb over the course of time. Partial weight bearing started within the 1st week. After 6 weeks, all patients with linear healing were allowed to complete weight bearing. X-ray and clinical follow-up were done to monitor union and callus formation, fracture collapse, 'Z' effect, stress raisers, and avascular necrosis.

Complication

Immediate complications include:

- Hypotension.
- Infection.
- Hardware prominence.
- Abductor weakness.
- Thromboembolism.

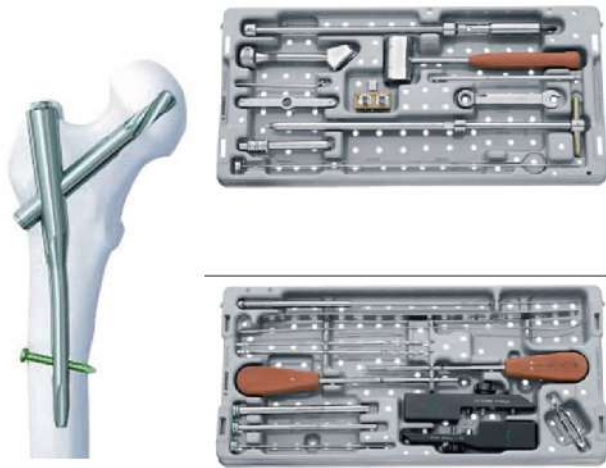


Fig. 2: Proximal Femoral Nailing Antirotation 2

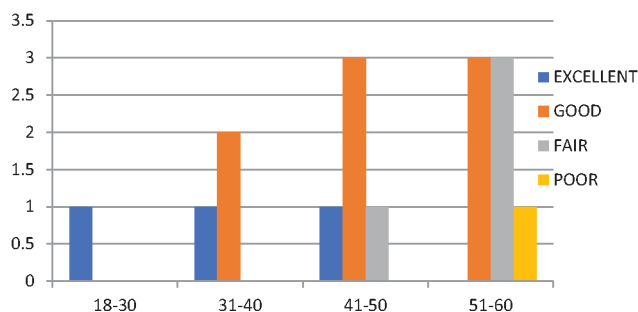


Fig. 3: Distribution of study participants as per types of fracture

Table 1: Distribution of study participants as per age-wise functional scoring in proximal femoral nailing

S. no.	Age-group (years)	n	Average Harris hip score	Grading: excellent	Grading: good	Grading: fair	Grading: poor
1	18-30	1	79.4	1	–	–	–
2	31-40	3	79.2	1	2	–	–
3	41-50	5	78.7	1	3	1	–
4	51-60	7	78.2	–	3	3	1

- Knee effusion.
- Depression.

Late complications include:

- Nonunion, malunion.
- Z-effect.
- Arthritis of the hip.
- Stress risers.
- Superior cut-through of the head screws.
- Trochanteric bursitis.
- Snapping hip.

Reduced pre- and intraoperative time seems to have reduced many immediate complications and resulted in a good outcome.

Early mobilization and appropriate physiotherapy along with constant education to the patient are hugely beneficial.

Analysis

The patient data were collected and charted under various variables such as fracture pattern, age distribution, intraoperative time, blood loss, postoperative Parker–Palmer score for functional outcome, Harris hip score recovery assessment, and incidence of complications. Compilation of these parameters was evaluated on individual *t*-score, and *p*-value was calculated.

RESULTS

Our study is a comparative prospective study conducted among 30 patients, who were divided into two groups of 15 each, depending on the type of femoral nailing.

Figure 3 shows the distribution of study participants as per type of fracture. The most common Boyd and Griffin type of fracture observed in our study was type I. The type I fracture was seen among 17% of the study participants. The majority, about 47% of participants, had type II fracture. About 33% had type III fracture, and the least, about 3%, had type IV fracture among our study participants.

Functional analysis was done using Harris' hip score, which is a clinical scoring system filled by the surgeon. Among the study participants who had proximal femoral nailing, most of the patients of the age-group 51–60 had fair outcome and no patient had excellent outcome. It was found that as age advances, the scoring decreases (Table 1 and Fig. 3).

Functional analysis of proximal femoral nailing antirotation 2 using Harris hip score, which is a clinical scoring system filled by the surgeon. Among the study participants who had proximal femoral nailing antirotation 2, most of the patients of the age-group 51–60 had excellent outcomes and when compared to proximal femoral nailing the results seem to be better among our study participants (Table 2).

Of the 30 patients included in the study, the operative time was recorded and compared between groups A and B. The timer was

Table 2: Distribution of study participants as per age-wise functional scoring in proximal femoral nailing antirotation 2

S. no.	Age-group (years)	n	Average Harris hip score	Grading: excellent	Grading: good	Grading: fair	Grading: poor
1	18–30	1	79.5	1	–	–	–
2	31–40	2	79.6	1	1	–	–
3	41–50	6	79.2	4	1	1	–
4	51–60	5	65.2	2	2	1	–

Table 3: Comparison of study participants as per the mean operating time

Mode of treatment	n	Mean operating time (minutes)	SD	p-value
Group A (proximal femoral nailing)	16	73.25	7.55	0.0001
Group B (proximal femoral nailing antirotation 2)	14	43.07	5.40	–

Table 4: Comparison of study participants as per the average reduction in Hb (%)

Mode of treatment	n	Average reduction in Hb (%)	SD
Group A (proximal femoral nailing)	16	2.35	0.53
Group B (proximal femoral nailing anti-rotation 2)	14	0.98	0.24

started after the patient was under anesthesia and positioned with appropriate skin preparations and draping. The timer stopped with the removal of the guide jig.

The mean operative time for group A was calculated to be 73.25 minutes. The same was calculated for group B to be 43.07 minutes. The mean operative time found out to be less among those who had proximal femoral nailing antirotation 2. Based on the observation, the *p*-value was calculated and was found to be < 0.05. This proves the significance of PFNA2 in the operative time (Table 3).

The mean percentage of hemoglobin reduction is calculated based on the Hb difference between pre- and postoperative patient values. The patients fixed with PFN in group A averaged 2.35%, and the PFNA2 patients in group B had an average of 0.98% (Table 4).

COMPLICATIONS

In our study, we encountered the following complications. Though less in incidence, they were some of the common shortcomings in the fixation of intertrochanteric fractures. None of the complications were reported in group B: proximal femoral nailing antirotation 2. In group A, which had proximal femoral nailing, there was the Z-effect: the proximal migration of the derotation screw along the distal backing out of the compression screw is termed the 'Z' Effect.

Superior cut-through: The screws placed in the head of the femur are loaded by weight bearing and are meant of collapse of the fracture site. Absence of sliding or a diseased head can cause the bone to undergo lysis, leading to the cut-through of the screw/s from the superior aspect into the articular surface.

Avascular necrosis: Not common, still observed in multiple cases. Multiple causes include medial entry of the nail, varus collapse of the fracture, rotation of the head, and increased intraosseous pressure.

DISCUSSION

Due to age-related osteoporosis, trochanter fractures have long been a nuisance for the elderly. The age of occurrence of bone disease decreases with changes in lifestyle and other

controllable variables. Women going through menopause might have demineralization of the bones as early as 40 years old, which increases their risk of brittle fractures. Despite the equal representation of the sexes in our study, women are often more impacted than males. Young people who participate in RTAs are more likely to have high-intensity injuries.

Low-energy injuries can include a range of incidents, such as trips and falls, falls from standing height, and falls from beds, and are often not known to result in any significant bone damage. A pathological fracture can occur in a sick bone with the same amount of force. Elderly people who fall are at risk of developing trochanteric fractures, which are similar to stress fractures in the femur's neck. The bone mineral density (BMD) scan, Dorr's classification, and Singh's index can all be used to assess osteoporosis. The development of a healthy lifestyle and early identification of the osteoporosis disease process are two strategies used to try to prevent trochanteric fractures in the elderly. Supports such as walkers or wheelchairs can also be provided for people with poor walking patterns and gradual physical health degradation. Wearable hip guards with soft padding lessen the direct force on the trochanteric region.⁷

Hip fracture morbidity starts even prior to the trauma's occurrence. Individuals within this age range are more likely to have one or more comorbid conditions. Furthermore, a femur fracture that is incapacitating may result in death. At this age, the surgical adjustments are also complicated by these conditions. Worldwide recommendations call for early, minimally invasive fixation with a focus on appropriate physiotherapy.⁸ Following a closed reduction, proximal femoral nailing is a procedure that is here to stay. It is improved by additions such as a single compression screw, a single helical blade, or more screws built into the head. Regardless of the implant chosen, a thorough rehabilitation program and a decent reduction are always necessary⁹ ideally, a positive variance or a Valgus decrease. Not all Western implants do well among Indians. To properly accommodate the demanding patients, even the PFNA2 needed to be adjusted. Instead of using a two-screw system in the proximal head, it employs a single helical blade

Distal locking options of PFNA-II (short nails)



Fig. 4: Distal locking through a combi-hole of PFNA2

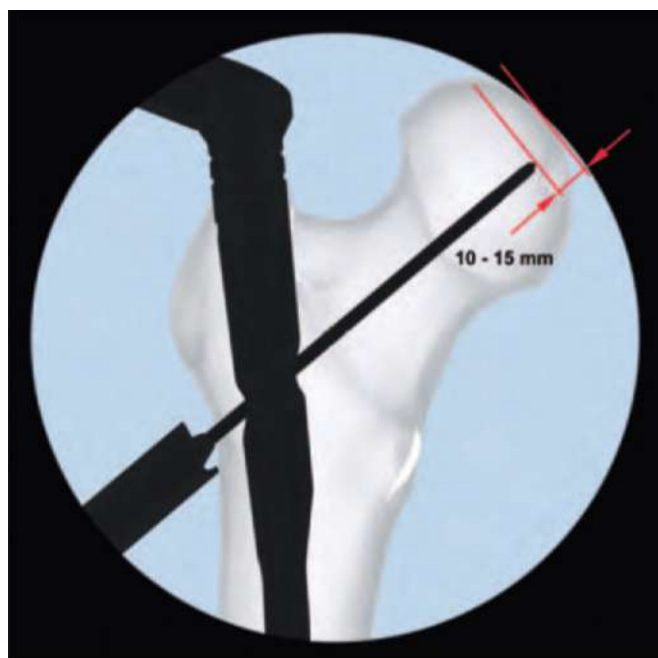


Fig. 5: Tip-apex distance

screw. To improve fracture stabilization and the line of axis of weight-bearing, the standard PFN requires a compression screw in addition to a derotation screw to prevent rotation of the femur neck. When the blade is malletted into the head of the A2 system, the sophisticated screw mechanism provides the compression, and the helical blade latches to the nail with its triangular design as opposed to the cylindrical one. Furthermore, the helical blade inside the nail cap is locked in place by a lengthy stem. Consequently, avoiding excessive collapse.¹⁰ Additionally, the nail encourages static as opposed to dynamic distal locking when one bolt is used with the jig. The bolt positioned tangentially secures the nail in place, whereas the horizontal bolt encourages dynamization. Maintaining a tip apex distance (TAD) of 25 mm is also advised (Fig. 4).

The "Z" effect is among the most excruciating PFN side effects. It happens as a result of the compression screw backing out and the derotation screw migrating proximally. It happens as a result of the implant being loaded incorrectly. Instead of using the derotation screw,¹¹ the PFN was intended to transmit the load through the compression screw. Both of the proximal screws slip

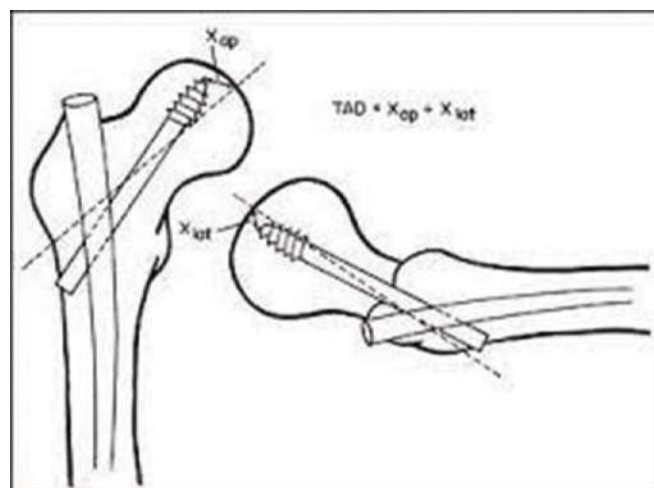


Fig. 6: Tip-apex distance measurement

when the force is transmitted, resulting in collapse. The proximal locking mismatch, which causes the load to be distributed unevenly between the proximal screws, results in the "Z" effect, also known as a reverse "Z" effect with a superior cut-out of the screw.¹² With the one centrally positioned helical blade in the newer PFNA2, this is entirely avoided. In addition, the blade's body perfectly follows the shape of the nail. This avoids any imbalanced loading. A lengthy stem that secures the helical blade and stops movement at the nail-proximal screw junction is another feature of the nail head cap. In both the lateral and anteroposterior views, the tip apex distance is the measurement of the distance between the head screw's tip and the subchondral bone. Subchondral collapse is more likely the closer the screw point is to the chondral bone (Fig. 5).¹³

The image intensifier is used to determine the tip apex distance. The guide pin's AP and lateral distances to the femur head center are combined. It is kept at 15–25 mm (Fig. 6).¹⁴

The complications could have been prevented in our study. However, the same factors that produce a nonanatomical decrease will also cause the nail to fail. There is still tension raised at the medullary nail-helical blade junction. It may disastrously fail due to periprosthetic fracture or complete implant rupture.

In addition, the PFNA2 blade's helical design has an advantage over the PFN's threaded screws. Anatomical models were used in a study that revealed a much smaller footprint by the latter. There is relatively little bone loss since it is tapped into the head of the femur rather than being reamed to its full length.¹⁵

CONCLUSION

It is determined from the aforementioned study, which had a sample of 30 patients, that the functional result of fracture union is the same regardless of the implant used. It is noteworthy, therefore, that PFNA2 shortens both the intraoperative period and the blood loss during surgery. Additionally, it avoids issues such as superior cut-out and the "Z" effect, which are common in traditional PFN.

ETHICS APPROVAL

Ethics approval was obtained from the Institutional Ethics Committee of Vinayaka Missions Kirupananda Variyar Medical College and Hospitals, Salem (Approval No. VMKVMC&H/IEC/21/077; dated 5 February 2021).

INFORMED CONSENT

Written informed consent was obtained from all participants prior to enrolment.

CLINICAL TRIAL REGISTRATION

Not applicable.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

AUTHOR CONTRIBUTIONS

Conceptualization: Dr Meenakshi Sundaram K; Data collection: Dr Shebin Christin I; Writing – original draft: Dr Shebin Christin I; Writing – review & editing: Dr Vignesh Ilangoan.

ACKNOWLEDGMENTS

The authors thank the Department of Orthopedics, Vinayaka Missions Kirupananda Variyar Medical College and Hospitals, Salem, for their technical support.

AI USE DECLARATION

AI tools were used only for language editing. All intellectual content was developed by the authors.

REFERENCES

- Babhulkar SS. Management of trochanteric fractures. *Indian J Orthop* 2006;40(4):210–218.
- Zhang K, Zhang S, Yang J, et al. Proximal femoral nail vs. dynamic hip screw in treatment of intertrochanteric fractures: a meta-analysis. *Med Sci Monit* 2014;20:1628–1635. DOI: 10.12659/MSM.890962
- Pawar ED, Agrawal SR, Patil AW, et al. A study of management of intertrochanteric fractures using external fixator. *J Evol Med Dent Sci* 2014;3(21):5661–5669.
- Hohendorff B, Meyer P, Menezes D, et al. Behandlungsergebnisse und Komplikationen nach PFN-osteosynthese. *Unfallchirurg* 2005;108(11):938–953. DOI: 10.1007/s00113-005-0962-8
- Raviraj A, Anand A, Chakravarthy M, et al. Proximal femoral nail antirotation (PFNA) for treatment of osteoporotic proximal femoral fractures. *Eur J Orthop Surg Traumatol* 2012;22(4):301–305.
- Strauss E, Frank J, Lee J, et al. Helical blade versus sliding hip screw for treatment of unstable intertrochanteric hip fractures: a biomechanical evaluation. *Injury* 2006;37(10):984–989. DOI: 10.1016/j.injury.2006.06.008
- Parkkari J, Kannus P. Hip protectors for preventing hip fractures among elderly adults. *Aging Health* 2009;5(4):509–517.
- Richmond J, Aharonoff GB, Zuckerman JD, et al. Mortality risk after hip fracture. *J Orthop Trauma* 2003;17(8):S2–S5. DOI: 10.1097/00005131-200309001-00002
- Jung EY, Oh IT, Shim SY, et al. The effect of valgus reduction on the position of the blade of the proximal femoral nail antirotation in intertrochanteric hip fractures. *Clin Orthop Surg* 2019;11(1):36–42. DOI: 10.4055/cios.2019.11.1.36
- Ma KL, Wang X, Luan FJ, et al. Proximal femoral nails antirotation, Gamma nails, and dynamic hip screws for fixation of intertrochanteric fractures of femur: a meta-analysis. *Orthop Traumatol Surg Res* 2014;100(8):859–866. DOI: 10.1016/j.otsr.2014.07.023
- Kashigar A, Vincent A, Gunton MJ, et al. Predictors of failure for cephalomedullary nailing of proximal femoral fractures. *Bone Joint J* 2014;96-B(8):1029–1034. DOI: 10.1302/0301-620X.96B8.33644
- Caruso G, Bonomo M, Valpiani G, et al. A six-year retrospective analysis of cut-out risk predictors in cephalomedullary nailing for pertrochanteric fractures: can the tip-apex distance (TAD) still be considered the best parameter? *Bone Joint Res* 2017;6(8):481–488. DOI: 10.1302/2046-3758.68.BJR-2016-0299.R1
- Baumgaertner MR, Solberg BD. Awareness of tip-apex distance reduces failure of fixation of trochanteric fractures of the hip. *J Bone Joint Surg Br* 1997;79(6):969–971. DOI: 10.1302/0301-620X.79B6.0790969
- Andruszkow H, Frink M, Frömke C, et al. Tip apex distance, hip screw placement, and neck shaft angle as potential risk factors for cut-out failure of hip screws after surgical treatment of intertrochanteric fractures. *Int Orthop* 2012;36(11):2347–2354. DOI: 10.1007/s00264-012-1636-0
- Al-Munajjed AA, Hammer J, Mayr E, et al. Biomechanical characterisation of osteosyntheses for proximal femur fractures: helical blade versus screw. *Stud Health Technol Inform* 2008;133:1–10. PMID: 18376008.

Emotional Intelligence and Parenting Styles: An Observational Study on Adolescent Students and Their Parents in a South Indian School

Karthikraj T¹, Sri Andaal², Saravanan Muthuarumugam³

Received on: 03 June 2024; Accepted on: 16 July 2024; Published on: 10 July 2026

ABSTRACT

Introduction: This study aimed to determine the association between parenting style and emotional intelligence in adolescent children. Emotional intelligence develops from early childhood, so parenting can influence emotional development.

Methods: 327 students from a higher secondary school participated in the study. The students were given Schutte's Emotional Intelligence Self-assessment for emotional quotient (EQ) assessment, while their parents' parenting style was assessed using the Parenting Practices questionnaire. Responses were graded on a Likert scale, and the EQ was graded as low, normal, and high, while the parenting styles were categorized as authoritative, authoritarian, permissive, or neglectful.

Results: The participants were predominantly females (69.1%) in late adolescence (16–18). Nearly 77.4% of the study population had an average EQ, 3.4% had a high EQ, and the remaining 19.3% had a low EQ.

According to univariate analysis, there was no significant statistical (p -value = 0.975) association between the EQ score and the age-group. In females, 20.8% had low EQ, 77.4% had average EQ and 1.8% had high EQ. In males, 15.8% had low EQ, 77.2% had average EQ and 6.9% had high EQ. This difference was statistically significant (p -value = 0.038).

Around 69.7% of the parents were authoritative type, 15.9% neglectful, 9.48% authoritarian, and 4.9% were permissive.

Among the high EQ kids, the common parenting styles were authoritative (90.9%) and permissive (9.1%). In average EQ kids, it was authoritative (72.3%) followed by neglectful (17%). In low EQ kids, the authoritarian and permissive styles were common. There is a statistically significant (p -value = 0.002) difference in the association between EQ score and parenting style.

Conclusion: We concluded that there is a significant association between parenting style and the development of emotional intelligence in a child.

Keywords: Adolescence, Emotional intelligence, Emotional quotient, Parenting styles.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0033

INTRODUCTION

Background

Emotional intelligence started with the concept of "social intelligence," which was first proposed in 1920, followed by the first research paper on the subject that was published in 1990. Emotional intelligence was popularized later by the best seller "Emotional Intelligence" written by Daniel Goleman. This was followed up in the subsequent years with the publication of a self-report questionnaire (1997) and the first skill measure developed in 2003.

Definition

Salovey and Mayer defined emotional intelligence as "the ability to perceive and express emotion, assimilate emotion in thought, understand and reason with emotion, and regulate emotion in the self and others".¹

IMPORTANCE

They explained the construct of emotional intelligence as the ability of an individual to recognize, understand, and cope with their own emotions, be aware of them, and appropriately react to others' emotions and experiences as well.²

^{1,3}Department of Pediatrics, Velammal Medical College Hospital and Research Institute, Madurai, Tamil Nadu, India

²Department of Community Medicine, Velammal Medical College Hospital and Research Institute, Madurai, Tamil Nadu, India

Corresponding Author: Karthikraj T, Department of Pediatrics, Velammal Medical College Hospital and Research Institute, Madurai, Tamil Nadu, India, Phone: +91 94882 47192, e-mail: karthikrajmmc@gmail.com

How to cite this article: Karthikraj T, Andaal S, Muthuarumugam S. Emotional Intelligence and Parenting Styles: An Observational Study on Adolescent Students and Their Parents in a South Indian School. *J Indian Med Assoc* 2026;124(7):33–37.

Source of support: Nil

Conflict of interest: None

Emotional intelligence has a significant influence on adolescent mental health through a variety of coping mechanisms and the promotion of adaptation.³ Relationships between adolescents and their parents during their formative years were also critical to their emotional growth.⁴ Generally, family is considered the first interaction where emotional lessons are learned.⁵

PARENTING STYLES

Parents have a significant influence on their child's life. Parenting promotes and supports the physical, emotional, social, spiritual, and cognitive development of a child from infancy to adulthood.

In the context of daily life, the emotional expressiveness of parents provides the child with instructions for the use of emotion in ongoing social interactions. Healthy and warm relationships between parents and children have been discovered to improve psychosocial capacity, have greater academic competence, and have fewer somatic symptoms.^{6,7}

Rationale

It is a relatively unexplored area, especially in adolescents, and is unknown to many parents and teachers. Studies have proved that emotional intelligence begins to develop in early childhood itself. So, parenting becomes an important factor that can influence emotional development.

Adolescence is the time that is crucial for the overall development of a person both mentally and physically. In this period, along with academic intelligence, emotional intelligence (EI) also plays an equal or strong role in student life.

Aim

Our study aims to find out whether parenting style has a significant impact on the emotional quotient (EQ) of the child.

OBJECTIVES

Primary

To determine the association between parenting style and emotional intelligence in children aged 12 to 18 (studying standards VII–XII).

Secondary

- To assess the emotional intelligence in school-going adolescents.
- Identify the common parenting styles in South India.

METHODOLOGY

Study Design

This observational cross-sectional study was conducted at an urban matriculation school in Madurai, Tamil Nadu.

Participants

A total of 327 adolescents from grades VII to XII participated. Students were selected using convenience sampling and included if they were living with either or both parents.

Selection Criteria

Inclusion criteria: All day-scholar students of the study population living with either or both parents.

Exclusion criteria: Hostel students, Students living with grandparents.

Table 1: Distribution of the participants according to their gender

Gender	Frequency	Percent
Female	226	69.1
Male	101	30.9
Total	327	100.0

Sampling Procedure

Convenience sampling: Students (boys and girls) from all sections VII, VIII, IX, X, XI, and XII classrooms, who consented to participate were selected.

Sample size: 204 (Power: 80%, CI: 95%)

Asghari and Besharat⁸ in their study about the relationship between emotional intelligence and perceived parenting styles have shown a correlation coefficient of 0.195(r).

Data Collection

Students of classes VII, VIII, and IX who were willing to participate were included in the study after formal consent from both the parent and adolescent. Both the kid and the parents were included in the study. The parent filled out the questionnaire at home in Google Form format, while the student completed the EQ questionnaire at school.

Tool

The students selected for the study were administered a self-assessment of the emotional intelligence test (Schutte Self-Report EI Test), and the students' parents filled out the parenting practices questionnaire.

The Schutte Self-report Emotional Intelligence Test (SSEIT) is a method of measuring general emotional intelligence (EI), using four subscales: emotion perception, utilizing emotions, managing self-relevant emotions, and managing others' feelings. The SSEIT is based on the EI model by Salovey and Mayer. The SSEIT model is closely associated with the EQ-I model of Emotional Intelligence.

The SSEIT includes a 33-item self-report using a 1 (strongly disagree) to 5 (strongly agree) scale for responses. Each subtest score is graded and then added together to give the total score for the participant.

The responses were assessed, and the student's EQ was calculated online through psytests.org.

The Parenting Practices (PPQ; Robinson et al., 1995) is a 62-item parenting questionnaire for parents of young children. The PPQ is designed to measure Baumrind's (1971) authoritative, authoritarian, and permissive typology of parenting styles.

The probable parenting style was assessed using this questionnaire and its association with the EQ of the student was observed.

DATA ANALYSIS

Descriptive

Total participants were 327 out of 750 students of classes VII to XII (Table 1 and Figs 1 and 2).

Most (77.4%) of the study adolescents had an average EQ; only 3.4% had a high EQ, and the remaining 19.3% had a low EQ.

In our study, 69.7% of the parents were authoritative type, 15.9% were neglectful, and only 4.9% of the parents were permissive.

Inferential

Among the adolescents, 3.7% (12) were early adolescents, 63.3% (207) were middle adolescents, and the rest 33% (108) were late adolescents. Average EQ was present among 77.4% of the adolescent in them 3.6% (9) were in the early phase, 62.5% (158)

were in the middle and the rest 34% (86) were in the late adolescent phase (Tables 2 to 5).

According to univariate analysis, there is no significant statistical association (p -value = 0.975) between the EQ score and the age group.

This is the cross-tabulation between EQ score and gender. In females, 20.8% had low EQ, 77.4% had average EQ and 1.8% had high EQ. In males, 15.8% had low EQ, 77.2% had average EQ and 6.9% had high EQ. This difference was found to be statistically significant (p -value = 0.038).

Among the high EQ kids, the common parenting style was authoritative (90.9%), followed by permissive (9.1%). On average, EQ kids also authoritative was highest followed by style (72.3%)

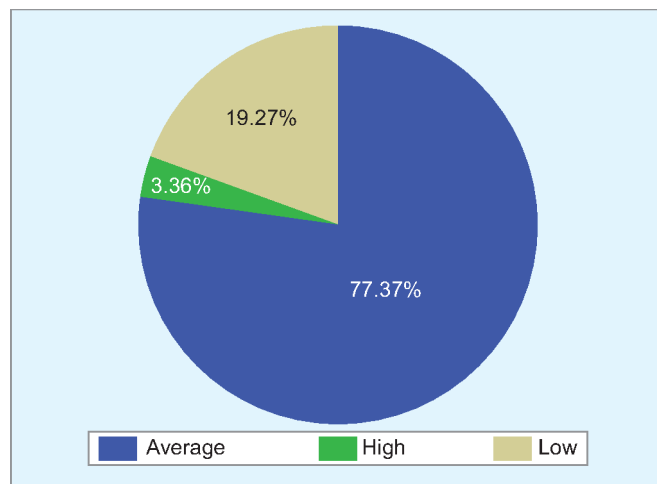


Fig. 1: Distribution according to their EQ

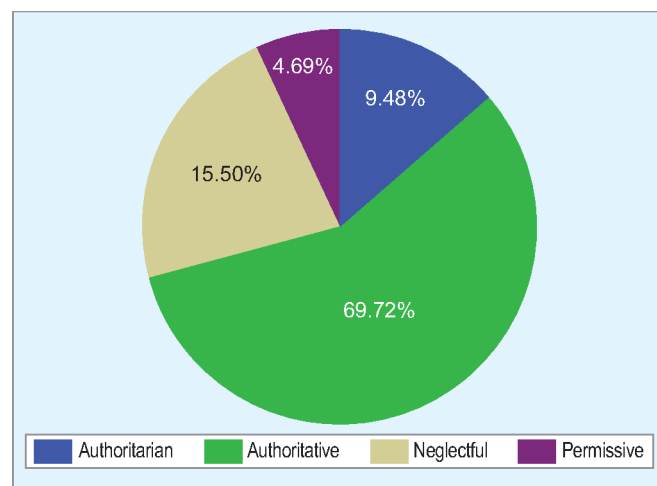


Fig. 2: Distribution according to their parenting style

followed by neglectful (17%). In low EQ kids, the authoritarian and permissive styles play a significant role. There is a statistically significant difference (p -value = 0.002) between the EQ score and the parenting style (Table 5).

There is a cross-tabulation between parenting style and the sociodemographic variables of the adolescent. Authoritative parenting style is most commonly found in middle adolescence (p -value = 0.96), and this type is also common among females (p -value = 0.208), but this difference is not statistically significant (Table 6).

RESULTS AND DISCUSSION

In our study, the total number of participants was 327, of whom the majority were female (69.1%). The age group was between 12 and 18 years, and the majority were between the ages of 16 and 18 (60.7%). The students were assessed for their EQ based on the SSEIT.

This is a method of measuring general EI, using four subscales: emotion perception, utilizing emotions, managing self-relevant emotions, and managing others' feelings. The SSEIT is based on the EI model by Salovey and Mayer. The SSEIT includes a 33-item self-

Table 2: Association between EQ score and age

EQ Score	Number	Mean	Std. deviation	Std. error	p-value*
Low	63	16.79	1.246	0.157	>0.05
Average	253	16.83	1.283	0.081	
High	11	16.82	1.471	0.444	
Total	327	16.83	1.279	0.071	

(EQ score vs age): $p = 0.975$ (>0.05) – not statistically significant. No association between EQ score and age group

Table 3: Association between EQ score and gender

EQ score	Gender		Test statistics	p-value*
	Male	Female		
High	7 (6.9%)	4 (1.8%)	6.42	<0.05
Average	78 (77.2%)	175 (77.4%)		
Low	16 (15.8%)	47 (20.8%)		
Total	101 (100%)	226 (100%)		

*Pearson Chi-square test; (EQ score vs gender): test statistic = 6.42, $p < 0.05$ – statistically significant. EQ score is significantly associated with gender

Table 4: Distribution according to their parenting style

Parenting style	Frequency	Percent
Authoritarian	31	9.5
Authoritative	228	69.7
Neglectful	52	15.9
Permissive	16	4.9
Total	327	100.0

Table 5: Association between EQ score and the parenting style

EQ score	Parenting style				Test statistics	p-value*
	Authoritarian	Authoritative	Neglectful	Permissive		
High	0	10 (4.4%)	0	1 (50%)	17.722	< 0.05
Average	19 (61.3%)	183 (80.3%)	43 (82.7%)	8 (6.2%)		
Low	12 (38.7%)	35 (15.4%)	91 (7.3%)	7 (43.8%)		
Total	31 (100%)	228 (100%)	52 (100%)	16 (100%)		

*Fisher's Exact test

Table 6: Cross tabulation between sociodemographic variables and parenting style

S.No	Sociodemographic variables		Parenting style				Test statistics	p-value*
			Authoritarian	Authoritative	Neglectful	Permissive		
1	Age	Early adolescence	1 (8.3%)	9 (75%)	2 (16.7%)	0	1.57	>0.05
		Middle adolescence	19 (9.2%)	145 (70%)	34 (16.4%)	9 (4.3%)		
		Late adolescence	11 (10.2%)	74 (68.5%)	16 (14.8%)	7 (6.5%)		
2	Sex	Male	5 (5%)	72 (71.3%)	17 (16.8%)	7 (6.9%)	4.53	>0.05
		Female	26 (11.5%)	156 (69%)	35 (15.5%)	9 (4%)		

*Pearson Chi-square test

report using a 1 (strongly disagree) to 5 (strongly agree) scale for responses. Each subtest score is graded and then added together to give the total score for the participant.

Distribution According to Their Emotional Quotient

The responses given by the adolescents to the various questions were recorded and scored on the Likert scale, and the cumulative score was calculated as the EQ. Most (77.4%) of the study adolescents had an average EQ; only 3.4% had a high EQ, while the remaining 19.3% had a low EQ.

Association between EQ Score and Age

Among the adolescents, 3.7% (12) were early adolescents, 63.3% (207) were middle adolescents, and the rest 33% (108) were late adolescents. An average EQ score was present among 77.4% of the adolescents. Of the 3.6%⁹ were in the early phase, 62.5% (158) were in the middle and the rest 34% (86) were in the late adolescent phase. According to univariate analysis, there is no significant statistical association (p -value 0.975) between the EQ score and the age group.

Association between EQ Score and Gender

Among the adolescents, 74.6% of females had low EQ and the rest of the 36.4% had high EQ. But among males, only 25.4% had low EQ and 63.6% had high EQ. This difference was found to be statistically significant (p -value = 0.038).

Distribution According to Their Parenting Style

The parenting style was assessed with the help of the Parenting Practices questionnaire, which was filled in by either of the parents. In our study, 69.7% of the parents were of the authoritative type, 15.9% were neglectful, 9.5% were authoritarian, and only 4.9% of the parents were permissive.

Association between EQ Score and the Parenting Style

Among the high EQ kids, the common parenting style was authoritative (90.9%) followed by permissive (9.1%). On average EQ kids also had the authoritative highest style (72.3%) followed by neglectful (17%). In low EQ kids, the authoritarian and permissive styles play a significant role. There is a statistically significant (p -value = 0.002) difference between the EQ score and the parenting style.

LIMITATIONS

- The following points were observed as limitations in our study.
- The study population was from one school only and that too from an urban region, so it may not reflect the real situation in society.
- Since it is a self-reported questionnaire, it has a few biases such as social desirability bias, recall bias, interpretation bias, and problems in accuracy because of deliberate deception, which could not be avoided.

SUMMARY AND CONCLUSION

Our study comprised 327 participants, predominantly between age groups 16–18 (60.7%). There were more female participants (69.1%) than male participants. The students' EQ was assessed with the SSEIT.

Most (77.4%) of the study adolescents had an average EQ, only 3.4% had a high and, the rest 19.3% had a low EQ. Among the adolescents, 3.7% (12) were early adolescents, 63.3% (207) were middle adolescents and the rest 33% (108) were late adolescents. Average EQ was present among 77.4% of the adolescent in them 3.6%⁹ were in the early phase, 62.5% (158) were in the middle and the rest 34% (86) were in the late adolescent phase. According to univariate analysis, there is no significant statistical association (p -value 0.975) between the EQ score and the age group.

Among the adolescents, 74.6% of females had low EQ and the rest of the 36.4% had high EQ, but in males, only 25.4% had low EQ and 63.6% had high EQ. This difference was found to be statistically significant (p -value = 0.038). In our study, 69.7% of the parents are authoritative type, 15.9% are neglectful, 9.48% authoritarian and only 4.9% of the parents were permissive.

Among the high EQ kids, the common parenting style was authoritative (90.9%) followed by permissive (9.1%). On average EQ kids also the authoritative was highest followed by style (72.3%) followed by neglectful (17%). In low EQ kids, the authoritarian and permissive styles play a significant role. There is a statistically significant (p -value = 0.002) difference between the EQ score and the parenting style.

RECOMMENDATIONS

Based on the observations in our study, we find that many students have only average emotional intelligence and only very few have high emotional intelligence. Many research studies have already proved beyond doubt that EQ is more important for success in life than IQ. The association between parenting style and the EQ is evidenced in our study like in previous Western studies. However, we included only one parent for assessing the parenting style, and the study was done only in a single school; hence, future studies including opinions of both parents and done as a multicentric one including both rural and urban populations can be even more representative and have a strong validity.^{9,10}

ETHICS APPROVAL

Ethics approval was obtained from the Institutional Ethics Committee of Velammal Medical College (Approval No. VMCIEC/072/20213; dated 4 September 2023).

INFORMED CONSENT

Written informed consent was obtained from all participants (parents) prior to enrolment.

CLINICAL TRIAL REGISTRATION

Not applicable. This study was not a clinical trial.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

ACKNOWLEDGMENT

Nil.

AUTHOR CONTRIBUTIONS

Conceptualization: Dr T Karthikraj.

Methodology: Dr Sri Andaal, Dr T Karthikraj.

Data collection: Dr Saravanan.

Writing – original draft: Dr T Karthikraj.

Writing – review & editing: Dr Sri Andaal.

AI USE DECLARATION

No AI tools were used in the preparation or language editing of this manuscript. All intellectual content was developed solely by the authors.

REFERENCES

1. Salovey PE, Sluyter DJ. Emotional Development and Emotional Intelligence: Educational Implications. Basic Books; 1997.
2. Fiori M, Vesely-Maillefer AK. Emotional intelligence as an ability: theory, challenges, and new directions. In: Emotional Intelligence in Education. UK:Springer; 2018. pp. 23–47.
3. Guerra-Bustamante J, León-Del-Barco B, Yuste-Tosina R, et al. Emotional intelligence and psychological well-being in adolescents. *Int J Environ Res Public Health* 2019;16(10):1720. DOI: 10.3390/ijerph16101720
4. Davis SK, Humphrey N. The influence of emotional intelligence (EI) on coping and mental health in adolescence: divergent roles for trait and ability EI. *J Adolesc* 2012;35(5):1369–1379.
5. Branje S. Development of parent-adolescent relationships: conflict interactions as a mechanism of change. *Child Dev Perspect* 2018;12:171–176. DOI: 10.1111/cdep.12278
6. Morris AS, Silk JS, Steinberg L, et al. The role of the family context in the development of emotion regulation. *Soc Dev* 2007;16(2):361–388. DOI: 10.1111/j.1467-9507.2007.00389.x
7. Huver RME, Otten R, de Vries H, et al. Personality and parenting style in parents of adolescents. *J Adolesc* 2010;33(3):395–402. DOI: 10.1016/j.adolescence.2009.07.012
8. Asghari M, Besharat MA. The relation of perceived parenting with emotional intelligence. *Procedia Soc Behav Sci* 2011;30:231–235. DOI: 10.1016/j.sbspro.2011.10.046
9. Abdollahi A, Abu Talib M, Motalebi SA. Perceived parenting styles and emotional intelligence among Iranian boy students. *Asian J Soc Sci Humanit* 2013;2:460–467.
10. Shalini A, Balakrishna Acharya YT. (2013). Perceived paternal parenting style on emotional intelligence of adolescents. [online] Available from: <http://gjbss.org/wp-content/uploads/2013/12/GJBSS-paper-3-Shalini+-balakrishna.pdf> [Last accessed June, 2026].

Usefulness of Antenatal Ultrasonographic Measurements in Prediction of Birth Weight and Its Correlation with Early Neonatal Outcome

Chalasani Vasanth Krishna¹, Chandru Bhaskar V², S Deepa³, Shri Ram T⁴, Mathivanan Malaisamy⁵, Vajrapu Keerthana⁶

Received on: 21 October 2024; Accepted on: 29 November 2024; Published on: 10 July 2026

ABSTRACT

Background: Birth weight is a reliable marker in determining intrauterine growth retrospectively and also a predictor of newborn survival rate. Hadlock and Campbell's method by ultrasound is widely used in Foetal weight estimation. This study is designed to find the correlation between antenatally estimated foetal weight using ultrasonography and the actual birth weight and early neonatal outcome.

Objectives: To compare the birth weight with estimated ultrasonic measurements of foetal weight to assess early neonatal outcome.

Materials and methods: A prospective observational study was done on 222 antenatal mothers >34 weeks of gestation. Mothers bearing twins and anomalous baby were excluded. Their demographic profile and obstetric history were collected. Foetal weight estimation was by ultrasound within 7 days prior to deliver, actual birth weight and other neonatal anthropometric measurements were noted. Postnatal follow up was done till 7 days of life. Data collected and analysed using SPSS.V.28.

Results: The mean foetal weights estimated by Hadlock and Campbell methods were 2.91 ± 0.53 kg and 2.96 ± 0.41 kg respectively. Mean actual birth weight of 2.93 ± 0.43 kg. Both methods showed significant correlation with actual birth weight ($P < 0.05$), but Campbell method (0.939) was more correlating than Hadlock (0.8). Of the samples, 187 babies weighed >2.5 kg, while 35 weighed <2.5 kg, with lower birth weight shown to have poor neonatal outcome.

Conclusion: In this study we found that birth weight was significantly correlating with the estimated foetal weight by ultrasonography (Hadlock and Campbell method) and Campbell is more correlating with birth weight. Hence foetal weight estimation would assist in possible early intervention antenatally and postnatal preparedness in management, thus improving early neonatal outcome.

Keywords: Birth weight, Campbell method, Foetal weight estimation, Hadlock method, Neonatal outcome, Ultrasonographic parameters.

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0046

INTRODUCTION

Birth weight is an essential factor that significantly determines early neonatal outcome.¹ Fetal weight is considered an independent risk factor for perinatal morbidity and mortality. Both SGA and LGA babies may have neonatal complications such as respiratory distress, hypoglycemia, and sepsis.² According to the World Health Organization, LBW is defined as weight < 2.5 kg irrespective of gestational age, noted within 1 hour of birth to eliminate any significant postnatal weight loss. LBW is considered a poor prognostic marker for perinatal survival and early neonatal morbidity and mortality.³ Every year, 25 million infants are born <2.5 kg, which accounts for 15.5% global prevalence. According to a nationally representative survey, the prevalence of low birth weight (LBW) is estimated to have decreased in the Republic of India from 22% to 17.5%. The country is on track to accomplish a 30% decrease in LBW burden by 2025.⁴ Hence, the prediction of fetal weight is an important part of antenatal care. Antenatal ultrasonography is a very sensitive, dependable, safe, and most accurate mode for estimating fetal weight.⁵

Fetal weight determination by ultrasonography would be forecasted by Hadlock and Campbell's method. The Hadlock method uses fetal parameters such as abdominal circumference (AC), biparietal diameter (BPD), head circumference (HC), and femur length (FL).⁶ Whereas the Campbell method uses only

^{1,2,5,6}Department of Pediatrics, Aarupadai Veedu Medical College and Hospital, Puducherry, India

³Department of Obstetrics and Gynecology, Aarupadai Veedu Medical College and Hospital, Puducherry, India

⁴Department of Radiodiagnosis, Aarupadai Veedu Medical College and Hospital, Puducherry, India

Corresponding Author: Chalasani Vasanth Krishna, Department of Pediatrics, Aarupadai Veedu Medical College and Hospital, Puducherry, India, Phone: +91 9096100542, e-mail: vasanthkrishna09@gmail.com

How to cite this article: Krishna CV, Chandru BV, Deepa S, et al. Usefulness of Antenatal Ultrasonographic Measurements in Prediction of Birth Weight and Its Correlation with Early Neonatal Outcome. *J Indian Med Assoc* 2026;124(7):38–41.

Source of support: Nil

Conflict of interest: None

abdominal circumference in fetal weight estimation. Most clinicians use antenatal ultrasound as an important tool for assessing fetal age, growth, and well-being. Therefore, any improvement in the accuracy of estimated fetal weight can help to improve clinical outcomes.⁷

This study is designed to find the correlation between antenatally estimated fetal weight using ultrasonography and the

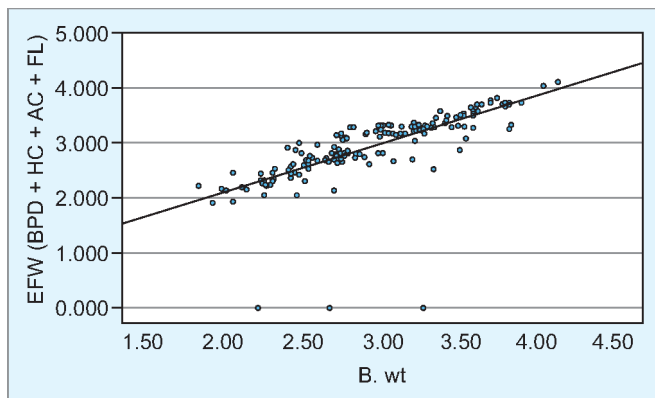
© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is included, and any changes are indicated.

Table 1: Mean EFW by Hadlock and Campbell methods

Parameter	EFW by Hadlock (BPD + HC + AC + FL)	EFW Campbell (AC)	Birth weight
Mean	2.90887	2.95563	2.9308
Standard deviation	0.531026	0.416821	0.43525

Table 2: Early neonatal outcomes

Parameter	Normal weight (n = 187)		Low birth weight < 2.5 kg (n = 35)	
	No. of cases	Percentage (%)	No. of cases	Percentage (%)
Normal	102	54.0	11	31.4
TTN	27	14.4	8	22.8
NNHB	22	11.7	5	14.2
EONS	13	6.9	3	8.5
PDA	2	1.0	2	5.7
Small ASD	3	1.6	1	2.8
Hypoglycemia	17	9.9	4	11.4
HIE	1	0.5	1	2.8

**Fig. 1:** Correlation between actual birth weight and EFW (Hadlock)

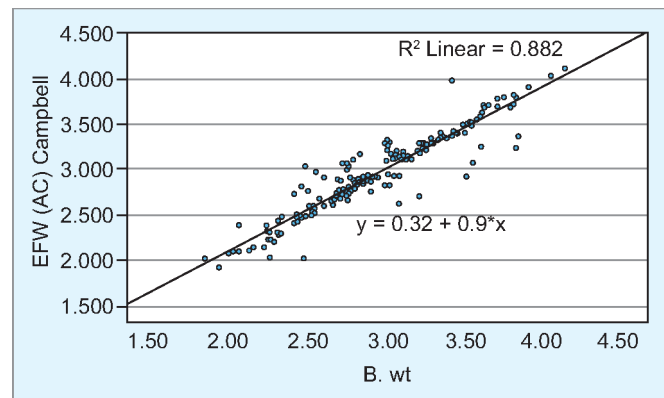
actual birth weight and early neonatal outcome. It also aims to compare the Campbell and Hadlock methods for better accuracy in estimation of fetal weight.

OBJECTIVES

To compare the birth weight with estimated ultrasonic measurements of fetal weight and to assess early neonatal outcomes. To compare and correlate the Hadlock and Campbell methods of estimation of fetal weight in predicting actual birth weight.

MATERIALS AND METHODS

This prospective observational study was carried out at a tertiary care teaching hospital, Aarupadai Veedu Medical College and Hospital, Puducherry, over a period of two years. All antenatal mothers (222) at >34 weeks' gestation who attended antenatal clinics were included in the study after obtaining informed consent. Antenatal mothers bearing twins and fetuses with congenital anomalies were excluded. After enrollment, the demographic profile and obstetric history were collected. Gestational age and fetal weight were estimated by ultrasound, performed within 7 days prior to delivery, and gestational age at birth, actual birth weight, and other neonatal anthropometric measurements were noted later. Babies were followed up to 7 days

**Fig. 2:** Correlation between actual birth weight and Campbell

of life to assess their well-being. Data were entered in an Excel sheet. The correlation between the two independent variables will be found out using the Pearson correlation test. Data were analyzed using SPSS-v.28.

RESULTS

Out of 222 antenatal mothers enrolled in the study, fetal weight was estimated using Hadlock and Campbell methods by ultrasonography. The mean expected fetal weight using Hadlock and Campbell methods was 2.91 ± 0.53 kg and 2.96 ± 0.41 kg, respectively. The mean birth weight measured for the neonates studied was 2.93 ± 0.43 kg, as shown in Table 1.

The correlation between the Hadlock and Campbell methods of estimating fetal weight using ultrasonography and the actual birth weight was found to be statistically significant with a p -value of < 0.05. On analyzing with Pearson correlation, the Campbell method (0.939) was found to be more closely correlated with actual birth weight than the Hadlock method (0.8), as shown in Figure 1 and Figure 2.

Among 222 babies, 187 were of normal weight. Out of 187 normal-weight babies, 54% were well, and the remaining had early neonatal issues such as TTN (14.4%), NNHB (11.7%), EONS (6.9%), PDA,¹ small ASD (1.6%), hypoglycemia (9.9%), and HIE (0.5%). Whereas out of 35 LBW babies, only 31.4% were well babies and remaining had a higher incidence of early neonatal complications,

such as TTN (22.2%), NNHB (14.2%), EONS (8.5%), PDA (5.7%), small ASD (2.8%), hypoglycemia (11.4%), and HIE (2.8%). This shows that early-onset complications were more common in low-birth-weight babies than in normal-weight newborns, as shown in Table 2.

DISCUSSION

In the current prospective observational study, 222 antenatal mothers were enrolled, and fetal weight was estimated using ultrasonography. With reference to the study by Milner and Arezina et al., the scan-to-delivery interval was decided to be within 7 days to increase the accuracy of estimated fetal weight.⁸ Mean estimated fetal weight was 2900 gm, which falls in the normal weight range between 2500 and 4000 gm. This observation is in agreement with the normal fetal weight range, which was reported by Glenn et al.⁹

In the present study, the mean birth weight was 2900 gm, which falls in the normal weight range for newborns. Similar mean birth weights were reported by Asian- and American-based studies by Iannelli;¹⁰ however, this was contrary to the findings from an African-based study by Shittu et al., as African babies are quite smaller than Caucasian babies.¹¹

This study confirmed the strong constructive affiliation between estimated fetal weight (using the Hadlock and Campbell method) and actual birth weight after delivery with $p < 0.05$, and there were no statistically significant variances noted. In a systematic review by Milner et al., the accuracy of EFW by ultrasonography using the Hadlock formula produced the smallest systematic mean errors on a normal fetal population and also stated that the AC measurement is the most sensitive individual indicator of abnormal fetal growth. It also showed no statistically significant variation between sonographically predicted fetal and actual birth weight and also excessive weight fetuses with actual weight.⁸

This study also shows that the Campbell method of fetal weight estimation is statistically more correlated with actual birth weight than the Hadlock method. In contradiction to these results, a study by Kurmanavicius et al.¹² shows that the Hadlock formula is more accurate for estimating fetal weight compared to other methods. Milner et al. also state that estimated embryonic weight with the grouping of abdominal circumference, length of the femur, and biparietal diameter can improve the exactness of fetal weight determination.⁸ This statement is consistent with Eze et al.; the combination of parameters could increase the prediction of fetal weight.¹³

The stable babies were discharged on the third day of life and were asked to review on day 7 of life at the pediatric outpatient department to assess their fetal well-being. The early neonatal consequences such as birth asphyxia, respiratory distress, hypothermia, jaundice, and hypoglycemia,^{14,15} were found to be more among LBW babies compared to babies with normal weight. Hence, antenatal counseling of parents is essential regarding morbidity and mortality in LBW babies.¹⁶

The strength of the study is that by predicting LBW babies antenatally, appropriate antenatal intervention can be provided, and anticipated early neonatal consequences can be addressed at the earliest, hence improving the neonatal outcome.

CONCLUSION

This study shows that the Campbell and Hadlock methods used for antenatal assessment of birth weight are significantly correlated with the actual birth weight. It also shows that the Campbell method

is comparatively better in accuracy in fetal weight estimation than the Hadlock method. Using antenatal fetal weight assessment, we can predict neonatal well-being. It provides us a chance to give parental counseling, possible antenatal interventions, and postnatal management, thus improving the overall neonatal outcome.

ETHICAL APPROVAL

Ethical approval for this study was obtained from the Institutional Ethics Committee of Aarupadai Veedu Medical College (IHEC No: AV/IHEC/2022/122).

INFORMED CONSENT

Written informed consent was obtained from all participants prior to enrolment.

CLINICAL TRIAL REGISTRATION

Not applicable. This study is not a clinical trial.

ACKNOWLEDGMENT

Nil.

AI USE DECLARATION

No artificial intelligence (AI) tools were used in the preparation of this manuscript.

REFERENCES

1. Tas EE, Kir EA, Yilmaz G, et al. Accuracy of sonographic fetal weight estimation in full-term singleton pregnant women. *Pak J Med Sci* 2019;35(1):34. DOI: 10.12669/pjms.35.1.373
2. Konwar R, Basumatary B, Dutta M, et al. Accuracy of fetal weight estimation by ultrasonographic evaluation in a northeastern region of India. *Int J Biomater* 2021;2021:9090338. DOI: 10.1155/2021/9090338
3. World Health Organization. (2025) Global targets 2030. To improve maternal, infant, and young child nutrition. Available from: <https://www.who.int/teams/nutrition-and-food-safety/global-targets-2030> [Last accessed July, 2026].
4. Girotra S, Mohan N, Malik M, et al. Prevalence and determinants of low birth weight in India: findings from a nationally representative cross-sectional survey (2019-21). *Cureus* 2023;15(3):e36717. DOI: 10.7759/cureus.36717
5. Hameed S, Saleem Z, Rauf M, et al. Comparison of ultrasonographic estimated fetal weight and actual birth weight. *Prof Med J* 2021;28(10):1428-1432.
6. Self A, Daher L, Schluskel M, et al. Second and third trimester estimation of gestational age using ultrasound or maternal symphysis-fundal height measurements: a systematic review. *BJOG* 2022;129(9):1447-1458. DOI: 10.1111/1471-0528.17123
7. Acharya S, Tiwari A. Accuracy of prediction of birth weight by fetal ultrasound. *J KIST Med Coll* 2020;2(2):11-14.
8. Milner J, Arezina J. The accuracy of ultrasound estimation of fetal weight in comparison to birth weight: a systematic review. *Ultrasound* 2018;26(1):32-41. DOI: 10.1177/1742271X17732807
9. Oppenheim L, Thomas A. (2002). Mass of a newborn baby. The Physics Factbook. [online] Available from: <https://hypertextbook.com/facts/2002/LeahOppenheim1.shtml> [Last Accessed July 2026].
10. Iannelli V. Baby weight statistics. [March 3, 2013].
11. Shittu AS, Kuti O, Orji EO, et al. Clinical versus sonographic estimation of foetal weight in southwest Nigeria. *J Health Popul Nutr* 2007;25(1):14-23. PMID: 17615900

12. Kurmanavicius J, Burkhardt T, Wisser J, et al. Ultrasonographic fetal weight estimation: accuracy of formulas and accuracy of examiners by birth weight from 500 to 5000 g. *Arch Gynecol Obstet* 2005;271(4):307–313. DOI: 10.1515/JPM.2004.028
13. Eze CU, Ohagwu CC, Abonyi LC, et al. Reliability of sonographic estimation of fetal weight: a study of three tertiary hospitals in Nigeria. *Saudi J Med Med Sci* 2017;5(1):38–44. DOI: 10.4103/1658-631X.194256
14. Pabbati J, Subramanian P, Renikuntla M. Morbidity and mortality of low birth weight babies in early neonatal period in a rural area teaching hospital, Telangana, India. *Int J Contemp Pediatr* 2019;6(4):1582.
15. Bhat BV, Adhisivam B. Trends and outcome of low birth weight (LBW) infants in India. *Indian J Pediatr* 2013;80(1):60–62. DOI: 10.1007/s12098-012-0922-6
16. Gupta S, Adhisivam B, Bhat BV, et al. Short-term outcome and predictors of mortality among very low birth weight infants – a descriptive study. *Indian J Pediatr* 2021;88(4):351–357. DOI: 10.1007/s12098-020-03456-z

Expression of *p16* in Cases of Oral Squamous Cell Carcinoma: A Study of 100 Cases

Prachi Chouhan¹, Sushama Gurwale², Charusheela Gore³, Gayatri Bhuibhar⁴, Pranjali Nibe⁵

Received on: 14 October 2024; Accepted on: 13 November 2024; Published on: 10 July 2026

ABSTRACT

Background: Oral and oropharyngeal cancers, mainly squamous cell carcinomas, are often linked to human papillomavirus (HPV). The expression of *p16* can indicate a better prognosis and serves as a useful surrogate marker for HPV infection. The Lewis/modified Lewis criteria for *p16* grading can identify individuals with better overall survival.

Materials and methods: The study included 100 cases of oral squamous cell carcinoma. Histological characteristics were graded, and *p16* expression was assessed using the Lewis/modified Lewis criteria. The results were analyzed and evaluated.

Results: Out of the 100 cases, 11 showed positive expression for *p16*. Positive expression was more prevalent among middle-aged male patients. The majority of *p16*-positive cases were well differentiated, with the tongue, gingivobuccal sulcus, and oropharyngeal region being the most common sites. A prolonged history of smoking or tobacco use was associated with higher levels of *p16* positivity. However, *p16* expression did not show a significant correlation with the depth of invasion or the worst pattern of invasion (WPOI) of the tumor.

Conclusion: HPV infection plays a pivotal role in a subset of oral squamous cell carcinoma cases. Due to its affordability and ease of use, *p16* immunohistochemistry should be routinely performed in histologically diagnosed cases, as *p16*-positive tumors are associated with a better prognosis.

Keywords: Histopathology, Human papillomavirus, Oral squamous cell carcinoma, *p16*, Tumor.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0043

INTRODUCTION

Oral squamous cell carcinoma (OSCC) is a major global health concern, being a common form of head and neck cancer with significant impacts on morbidity and mortality of the patients. Despite advancements in diagnostic and therapeutic approaches, the prognosis of OSCC remains poor, primarily due to late-stage diagnoses and a limited understanding of its molecular mechanisms. The oral cavity is one of the most common locations for benign and malignant lesions. Smoking, prolonged alcoholism, chewing betel nuts, poor oral hygiene, tooth fracture, dental prosthesis, and infection by human papillomavirus (HPV) are among the risk factors for oral cancer. Additional contributing variables to the development of all oral cancers are radiation, genetic predisposition, and immunological response.^{1,2}

The *p16* gene, encoded by the cyclin-dependent kinase inhibitor 2A (*CDKN2A*) gene, is crucial for regulating the cell cycle through its ability to inhibit cyclin-dependent kinases (CDKs) and suppress the retinoblastoma (Rb) protein. However, the precise role of *p16* in the initiation, progression, and clinical outcomes of OSCC is still the subject of ongoing research and debate.^{1,3} CDKs are enzymes that interact with cyclins (proteins named for their cyclical synthesis and degradation) to regulate the progression of the cell cycle.^{4,5} Studies have found that *p16* promoter methylation is a significant diagnostic and prognostic marker for various common malignancies.⁶⁻⁸

According to the reports by the Global Cancer Observatory (GLOBOCAN) 2022 version 1.1, oral cavity and lip cancers are the 14th and 3rd most fatal cancers in the world and India, respectively. In India, these cancers rank as the top most common cancers occurring in males and 4th most common among females

¹⁻⁵Department of Pathology, Dr D Y Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India

Corresponding Author: Prachi Chouhan, Department of Pathology, Dr D Y Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India, Phone: +91 7507412245, e-mail: prachischouhan.pc@gmail.com

How to cite this article: Chouhan P, Gurwale S, Gore C, *et al.* Expression of *p16* in Cases of Oral Squamous Cell Carcinoma: A Study of 100 Cases. J Indian Med Assoc 2026;124(7):42-46.

Source of support: Nil

Conflict of interest: None

after the malignancies of the female genital tract. Considering the sex distribution data on mortality, OSCC ranks 2nd after cervical cancer in India.⁹ Despite advances in diagnostic techniques and treatment, OSCC is still a global burden. The reports about mortality predictions for the next 25 years due to lip and oral cavity cancers by GLOBOCAN 2022 suggest a marked rise in the world as well as in India in both sexes and all age-groups.¹⁰

The Lewis and modified Lewis criteria are histopathological scoring systems used to assess the presence of HPV in OSCC. These criteria are particularly focused on identifying HPV-related SCC, which often expresses the *p16* protein. The Lewis criteria, developed by Lewis Jr *et al.*, were originally used for SCC of the oropharynx (tonsil and base of tongue). It consists of three main components: Histologic features of SCC, nonkeratinizing or minimally keratinizing morphology, and immunohistochemical staining for *p16* protein. According to the Lewis criteria, a tumor is considered HPV-positive if it shows nonkeratinizing

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is included, and any changes are indicated.



or minimally keratinizing morphology or it is positive for *p16* by IHC.¹¹ The modified Lewis criteria were a modification proposed by Chernock et al. to extend the application to SCC of the oral cavity. It includes the evaluation of histological features, presence of nonkeratinizing or minimally keratinizing squamous cell carcinoma, and positive *p16* IHC staining. The modified criteria aim to provide a standardized method to identify HPV-related oral SCC based on histopathological and immunohistochemical features.¹²

Our observational study aims to comprehensively investigate the expression patterns, clinical significance, and underlying molecular mechanisms associated with *p16* in OSCC. By elucidating the diagnostic, prognostic, and therapeutic implications of *p16* expression in OSCC, this research endeavors to contribute valuable insights toward enhancing our understanding of OSCC biology and refining therapeutic strategies for improved patient outcomes.

MATERIALS AND METHODS

The research includes 100 confirmed cases by histological examination of oral cavity biopsies and surgically extracted specimens (Figs 1A and B showing only excised specimens) acquired at the pathology department during a period of 18 months from September 2022 to February 2024. The clinical history and other information were noted from the requisition forms. After the tissue sample was fixed in 10% formalin, paraffin-processed tissue blocks were made. Tissue slices measuring between 3 and 5 μ m thick were cut by microtome, followed by staining with hematoxylin and eosin (H&E) and immunohistochemistry (IHC) marker *p16* (with both positive and

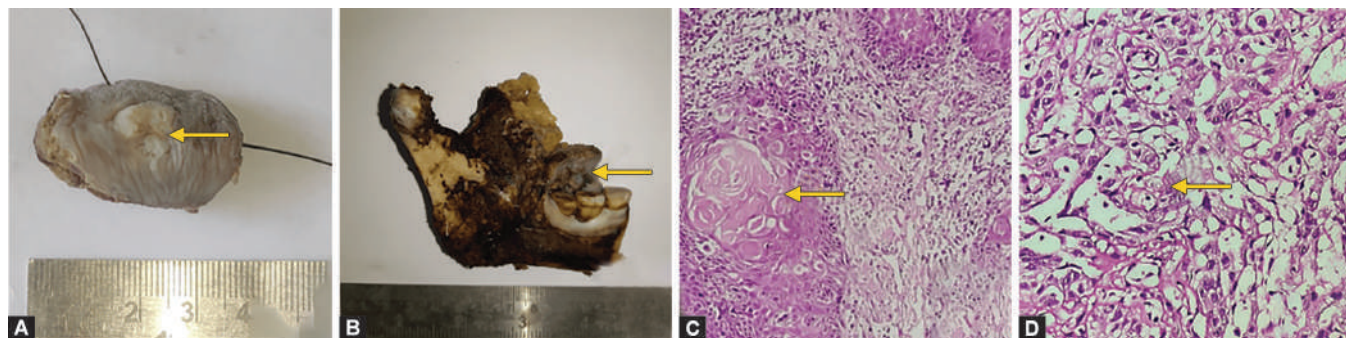
negative controls, using Pathn Situ Biotechnologies JC8 Clone kit, in accordance with the manufacturer's instructions.). A positive cervical carcinoma sample was used as control of IHC *p16*.

These 100 OSCC cases were categorized by the World Health Organization (WHO) classification and the conventional SCCs were graded from well to poorly differentiated.¹³ The College of American Pathologists (CAP) protocol template for "Examination of Specimens from Patients with Cancers of the Oral Cavity, Version: 4.2.0.0 [Standard (s): AJCC-UICC 8]" was referred for TNM staging.¹⁴ According to these protocols: grade I is well differentiated (Fig. 1C), grade II is moderately differentiated (Fig. 1D), and grade III is poorly differentiated.

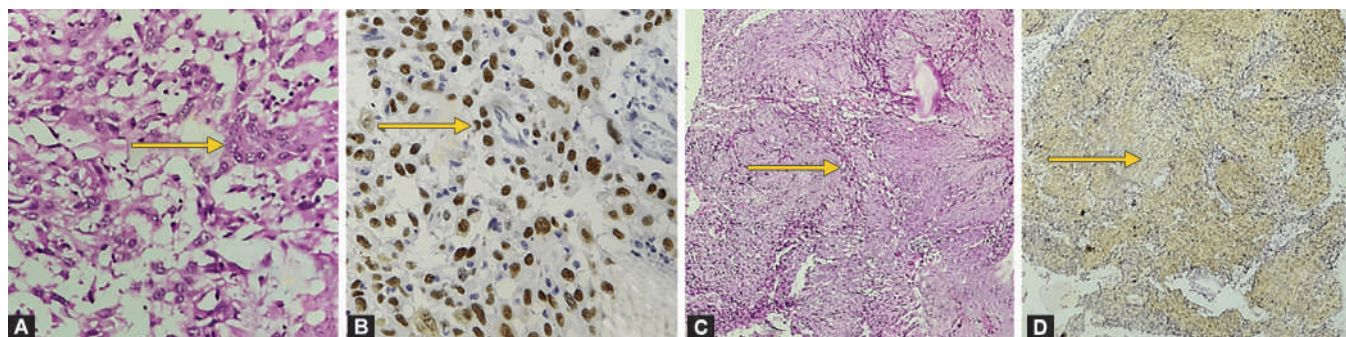
Counting Criteria

The presence of brown-colored end product (DAB positivity) was indicative of positive immunoreactivity. Interpretation of IHC expression was done. Sections exhibiting partial (only nuclear or cytoplasmic) or total (nuclear and cytoplasmic) staining in more than 5% of cells were deemed positive (Fig. 2). Negative sections were defined as those with no staining or staining in less than 5% of the cells.

To identify patients who might have higher overall survival and a better prognosis, we further applied the Lewis criteria and modified Lewis criteria. Based on the percentage of cells exhibiting positive immunostaining, the *p16* positive slides were semiquantitatively categorized in a quartile fashion into four grades: grade 1 (= up to 25%), grade 2 (= 26% to 50%), grade 3 (= 51% to 75%), and grade IV (= >75%). In addition, a semiquantitative quartile assessment was done to determine their degree of confluence, which was defined



Figs 1A to D: (A) Gross appearance of tumor in a partial glossectomy specimen; (B) Gross appearance of tumor in the buccal mucosa in a left partial mandibulectomy specimen; (C) Well-differentiated squamous cell carcinoma (grade I) showing keratin pearls and invasion into the underlying stroma (H&E, $\times 400$); (D) Moderately differentiated squamous cell carcinoma (grade II) showing tumor cells with moderate nuclear pleomorphism and hyperchromasia (H&E, $\times 400$)



Figs 2A to D: (A and B) Squamous cell carcinoma: H&E image (H&E, $\times 400$) with its corresponding immunohistochemical staining of *p16* showing nuclear positivity (*p16*, $\times 400$); (C and D) squamous cell carcinoma: H&E image (H&E, $\times 100$) with its corresponding immunohistochemical staining of *p16* showing cytoplasmic positivity (*p16*, $\times 100$)

as a group of ten contiguous cells with positive immunostaining: grade I (= up to 25%), grade II (= 26% to 50%), grade III (= 51% to 75%), and grade IV ($\geq 75\%$).^{11,12,15}

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 17.0 software.

RESULTS

Out of 100 oral SCC cases, 11% of the patients showed positive expression for *p16*.

Maximum OSCC cases were of the age-group 41–50 years (31%), followed by 51–60 years (28%). The mean age of OSCC cases in our study was 51.7 ± 11.8 years. Nearly half of the patients diagnosed with *p16* positive were between the ages of 41 and 50 (45.5%), with patients between the ages of 51 and 60 (27.2%) coming in second. Males accounted for 58% of OSCC patients, compared with 42% of females. Males (72.8%) made up the bulk of patients with *p16* positivity, compared to females (27.3%) (Table 1).

The majority of the OSCC patients with *p16* positivity had a history of smoking/tobacco chewing for 20 or more years (Table 2). The common sites of OSCC were tongue (27%), buccal mucosa (26%) and gingivobuccal sulcus (15%). The majority of the patients with *p16* positivity had tumors at the buccal mucosa (three cases) followed by the tongue, mandible, and pharynx (two cases each) (Fig. 3).

The mean tumor size in the study was 2.03 ± 1.5 cm and the mean depth of invasion of the tumor was 0.7 ± 0.9 cm. The majority of the patients had involvement of lymph nodes (14%), followed by 12% showing perineural invasion and 11% with lymphovascular emboli. Only 4% had an extranodal extension. Out of the 11 *p16*-positive cases, one showed the presence of perineural invasion and another had lymph node involvement and the extranodal extension. None of these 11 cases had vascular emboli.

Table 1: Distribution of *p16* expression according to gender

Gender	<i>p16</i> absent (%)	<i>p16</i> present (%)
Female	39 (43.8)	3 (27.3)
Male	50 (56.2)	8 (72.8)
Total	89 (100)	11 (100)

Table 2: Distribution of *p16* expression according to history of smoking/tobacco chewing

Smoking/tobacco chewing	<i>p16</i> absent (%)	<i>p16</i> present (%)
≤ 10 years	21 (23.7)	2 (18.18)
11–20 years	54 (60.6)	4 (36.4)
> 20 years	14 (15.7)	5 (45.42)
Total	89 (100)	11 (100)

Table 3: *p16* grading by Lewis and modified Lewis criteria

Grading	Confluence (5–25%)	Confluence (26–50%)	Confluence (51–75%)	Confluence ($> 75\%$)
Grade 1 (up to 25% positivity)	4 (4/5 = 80%)	1 (1/5 = 20%)	0	0
Grade 2 (26–50% positivity)	1 (1/1 = 100%)	0	0	0
Grade 3 (51–75% positivity)	0	0	0	1 (1/1 = 100%)
Grade 4 ($> 75\%$ positivity)	0	0	0	4 (4/4 = 100%)

The majority of OSCC patients with *p16* positivity had well-differentiated SCC. Since the majority of the specimens studied were biopsies, TNM staging could not be applied to these 61 cases. Among the remaining 39 cases, the majority (11%) were of pT3, 10% were pT1 and pT4a each, and 8% belonged to pT2. None of the pT1 cases expressed positive for *p16*, whereas 1% of the patients with *p16* positivity belonged to pT2, pT3, and pT4a TNM staging each.

All 11 malignant cases were graded according to the Lewis criteria and further subclassified into modified Lewis criteria (Table 3).^{11,12,15}

DISCUSSION

Oral squamous cell carcinoma is a malignant neoplasm originating in the stratified squamous epithelium.^{16–19} According to the GLOBOCAN 2022 version 1.1, in India, lip and oral cavity cancers rank as the top most common cancers occurring in males and 4th most common among females after cancers of the female genital tract.⁸

In our study, only 11% of all OSCC cases expressed *p16*. On the contrary, the study by Saxena et al. concluded that 66% of OSCC cases were positive for *p16*.¹⁵ According to previous research, the rate of *p16* overexpression in OSCC is rather varied.

In our study, the mean age-group, irrespective of gender, was 51.7 ± 11.8 years. The majority of the patients belonged to 41–50 years of age (31%) followed by 51–60 years of age (28%). This could be because those with a prolonged history of consumption of areca nut, tobacco, and smoking subsequently developed oral squamous cell carcinoma.

Johnson et al. claim that mouth cancer cases in Asians often peak in their fifth and sixth decades of life.⁴ The results therefore

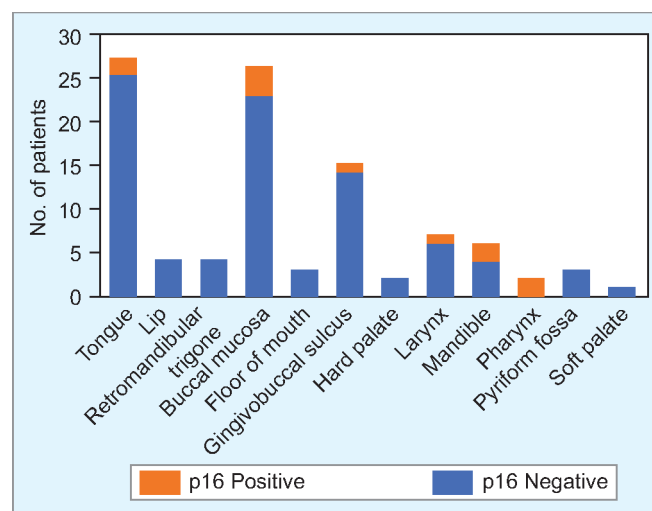


Fig. 3: Bar graph showing the distribution of *p16* according to the history of smoking/tobacco chewing

confirm the significance of age as a risk factor for oral squamous cell carcinoma development. This is comparable to our analysis, in which patients with *p16*-positive were mostly between the ages of 41 and 50 (45.5%), then 51 and 60 (27.2%). In a study by Saxena et al.,¹⁵ it was found that the mean ages of patients who were diagnosed as *p16*-positive for oral SCC were 63.7 years and 58.7 years, respectively. Especially in developing nations, men are more likely than women to suffer cancer of the head and neck, including cancer of the mouth. This is conceivable given that males are more likely than women to be addicted to substances such as alcohol and cigarettes.

However, Johnson et al.⁴ have observed that in certain emerging countries, including Brazil and India, females are increasingly exhibiting behaviors comparable to men, indicating that the trend is changing. In our study, of all the patients, males (72.8%) were more as compared to females (27.3%), this may be due to the increased prevalence of tobacco consumption in males than females. Our analysis revealed that there were more males (8/11 = 72.8%) *p16*-positive cases than females (3/11 = 27.3%) instances.

In our study, the majority (58% of all OSCC cases) of the patients had a history of smoking/tobacco chewing for 11–20 years of age. 23% had a history of less than 10 years and 19% had a history of more than 20 years of smoking or consumption of tobacco. Males made up the bulk of those who used alcohol, cigarettes, and pans. In our study maximum (5/11 = 45.4%) positive expression for *p16* was seen in patients with a history of >20 years of smoking or tobacco consumption.

In our study, there was a significant difference in the site distribution among the study groups. The most common sites for the tumors in our study were the tongue (27%) and buccal mucosa (26%) followed by gingivobuccal sulcus (15%). We found that the majority of the patients with *p16* positivity had tumors at the buccal mucosa (3/11 cases) followed by the tongue, mandible, and pharynx (2/11 cases each).

The mean tumor size in our study was 2.03 ± 1.5 cm and the mean depth of invasion of the tumor was 0.7 ± 0.9 cm. The majority of the patients had involvement of lymph nodes (14%), followed by 12% showing perineural invasion and 11% with lymphovascular emboli. Only 4% had an extranodal extension. Out of the 11 *p16* positive cases, one showed the presence of perineural invasion and another case had lymph node involvement as well as extranodal extension. None of these 11 cases had vascular emboli. The association of *p16* positivity with these variables was not significant when the chi-square test was applied ($p > 0.05$).

A few studies illustrate that *p16* positivity in oral SCC is often associated with favorable pathological features such as lower rates of extranodal extension, perineural invasion, and lymph node involvement, which collectively contribute to better prognostic outcomes.

In the current study, the majority of the patients had well-differentiated SCC (77%), and 23% of the patients had moderately differentiated SCC. Among those with positive expression of *p16*, the majority were (9/11 = 81%) WDSCC and a few were (2/11 = 18%) MDSCC. Differentiation status in oral squamous cell carcinoma (SCC) correlates with prognosis, with well-differentiated tumors generally having a better prognosis compared to moderately differentiated ones. *p16* positivity was seen in 2/11 (= 18%) MDSCC and 9/11 (81%) WDSCC cases in the current investigation.

Since the majority of specimens studied in our study were biopsies, the TNM staging could not be applied in these 61 cases. Among the remaining 39 large specimen cases, the majority (11%)

were of pT3, 10% were pT1 and pT4a each, and 8% belonged to pT2. None of the pT1 cases expressed *p16* positivity, whereas 1% of the patients with *p16* positivity belonged to pT2, pT3, and pT4a TNM staging each. The association of *p16* positivity with TNM staging was highly significant when the Chi-square test was applied ($p < 0.001$). These studies illustrate a consistent trend where a substantial proportion of oral SCC cases show *p16* positivity, and there is often a correlation between *p16* expression and advanced TNM stages, indicating its potential role as a marker of aggressive disease behavior.

Both the Lewis¹¹ and modified Lewis¹² criteria utilize histopathological evaluation and *p16* immunostaining to emphasize the importance of *p16* immunostaining as a surrogate marker for HPV-related SCC in both oropharyngeal and oral cavity cancers, aiding in diagnosis and prognostication. For each of these 11 *p16*-positive cases, the Lewis and modified Lewis criteria were used for interpretation. Among all the cases that showed positive expression for *p16*, five were grouped under grade 1 with staining of <25% cells, of which the majority showed confluence of 5–25%. Only one case each belonged to grade groups 2 and 3, with 26–50% cells and 51–75% cells having positive expression for *p16*, respectively. The remaining four cases were categorized into grade 4 (>75% cells expressing as positive for *p16*) with all of these showing a confluence of >75%. To evaluate risk stratification, Lewis et al. examined 239 instances of oropharyngeal OSCC and discovered that 78% of the patients tested positive for *p16*.¹¹ Of them, 74% had an HPV-positive result. They claimed that because the *Rb* gene usually suppresses *p16* transcription and its absence results in a notable overexpression of *p16*, overexpression of *p16* is caused by the degradation of the *Rb* gene by the HPV E7 oncoprotein. Furthermore, the tumor suppressor protein *p16* normally inhibits cyclin-dependent kinases. Because the gene is mutated, deleted, or methylated, it is missing or only faintly expressed in the majority of head and neck squamous cell carcinomas that are not associated with HPV.^{11,12} Additionally, they claimed that because *p16* can also be overexpressed by other pathways, it is not the best biomarker for oropharyngeal squamous cell carcinoma (OPSCC) and lacks specificity for HPV. A small percentage of OPSCC are highly positive for *p16* but negative for HPV. They continued by saying that it was still possible that the *p16* in their HPV-negative neoplasms had contributed to the tumors' carcinogenic process. They hypothesized that the tumor cells may have released HPV. They claimed that they had inherent *p16* overexpression and that the tumor may grow apart from HPV.¹¹ They hypothesized, based on their findings, that oropharyngeal squamous cell carcinomas that were *p16* positive and HPV negative had a higher prognosis than those that were *p16* negative.

LIMITATIONS

Our study centered on *p16* expression in 100 OSCC patients. Important findings about the expression of the *p16* IHC marker and its distribution in prevalence across age-groups, sexes, and tumor sites were drawn. Because there were fewer excised specimens of these 100 cases than biopsy specimens, we were unable to draw substantial conclusions about the expression of the *p16* marker in relation to factors such as the tumor's grade and stage.

CONCLUSION

Oral squamous cell carcinoma is a common and serious malignancy originating in the stratified squamous epithelium. In India, it ranks highest among cancers in males and fourth in females, highlighting its

significant impact. Globally, OSCC is a leading cause of cancer mortality, particularly affecting older age-groups and both sexes. Despite advancements in diagnosis and treatment, it remains a global health burden. This study has demonstrated key findings related to OSCC lesions and *p16* IHC marker expression in these lesions. In our study, 11% of cases were positive for *p16* expression. Male predominance was noted in oral squamous cell carcinoma cases and those with *p16*-positive expression, with a mean age of 51.7 ± 11.8 years. Tongue and buccal mucosa were the most common sites affected.

Human papillomavirus is known to cause cervical carcinoma; however, in all of our *p16*-positive oral squamous cell carcinoma cases, there was a history of addiction. So, we could not conclude a direct relation between *p16* and OSCC. Because there were fewer excised specimens of these 100 cases than biopsy specimens, we were unable to draw substantial conclusions about the expression of the *p16* marker with factors like the tumor's grade and stage. Future research may want to take into account a few things, such include a larger sample size of excised tissues, comparing the *p16* IHC marker with more sophisticated investigations like HPV molecular testing, and keeping track of these individuals.

ETHICS APPROVAL

Ethics approval was obtained from the Institutional Ethics Committee of Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pune (Approval No. IESC/PGS/2022/192; dated 28 September 2022).

INFORMED CONSENT

Written informed consent was obtained from all participants prior to enrolment.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

ACKNOWLEDGMENTS

The authors thank the Department of Pathology for technical support.

AUTHOR CONTRIBUTIONS

Conceptualization: Dr Sushama Gurwale, Dr Charusheela Gore.
Methodology: Dr Pranjali Nibe, Dr Gayatri Bhuibhar.
Data collection: Dr Prachi Chouhan.
Writing – original draft: Dr Prachi Chouhan.
Writing – review & editing: Dr. Prachi Chouhan.

AI USE DECLARATION

AI tools were used only for language editing. All intellectual content was developed by the authors.

REFERENCES

- Swaminathan U, Joshua E, Rao UK, et al. Expression of p53 and cyclin D1 in oral squamous cell carcinoma and normal mucosa: an

- immunohistochemical study. *J Oral Maxillofac Pathol* 2012;16(2):172–177. DOI: 10.4103/0973-029X.98451
- Rautava J, Kuuskoski J, Syrjänen K, et al. HPV genotypes and their prognostic significance in head and neck squamous cell carcinomas. *J Clin Virol* 2012;53(2):116–120. DOI: 10.1016/j.jcv.2011.11.005
- Smith J, Rattay T, McConkey C, et al. Biomarkers in dysplasia of the oral cavity: a systematic review. *Oral Oncol* 2009;45(8):647–653. DOI: 10.1016/j.oraloncology.2009.02.006
- Lingen M, Cipriani N. Head and neck. In: Kumar V, Abbas A, Aster J, et al (Eds). *Robbins & Cotran Pathologic Basis of Disease*, 10th edition. Philadelphia: Elsevier; 2021. pp. 731–752.
- Johnson NW, Jayasekara P, Amarasinghe AA. Squamous cell carcinoma and precursor lesions of the oral cavity: epidemiology and aetiology. *Periodontol* 2000 2011;57(1):19–37. DOI: 10.1111/j.1600-0757.2011.00401.x
- Ohtani N, Yamakoshi K, Takahashi A, et al. The *p16*INK4a-RB pathway: molecular link between cellular senescence and tumor suppression. *J Med Invest* 2004;51(3–4):146–153. DOI: 10.2152/jmi.51.146
- Minami K, Kogashiwa Y, Ebihara Y, et al. Human papillomavirus and *p16* protein expression as prognostic biomarkers in mobile tongue cancer. *Acta Otolaryngol* 2017;137(10):1121–1126. DOI: 10.1080/00016489.2017.1339327
- Herman JG, Merlo A, Mao L, et al. Inactivation of the CDKN2/*p16*/MTS1 gene is frequently associated with aberrant DNA methylation in all common human cancers. *Cancer Res* 1995;55(20):4525–4530. PMID: 7553621.
- International Agency for Research on Cancer. (2024). *Cancer Today*. [online] Available from: <https://gco.iarc.fr/today/en/dataviz/bars> [Last accessed June, 2024].
- Doll C, Steffen C, Beck-Broichsitter B, et al. The prognostic significance of *p16* and its role as a surrogate marker for human papilloma virus in oral squamous cell carcinoma: an analysis of 281 cases. *Anticancer Res* 2022;42(5):2405–2413. DOI: 10.21873/anticancer.15719
- Lewis JS, Thorstad WL, Chernock RD, et al. *p16* positive oropharyngeal squamous cell carcinoma: an entity with a favorable prognosis regardless of tumor HPV status. *Am J Surg Pathol* 2010;34(8):1088–1096. DOI: 10.1097/PAS.0b013e3181e84652
- Chernock RD, Lewis JS, Zhang Q, et al. Human papillomavirus-positive basaloid squamous cell carcinomas of the upper aerodigestive tract: a distinct clinicopathologic and molecular subtype of basaloid squamous cell carcinoma. *Hum Pathol* 2010;41(7):1016–1023. DOI: 10.1016/j.humpath.2010.01.006
- WHO Classification of Tumours Editorial Board. *Head and Neck Tumours*. Lyon: International Agency for Research on Cancer; 2022.
- College of American Pathologists. (2024). *Protocols and guidelines: cancer Protocols*. [online] Available from: <https://www.cap.org/protocols-and-guidelines/cancer-reporting-tools/cancer-protocol-templates> [Last accessed June, 2024].
- Saxena P, Prasad S. Evaluation of *p16* expression in oral and oropharyngeal squamous cell carcinoma. *J Oral Maxillofac Pathol* 2022;26(3):376–381. DOI: 10.4103/jomfp.jomfp_278_22
- Gupta N, Gupta R, Acharya AK, et al. Changing trends in oral cancer: a global scenario. *Nepal J Epidemiol* 2016;6(4):613–619. DOI: 10.3126/nje.v6i4.17255
- Ferlay J, Soerjomataram I, Dikshit R, et al. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. *Int J Cancer* 2015;136(5):E359–E386. DOI: 10.1002/ijc.29210
- Coelho KR. Challenges of the oral cancer burden in India. *J Cancer Epidemiol* 2012;2012:701932. DOI: 10.1155/2012/701932
- Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018;68(6):394–424. DOI: 10.3322/caac.21492

Impact Evaluation of Errors in Documentation on the Healthcare System: A Systematic Review

Subhasish Chatterjee¹, Amrita Ghosh², Ranabir Pal³, Kaushik Bhattacharya⁴

Received on: 03 July 2025; Accepted on: 28 October 2025; Published on: 10 July 2026

ABSTRACT

There have been frequent instances of missing parts, false information, and incomplete documentation in medical records. To fix problems such as missing information and mistakes in documents, using AI tools, standard practices, and other automated methods can help make the documents better and lower the chances of errors. Digitalization may not ensure completion of many examination elements due to the man behind the machine. This review was conducted with the objective of focusing on conceptual errors in the context of looking for those errors and their consequences that crop up as a shadow of our everyday activities. Coming from the definition, classification, and categorization of documentation, events, errors, checklists, and safety issues pertaining to surgical wards, an attempt was made to search the databases PubMed, Scopus, Google Scholar, and ResearchGate to find published literature including References and Extracts of Potential Research. More of our time is reportedly being consumed by regulatory documentation, shifting focus from direct patient care to mere documentation, reducing the quality of care as healthcare professionals focus on charting rather than attending to patients. Research groups are offering innovative avenues to improve patient safety within systematic documentation. The checklist promoted by the WHO has provided a potential solution for error reduction and thus has been implemented throughout the world in a multitude of different settings. Studies targeting the low-quality paradigm of developing perioperative care are identifying these potential complications and have proposed improved communication and advanced role training with operating room personnel as patient safety mitigators. We really need to mitigate the ethical, legal, and quality assurance issues that come with documentation with the mindset of the paramount importance of patient safety at the center stage of healthcare delivery.

Keywords: Delivery of healthcare, Documentation, Medical errors, Outcome, Safety.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0036

INTRODUCTION

The best example of 'self-service' contributing to clinical errors is the healthcare industry, where accurate or even complete information related to patients is left undocumented. These mistakes and oversights lead to lower quality of care and often cause problems because patient history, treatment plans, and prescription orders are misunderstood. In hospitals, the frequency of mistakes related to paperwork is particularly high. Instead of traditional handwritten forms, the implementation of information systems for documentation improves the efficiency of processing documentation. Prescription errors are bound to come up even though there is improved technology for doctors. When writing prescriptions, the focus should be on creating and using a digital system that specifically addresses serious patient safety problems. An advanced clinical decision support system should integrate a pharmacist into the CPOE system to enhance safety. We need to address the legal, medical, and quality control issues associated with investigation errors. The emphasis and reasoning in our review focused on the identification of gaps within the documentation processes at different levels of the healthcare system and ways to address them. To accomplish this, changes were designed and proposed to the scaffolding and implementation of documentation mistakes and their consequences using contextual responsiveness, healthcare personnel capacity building, communication, and PRISMA reporting guidelines.

¹Faculty of Management and Commerce, ICAI University Tripura, Tripura, India

²Department of Biochemistry, Midnapore Medical College and Hospital, Paschim Midnapore, West Bengal, India

³Department of Community Medicine, Mata Gujri Memorial Medical College and Lions Seva Kendra Hospital, Mata Gujri University, Kishanganj, Bihar, India

⁴Department of Surgery, Mata Gujri Memorial Medical College and Lions Seva Kendra Hospital, Mata Gujri University, Kishanganj, Bihar, India

Corresponding Author: Kaushik Bhattacharya, Department of Surgery, Mata Gujri Memorial Medical College and Lions Seva Kendra Hospital, Mata Gujri University, Kishanganj, Bihar, India, Phone: +91 9933353536, e-mail: kbhattacharya10@yahoo.com

How to cite this article: Chatterjee S, Ghosh A, Pal R, *et al.* Impact Evaluation of Errors in Documentation on the Healthcare System: A Systematic Review. *J Indian Med Assoc* 2026;124(7):47–53.

Source of support: Nil

Conflict of interest: None

METHODS

Our interprofessional study team initiated a systematic evaluation that started with an in-depth bibliographic search addressing the question: "What are the health system-wide ramifications of documentation errors and their consequences?" We engaged with

both the actual library and online resources in utmost good faith, aiming to collect a multitude of materials.

Inclusion Criteria

In a systematic review, any inaccuracies or errors in documentation, whether digital, print, or handwritten, are considered regarding definitions, classifications, categorizations, assessment of error amount, record evaluation, never events, and perspectives. Both prospective and retrospective investigations, together with additional literature in English, are considered.

Exclusion Criteria

We removed texts that did not contain “adverse event of documentation,” ambiguous effects of faulty error reports, and lacked entire material relevant to record mistakes.

Search Strategy

A comprehensive review was conducted to assess the impact of documentation errors on healthcare system procedures. This review identified 75 distinct categories of literature from databases, including PubMed, Google Scholar, ResearchGate, and SCOPUS. 75 studies were deemed possibly suitable following the elimination of duplicates. In a further phase of the evaluation, 54 studies were deemed suitable, of which 24 were utilized to enhance the debate. The reviews were performed separately and subsequently aggregated for the primary result, encompassing epidemiology, interventions, capacity building, and research and development. Research examining documentation mistakes was subsequently studied in relation to the eligibility requirements for data extraction and synthesis. All included studies were evaluated for quality using established procedures, excluding un sourced literature and utilizing trustworthy databases, viz. PubMed, SCOPUS, Google Scholar, ResearchGate for data acquisition.

Data Extraction and Synthesis

The data was coded following document selection methods, including the document title, authors, year of publication, research type, study purpose, study duration, utilized tools, variables (adverse events and the number of patients impacted by age and gender), and key findings.

Study Selection

During the execution of the systematic database search technique, 80 distinct categories of literature were identified, three of which originated from the articles in the reference list. The records acquired after eliminating duplicates were 68 in total. These were considered possibly suitable based just on the title, abstract, or both, for which the complete texts were obtained. Following the evaluation of complete texts, 50 papers were identified as suitable; however, 19 lacked full-text availability. Of the remaining 22 documents satisfied the inclusion requirements, and 9 systematic reviews were regarded as appropriate for enriching the discourse with our peers in the field.

Characteristics of Included Studies

Unfavorable documentation processes, encompassing the development of mistake mitigation measures, the improvement of healthcare professionals' competencies, and the obstacles to implementation, have been examined in research studies. The design categories comprised nine cross-sectional studies, three multicenter data analyses, four viewpoint articles, one literature review, one safety checklist assessment, one training and certification evaluation, one cohort study, one editorial, and several forms of telephone interviews and mailed surveys (Fig. 1).

RESULTS

Data Abstraction and Analysis

A scoping review aims to identify methods for measuring the documentation burden associated with electronic health records (EHRs), which leads to clinicians' burnout; analyzed 3,482 articles, identifying 15 measurement characteristics and 15 effort constructs.¹ A systematic review of 628 abstracts found 23 papers met the selection criteria: majority using time and motion methodology. Analyzing impact of electronic health records on physician and nurse papers time and identifying factors influencing efficiency differences across studies.²

A study emphasized the significance of computer experience in nursing, the acceptance of nursing processes, and the compatibility between nursing workflow and documentation functionality.³

The authors analyzed and compared the documentation errors in medication treatment records using handwritten notes and ICU flowcharts with pre-printed sections.⁴ The analysis of blood glucose tests performed on 234 patients revealed that out of 5,049 tests, 12.04% were not documented, and 98.1% constituted record inaccuracies. EHR is crucial for higher precision in updated lab data in ICUs, eliminating transcription errors and insulin-related errors.⁵

Another study aimed to identify and quantify errors in manual documentation and dispensation with potential adverse drug events (ADEs) in hospitalized patients.⁶ ADEs are the leading cause of hospital-acquired injuries, often due to medication errors during the prescribing stage.⁷ Another research systematically examined studies reporting documentation errors and deficiencies in medical records to improve the quality of healthcare services and systems.⁸ Researchers studied elements of documentation errors following “Ottawa Ankle Rules” using EHR.⁹ The Health Information Technology Act and EHR adoption increased documentation burden, affected healthcare professionals' work experience, and contributed to burnout.¹⁰ Other research group also identified, quantified and correlated errors in manual work that potentially lead to ADEs in hospitalized patients.⁶ Assessment of medical records at Bir Hospital shows that discharge summaries fail to capture sufficient information about hospital stay, including

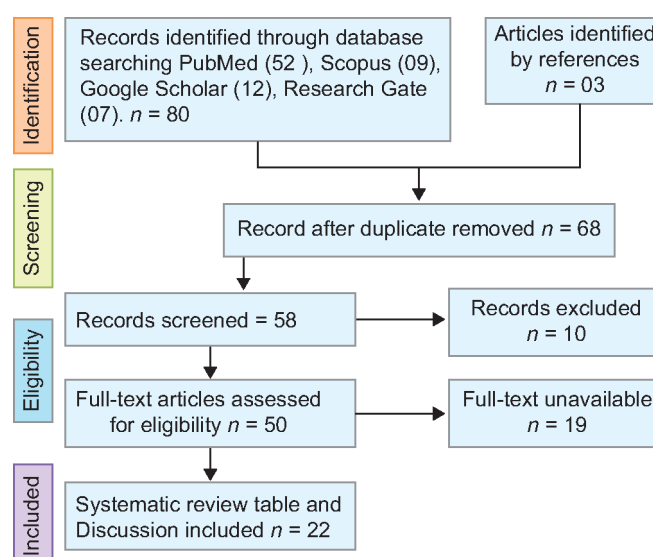


Fig. 1: Prisma diagram of the Systematic Review on 'Impact evaluation of errors in documentation on the healthcare system'

condition, instructions provided, and details of the physician who was in charge; it recommended the use of electronic records.¹¹

This study documents the gaps in nursing documentation in 197 care plans across five long-term care institutions, with the highest accuracy in the somatic and psycho-geriatric wards.¹²

Although computer-based records, integration of pharmacy, decision support systems, and bar-coding mitigate treatment errors, training personnel and budget for devices are difficult.¹³ The review emphasizes benefits of EHRs regarding reduction of documentation errors and waiting time for patients in outpatient clinics, but no improvement was noted in other settings.¹⁴ Although research is available documenting CPOE systems achieving an 81% reduction in medication errors, very few have studied its contributions to prescription errors. This gap, along with several others, highlights the need for deeper exploration linked to increase in prescription error risks.¹⁵ This study specifically sought to assess how effective a computerized medication management system is when compared to a traditional paper-based approach, with an emphasis on integrating clinical workflow and decision support into the system.¹⁶

Using CPOE systems and handwritten orders, the study assessed whether physicians included their signatures, dates, and timestamps, as well as the overall clarity and completeness of the orders, and legibility of the signatures.¹⁷ This study focuses on aspects that nurse practitioners identify and manipulate when formulating nursing documentation policies within the context of Iranian nursing.¹⁸

Research conducted in Shahid Mohammadi Hospital, Iran, reveals that documentation errors had a significant impact on coding the cause of death, with major errors being predominant. Factors contributing include a lack of coder training and an undesirable death certificate structure.¹⁹

Researchers aimed to assess the impact of high-alert medication prescribing on the prevalence of medication errors in hospital settings, a significant global public health concern.²⁰ The role of documents and communication failures in healthcare professionals' interactions throughout the perioperative pathway, concentrating on the preoperative, intraoperative, and postoperative phases.²¹ Another systematically studied documentation errors by analyzing data from MEDLINE, EMBASE, CINAHL, and International Pharmaceutical Abstracts from 1985 to 2007 excluding electronic prescriptions, unit disease, route of administration, type, and language of the paper, being English only (Table 1).²²

DISCUSSION

Even having an electronic medical record does not automatically mean that all parts of an examination will be completed. Our review attempted to spotlight the gaps in documentation processes across various levels of the healthcare system and explored ways to bridge those gaps. To make this happen, we proposed some changes aimed at improving how documentation errors are handled and their impact, focusing on being responsive to the context, enhancing communication among healthcare staff, and following PRISMA guidelines for systematic reviews and meta-analyses.

This study found that organizations can improve online patient documentation systems by reengineering, as demonstrated in a 150-bed rural community hospital, resulting in increased end-user satisfaction.²³

In this research, the "END-IT system," a performance improvement model, significantly enhances reduction of errors of nurses at trauma centers utilizing existing computer software.²⁴

Health professionals are satisfied with EHRs, but concerns about power supply, internet connectivity, security, and confidentiality need attention to improve their confidence and satisfaction.²⁵

The study used a naturalistic stepped wedge design to compare prescribing errors in electronic and paper prescribing across 20 wards in big hospital did not show major changes; patient and ward factors significantly influenced errors; errors mainly involved incorrect dose and order.²⁶

The study aims to assess the availability and usage of inpatient computerized physician order entry in U.S. hospitals, revealing that 1 in 10 US facilities used "Computerized physician order entry" (CPOE) and were optimally utilized.²⁷

This study evaluates prescription quality in Aberdeen Royal Infirmary's AMAU, revealing acceptable levels compared to the literature, but concerns about DDIs and allergy documentation highlight the need for further education.²⁸

Prescription quality indicators based on register data are widely used in quality management. However, validation is crucial for the indicators, and concurrent validity with a "gold standard" is mandatory. Future studies should focus on detailed clinical information from practice databases and hospital records.²⁹

Agrawal et al. conducted a quasi-experimental and longitudinal observational study of the Med Recon system, which, with its interactive reminder alert, significantly reduced medication errors on admission, enhancing patient safety and ensuring physician compliance despite the limitations of computerized decision support tools. The pilot phase decreased the unintentional disparity between home and admission medicine orders. Med Recon compliance increased from 34% to 98–100% with computerized alarms.³⁰

The study aimed to assess the influence of electronic health records (EHRs) systems on patients' time spent on various tasks during their primary health care visits. The study found no significant difference in patient reception area and consultation time between paper-based and nonpaper-based groups.³¹ EHRs have drawbacks such as cost and maintenance, among others. However, widespread adoption and meaningful use can yield significant benefits for patients and society.³²

Kariotis et al. introduced electronic health records (EHRs) into the mental health sphere to analyze their impact on the psychosocial clinical information system by informing faculty mental health clinicians on the documentation systems, coaching them to prevent workflow problems, and promoting collaboration through digital teamwork.³³

McGregor et al. focused on the integration of EHRs toward better coordination of mental health services by educating providers on cross-cultural matters, enhancing collaboration among disparate agencies to reduce fragmentation, and developing methods for ongoing feedback on system usability.³⁴

To improve system trust and participation, Tapuria et al. trained patients in fundamental navigation skills and provided them with tools to interpret their health data, fostering active participation. Clinicians also received instruction on appropriate digital communication techniques. The infrastructure was also bolstered on these subsystems as usability broadens at the same time increasing data security and confidentiality support system trust.³⁵

Table 1: Summary table for the general characteristics of the included studies in 'impact of errors in documentation on health care: a systematic review' (n = 22)

<i>Authors and study type</i>	<i>Summary findings in the study</i>
Moy et al. (Review) ¹	Only 45.0% assessed EHR impact on clinicians and patients, and 40.0% mentioned clinician burnout
Lise Poissant et al. (Systematic Review) ²	Major technology improvements have made systems developed 20 years ago incomparable with those developed more recently
Elske Ammenwerth et al. (Original Investigation) ³	Previous acceptance of the nursing process and self-confidence in using computers significantly influence the acceptance of a new computer-based nursing documentation system
Natasha Franklin et al. (Cohort Study) ⁴	Audit found no significant difference in error rates between handwritten and pre-printed ICU medication flowcharts; largest category was 'prescribing documentation errors', with a 44% error rate using handwritten flowcharts and 78% using pre-printed ones
Sowan et al. (Systematic Review) ⁵	Average time from point-of-care testing to meter docking-8 hours, with some taking 56 hours to upload. Overall, 30 unique insulin errors affected 25 of 234 patients, affecting 10.7% of the total
Hartel et al. (Retrospective observational quantitative study) ⁶	Documentation errors were found in 3.5% of prescribed agents, with patient charts showing at least one error. Handwriting readability varied from good to unreadable
Bobb et al. (Quantitative: observational and descriptive analytical study) ⁷	A study identified 1,111 prescribing errors, with most occurring on admission. 30.8% were clinically significant, often related to anti-infective orders, incorrect dose, and medication knowledge deficiency. 64.4% were likely to be prevented with CPOE
Shahbodaghi et al. (Systematic Review) ⁸	Out of 7,624 articles, 48 met the study's requirements. However, 47 were incomplete, 14 were inaccurate, 8 were inconsistent, 7 were illegible, 4 were unsigned documents, and 2 were irrelevant
Salazar et al. (Descriptive observational research) ⁹	The study evaluated 700 charts, 663 received radiographs, 138 fractures were identified, and 41% of OAR components documented weight-bearing status in 288 subjects
Murad et al. (systematic review) ¹⁰	Measures for healthcare professionals, primarily physicians and nurses in USA; developed and applied; but their validity and appropriateness were limited; focused heavily on stress & burnout
Mishra et al. (Cross-sectional study) ¹¹	The patient's discharge information, including condition, address, age, and sex, was missing, and most discharge sheets had illegible signatures. 96.9% of patients were not given discharge instructions
Tuinman et al. (Cross-sectional study) ¹²	Inadequacies found in residents' care needs, nursing diagnoses, progress, outcome reports, with higher accuracy scores in somatic and psychogeriatric units compared to residential care units
Edwards et al. (Descriptive and exploratory study) ¹³	Combination errors—such as wrong-site surgeries, lab results, medication mishaps, patient misidentification, and equipment failures—can lead to diagnostic and ordering errors due to the unavailability of patient information and illegible handwriting.
Albagmi (Systematic review study) ¹⁴	EMRs reduce medical mistakes due to fewer documentation errors and patient wait times due to improved system workflow
Koppel et al. (Mixed method, both qualitative and quantitative study) ¹⁵	Widely used CPOE system led to 22 medication error risks, including fragmented displays, incorrect dosage guidelines, missed antibiotic renewal notices, function separation, and inflexible ordering formats
Donsa et al. (Comparative study and quantitative research) ¹⁶	The BG documentation error rate was comparable between the PaperG group (4.9%) and the CompG group (4.0%)
Winslow et al. (Descriptive study) ¹⁷	The study found that 28% of medication orders were incorrect, 78% were illegible, 24% were incomplete, 18% had a date omitted, and 58% had a missing time
Tajabadi et al. (Qualitative study) ¹⁸	This study focuses on unsafe documentation in Iranian nursing, identifying types of errors, reasons for errors, and 12 subcategories influencing nursing documentation
Haghighi et al. (Cross sectional, descriptive analytical) ¹⁹	Poor quality of Cause of Death coding in SMH is attributed to a lack of coder training, documentation errors, and the undesirable structure of death certificates.
Rosa et al. (Cross-sectional study) ²⁰	Prescription errors in heparin, phentanyl, and midazolam were highest in intensive care and neurology units, with 3.3 errors per order form, whereas pre-typed prescriptions were less likely
Braaf et al. (Systematic review) ²¹	Inadequate documentation in surgical teams leads to inefficiency, delays, and poor patient outcomes. Preoperative checklists facilitate coordination and improve patient outcomes
Lewis et al. (Systematic review) ²²	Prescription errors are prevalent, affecting 7% of medication orders, 2% of patient days, and 50% of hospital admissions. However, reported rates vary due to differences in definitions, data collection methods, and study settings. Future research should address this disparity

Dendere et al. used incorporation of patient-controlled portals as a mechanism to drive greater participatory EHRs engagement and designed appealing portal interfaces for hospital inpatients. Staff members were instructed to participate in digital interaction with patients, and access to information was granted in a secure, real-time environment. After the intervention, the public and physicians analyzed their ethical issues and expectations regarding EHRs.³⁶

Entzeridou et al. added ethical concerns to the strategies for EHR rollout by enhancing information security infrastructure and building trust through public awareness campaigns on the benefits of EHRs and their protective measures.³⁷

Muli et al. researched the adoption of EHRs by Swedish patients in primary care. The study-built capacity by fostering e-literacy among patients, promoting dialog between healthcare providers and patients regarding the use of EHRs, and creating systems that address diverse literacy and language levels.³⁸

Thielmann et al. explored the expectations of patients regarding access to GPs' medical records and built capacity by improving system responsiveness to patients through co-designing tailored digital solutions alongside preparatory training for providers in patient-centered digital communication.³⁹

Concerning Spring et al. improvement of automated billing accuracy, they used machine learning for error documentation problem identification, trained anesthesiology teams' error remedial system, and improved audit trails and billing compliance procedures.⁴⁰

Bobb et al. addressed the issue of Computerized Physician Order Entry (CPOE) and its effect on the prescribing error rate by developing a standardized CPOE protocol and providing clinical CPOE training. They integrated reporting systems focused on error causation and organizational learning.⁷

Derived from prescriptive error reduction through competency control development, Barber et al. advanced capacity through shifts in organizational culture towards defined accountability, increased frequent competency-based evaluations, and a strengthened peer-review framework.⁴¹

Nightingale et al. diagnosed the computerized bedside prescribing challenge using a rule-based approach and suggested developing context-sensitive prescribing algorithms, nurse and physician onboarding frameworks, and real-time mismatch alerts as part of structured capacity-building interventions.⁴²

During an intervention aimed at assessing prescription writing practices within PHC in Brazil, capacity building was identified by Batista et al. as requiring training on writing legible and complete prescriptions, implementing auditing systems for prescriptions, and lobbying for digitized prescriptions in resource-poor environments.⁴³

In their study, Ball and McBeth focused on the documentation burden impacting surgeons' performance and satisfaction, reaching conclusions that involved expanding capacity by re-engineering documentation workflows to eliminate unnecessary steps, teaching clinical members of the surgical team about affordable documentation systems, and offloading non-patient-facing data entry work.⁴⁴

As part of documenting nursing activities, Pabst et al. studied computerized documentation on nurses' time management and proposed the use of streamlined templates with auto-populate capabilities, documented role-specific training, and

assessing the nursing workflow for optimization as areas to be implemented.⁴⁵

Encouraging Cloete to intervene to enhance the allocation of nurses' time and reduce nursing practice medication errors, embarked on empowering nurses through medication error training workshops, developed curricula that incorporated error prevention into training, and fostered reflection and learning.⁴⁶

Noraziani et al. investigated the use of electronic medical records globally with a SWOT analysis with the intention of learning from the system's evolutionary process. The research proposes that the adoption of Electronic Medical Records (EMR) in health services in Malaysia stands to offer other nations emulative opportunities.⁴⁷

Antor E et al. undertook an intervention at Komfo Anokye Teaching Hospital in Ghana; health workers are said to accept and utilize electronic health records (EHRs). The research looks into what drives adoption and what barriers exist. The study found that 86.8% of the respondents reported active use and adoption of the EHR system.⁴⁸

CONCLUSION

Documentation mistakes continue to be common and diverse across healthcare settings, and these gaps have not changed despite advancements in health information technology. With inventions such as EHRs, CPOE, and END-IT, there is hope in bettering health record documentation; however, some degree of error continues to occur due to system acceptance, design, training, and user factors. Studies continue to emphasize challenges like clinician fatigue, handwriting or typing that is difficult to read, insufficient documentation, and incomplete frameworks. Effective mitigation of issues regarding patient and subject safety will require proper planning, training, and user-targeted healthcare system design geared toward digital documentation systems. This approach is crucial for enabling healthcare providers to effectively use digital documentation tools, thus reducing errors and improving patient safety. Focusing on these key areas can enhance the quality of health records and decrease the probability of miscommunication or oversight within the healthcare system.

Future Directions

Maintaining thorough and accurate records is crucial for providing high-quality care, particularly in non-emergency environments such as home healthcare, rehabilitation centers, and mental health services. Going forward, it is important for researchers to examine both the practicality and the ethical considerations of using these technologies across different therapeutic situations. It is also vital to study how training programs focused on structured documentation for healthcare professionals and support staff affect the precision of records over an extended period, aiming for sustained enhancements. In terms of warding off documentation mistakes, the layout, ease of use, and compatibility of EHRs are extremely significant. Principles of human factors engineering and design that put the user first are central to this. A lot of current research seems to concentrate on finding connections rather than clear cause-and-effect links. In the future, research should look deeper into how inaccuracies in documentation affect clinical choices, communication, and results in various ways or by using different experimental methods. Not much work has been done on how individual people, their thinking patterns, and the dynamics

within an organization contribute to these kinds of errors. Future studies should utilize qualitative and ethnographic methods to better understand issues like burnout, overwhelming workloads, insufficient training, and the overall culture of the workplace.

ETHICS APPROVAL

As this is a systematic review that collated and analyzed data from the published medical literature available in the public domain, approval from an Institutional Ethics Committee was not required.

INFORMED CONSENT

Not applicable. As this is a systematic review, no primary data were collected from human participants, and no identifiable patient information or images were included.

CLINICAL TRIAL REGISTRATION

Not applicable.

DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this published article.

ACKNOWLEDGMENT

Nil.

AUTHOR CONTRIBUTIONS

Conceptualization: SC, RP; Methodology: SC, AG, RP, KB.

Data collection: SC, AG, RP, KB.

Writing – original draft: SC, AG, RP, KB.

Writing – review & editing: SC, AG, RP, KB.

AI USE DECLARATION

No AI tools were used in the preparation or language editing of this manuscript. All intellectual content was developed solely by the authors.

REFERENCES

- Moy AJ, Schwartz JM, Chen R, et al. Measurement of clinical documentation burden among physicians and nurses using electronic health records: a scoping review. *J Am Med Inform Assoc* 2021;28(5):998–1008. DOI: 10.1093/jamia/ocaa325
- Poissant L, Pereira J, Tamblyn R, et al. The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. *J Am Med Inform Assoc* 2005;12(5):505–516. DOI: 10.1197/jamia.M1700
- Ammenwerth E, Mansmann U, Iller C, et al. Factors affecting and affected by user acceptance of computer-based nursing documentation: results of a two-year study. *J Am Med Inform Assoc* 2003;10(1):69–84. DOI: 10.1197/jamia.M1118
- Franklin N. Identifying medication documentation errors using handwritten versus pre-printed ICU flowcharts. *Aust J Adv Nurs* 2012;29(3):30–39. DOI: 10.37464/2012.293.1644
- Sowan AK, Vera A, Malshe A, et al. Transcription errors of blood glucose values and insulin errors in an intensive care unit: secondary data analysis toward electronic medical record-glucose interoperability. *JMIR Med Inform* 2019;7(1):1–17. DOI: 10.2196/11873
- Hartel MJ, Staub LP, Röder C, et al. High incidence of medication documentation errors in a Swiss university hospital due to the handwritten prescription process. *BMC Health Serv Res* 2011;11:199. DOI: 10.1186/1472-6963-11-199
- Bobb A, Gleason K, Husch M, et al. The epidemiology of prescribing errors: the potential impact of computerized prescriber order entry. *Arch Intern Med* 2004;164(7):785–792. DOI: 10.1001/archinte.164.7.785
- Shahbodaghi A, Moghaddasi H, Asadi F, et al. Documentation errors and deficiencies in medical records: a systematic review. *J Health Manag* 2024;26(2):351–368. DOI: 10.1177/09720634241229545
- Salazar L, Best TM, Hiestand B. Incomplete documentation of elements of the Ottawa Ankle Rules despite an electronic medical record. *Am J Emerg Med* 2011;29(9):999–1002. DOI: 10.1016/j.ajem.2010.05.012
- Murad MH, Vaa Stelling BE, West CP, et al. Measuring documentation burden in healthcare. *J Gen Intern Med* 2024;39:2837–2848. DOI: 10.1007/s11606-024-08956-8
- Mishra AK, Bhattarai S, Bhurtel P, et al. Need for improvement of medical records. *JNMA J Nepal Med Assoc* 2009;48(174):103–106. DOI: 10.31729/jnma.222
- Tuinman A, De Greef MHG, Krijnen WP, et al. Accuracy of documentation in the nursing care plan in long-term institutional care. *Geriatr Nurs* 2017;38(6):578–583. DOI: 10.1016/j.gerinurse.2017.04.007
- Edwards M, Moczygemba J. Reducing medical errors through better documentation. *Health Care Manag* 2004;23(4):329–333. DOI: 10.1097/00126450-200410000-00007
- Albagmi S. The effectiveness of EMR implementation regarding reducing documentation errors and waiting time for patients in outpatient clinics: a systematic review. *F1000Res* 2021;10:514. DOI: 10.12688/f1000research.45039.2
- Koppel R, Metlay JP, Cohen A, et al. Role of computerized physician order entry systems in facilitating medication errors. *JAMA* 2005;293(10). DOI: 10.1001/jama.293.10.1197
- Donsa K, Beck P, Höll B, et al. Impact of errors in paper-based and computerized diabetes management with decision support for hospitalized patients with type 2 diabetes. A post-hoc analysis of a before-and-after study. *Int J Med Inform* 2016;90. DOI: 10.1016/j.ijmedinf.2016.03.007
- Winslow EH, Nestor VA, Davidoff SK, et al. Legibility and completeness of physicians' handwritten medication orders. *Heart Lung* 1997;26(2):158–164. DOI: 10.1016/s0147-9563(97)90076-5
- Tajabadi A, Ahmadi F, Sadooghi Asl A, et al. Unsafe nursing documentation: a qualitative content analysis. *Nurs Ethics* 2020;27(5):1213–1224. DOI: 10.1177/0969733019871682
- Haghighi MHH, Dehghani M, Teshizi SH, et al. Impact of documentation errors on accuracy of cause of death coding in an educational hospital in southern Iran. *Health Inf Manag* 2014;43(2):34–42. DOI: 10.1177/183335831404300205
- Rosa MB, Perini E, Anacleto TA, et al. Errors in hospital prescriptions of high-alert medications. *Rev Saude Publica* 2009;43(3):490–498. DOI: 10.1590/S0034-89102009005000028
- Braaf S, Manias E, Riley R. The role of documents and documentation in communication failure across the perioperative pathway. A literature review. *Int J Nurs Stud* 2011;48(8):1024–1038. DOI: 10.1016/j.ijnurstu.2011.05.009
- Lewis PJ, Dornan T, Taylor D, et al. Prevalence, incidence, and nature of prescribing errors in hospital inpatients. *Drug Saf* 2009;32:379–389. DOI: 10.2165/00002018-200932050-00002
- LaDuke S. Online nursing documentation: finding a middle ground. *J Nurs Adm* 2001;31(6):283–286. DOI: 10.1097/00005110-200106000-00003
- Wainwright GA, Stehly CD, Wittmann-Price RA. Emergency nurse documentation improvement tool. *J Trauma Nurs* 2008;15(1):16–18. DOI: 10.1097/01.JTN.0000315784.27837.ba
- Mensah NK, Adzakpah G, Kissi J, et al. Health professionals' perceptions of electronic health records system: a mixed-method study in Ghana. *BMC Med Inform Decis Mak* 2024;24(1):254. DOI: 10.1186/s12911-024-02672-3
- Franklin BD, Puaar S. What is the impact of introducing inpatient electronic prescribing on prescribing errors? A naturalistic stepped



- wedge study in an English teaching hospital. *Health Informatics J* 2019. DOI: 10.1177/1460458219833112
27. Ash JS, Gorman PN, Seshadri V, et al. Computerized physician order entry in U.S. hospitals: results of a 2002 survey. *J Am Med Inform Assoc* 2004;11(2):95–99. DOI: 10.1197/jamia.M1427
28. Alyamani NA, Hopf Y, Williams DJ. Prescription quality in an acute medical ward. *Pharmacoepidemiol Drug Saf* 2009;18(12). DOI: 10.1002/pds.1830
29. Andersen M. Basic, is it possible to measure prescribing quality using only prescription data? *Clin Pharmacol Toxicol* 2006;98(3):314–319. DOI: 10.1111/j.1742-7843.2006.pto_411.x
30. Agrawal A, Wu WY. Reducing medication errors and improving systems reliability using an electronic medication reconciliation system. *Jt Comm J Qual Patient Saf* 2009;35(2):106–114. DOI: 10.1016/s1553-7250(09)35014-x
31. Jabour AM. The impact of electronic health records on the duration of patients' visits: time and motion study. *JMIR Med Inform* 2020. DOI: 10.2196/16502
32. Menachemi N, Collum TH. Benefits and drawbacks of electronic health record systems. *Risk Manag Healthc Policy* 2011;4:47–55. DOI: 10.2147/RMHP.S12985
33. Kariotis TC, Prictor M, Chang S, et al. Impact of electronic health records on information practices in mental health contexts: scoping review. *J Med Internet Res* 2022;24(5):e30405. DOI: 10.2196/30405
34. McGregor B, Mack D, Wrenn G, et al. Improving service coordination and reducing mental health disparities through adoption of electronic health records. *Psychiatr Serv* 2015;66(9):985–987. DOI: 10.1176/appi.ps.201400095
35. Tapuria A, Porat T, Kalra D, et al. Impact of patient access to their electronic health record: systematic review. *Inform Health Soc Care* 2021;46(2):192–204. DOI: 10.1080/17538157.2021.1879810
36. Dendere R, Slade C, Burton-Jones A, et al. Patient portals facilitating engagement with inpatient electronic medical records: a systematic review. *J Med Internet Res* 2019;21(4):e12779. DOI: 10.2196/12779
37. Entzeridou E, Markopoulou E, Mollaki V. Public and physicians' expectations and ethical concerns about electronic health record: benefits outweigh risks except for information security. *Int J Med Inform* 2018;110:98–107. DOI: 10.1016/j.ijmedinf.2017.12.004
38. Muli I, Calander Å, Hvitfeldt H, et al. To read or not to read - a cross-sectional study of Swedish primary care patients' adoption of patient accessible electronic health records. *Digit Health* 2024. DOI: 10.1177/205520762412876
39. Thielmann RR, Hoving C, Schutgens-Kok E, et al. Patient online access to general practice medical records: a qualitative study on patients' needs and expectations. *Health Inf Manag* 2024;53(3):166–173. DOI: 10.1177/18333583221144666
40. Spring SF, Sandberg WS, Anupama S, et al. Automated documentation error detection and notification improves anesthesia billing performance. *Anesthesiology* 2007;106:157–163. DOI: 10.1097/00000542-200701000-00025
41. Barber N, Rawlins M, Dean Franklin B. Reducing prescribing error: competence, control, and culture. *Qual Saf Health Care* 2003;12(Suppl 1):i29–i32. DOI: 10.1136/qhc.12.suppl_1.i29
42. Nightingale PG, Adu D, Richards NT, et al. Implementation of rules-based computerized bedside prescribing and administration: intervention study. *BMJ* 2000;320(7237):750–753. DOI: 10.1136/bmj.320.7237.750
43. Batista AM, Gama ZADS, Hernández PJS, et al. Quality of prescription writing in Brazilian primary health care. *Prim Health Care Res Dev* 2023;24:e49. DOI: 10.1017/S1463423623000415
44. Ball CG, McBeth PB. The impact of documentation burden on patient care and surgeon satisfaction. *Can J Surg* 2021;64(4):E457–E458. DOI: 10.1503/cjs.013921
45. Pabst MK, Scherubel JC, Minnick AF. The impact of computerized documentation on nurses' use of time. *Comput Nurs* 1996;14(1):25–30. PMID: 8605657.
46. Cloete L. Reducing medication errors in nursing practice. *Cancer Nurs Pract* 2015;14(1). DOI: 10.7748/ns.29.20.50.e9507
47. Noraziani K, Nurul'Ain A, Azhim MZ, et al. An overview of electronic medical record implementation in healthcare system: lessons to learn. *World Appl Sci J* 2013;25(2):323–332. DOI: 10.5829/idosi.wasj.2013.25.02.2537
48. Antor E, Owusu-Marfo J, Kissi J. Usability evaluation of electronic health records at the trauma and emergency directorates at the Komfo Anokye teaching hospital in the Ashanti region of Ghana. *BMC Med Inform Decis Mak* 2024;24(1):231. DOI: 10.1186/s12911-024-02636-7

Surgeon's Approach to Spontaneous Small Bowel Intramural Hematoma: A Case Series of Three Cases

Jyoti Bansal¹, Vijayendra Kedage², Kallya Rajgopal Shenoy³, Asish Kishore⁴, Manasa U⁵

Received on: 29 February 2024; Accepted on: 17 May 2025; Published on: 10 July 2026

ABSTRACT

Background: Spontaneous intramural intestinal hematoma is rare in anticoagulant therapy, occurring in 1 case per 2,500 patients annually. Hemophilia patients have a 4.85% risk. Misdiagnosis may prompt unnecessary surgery.

Aim and objectives: We wanted to formulate this case series to compare different options of treatment for this condition on the basis of presentation and severity.

Materials and methods: *Case 1:* A 58-year-old on dual anticoagulants post-aortic valve replacement experienced abdominal pain, tenderness, and rebound tenderness. CT showed SMA stenosis, jejunal hematoma, and mesenteric ischemia. Emergency laparotomy revealed a nongangrenous jejunal hematoma, leading to resection.

Case 2: A 31-year-old female post-mitral valve replacement presented with abdominal symptoms and a deranged coagulation profile. CT showed ileal wall thickening. Conservative management after anticoagulant reversal resulted in recovery.

Case 3: A 31-year-old male with hemophilia A had abdominal pain for a week. CT revealed a small bowel hematoma. Medical treatment led to recovery. It is crucial to suspect small bowel hematoma in anticoagulated or coagulopathy patients. Early diagnosis avoids unnecessary surgeries.

Results: Small bowel intramural hematoma is a serious complication of unmonitored anticoagulants and coagulant disorders. One should have high suspicion for diagnosing it on the basis of history and radiology to make the appropriate treatment plan and to avoid unnecessary laparotomies.

Conclusion: It is important to consider the possibility of spontaneous small bowel hematoma in patients who are on long-term anticoagulation therapy or those who have diseases associated with coagulation factors. Early and accurate diagnosis is critical, as it enables prompt treatment and avoids unnecessary laparotomies.

Keywords: Acute abdomen, Case report, Hemophilia, Intestinal obstruction, Small bowel intramural hematoma, Warfarin.

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0024

INTRODUCTION

Although spontaneous intramural small-bowel hematoma due to warfarin therapy has been reported in medical literature, it is still considered a rare complication. People with hemophilia are at a higher risk of experiencing gastrointestinal bleeding than the general population. This type of bleeding accounts for 4% of deaths in hemophilia patients.¹ In addition to common causes of gastrointestinal bleeding, hemophilia patients can also develop intramural bowel hematomas. Nonetheless, excessive usage of warfarin can lead to bleeding manifestations such as hematuria, gastrointestinal bleeding, epistaxis, soft tissue hematoma, and more severe events such as cerebral hemorrhage.² The jejunum is the most commonly affected part of the small intestine, followed by the ileum and duodenum. The symptoms range from mild and vague abdominal pain to intestinal tract obstruction and an acute abdomen. Often, the diagnosis is missed clinically and is established only after abdominal imaging or an exploratory laparotomy.

People with hemophilia are at a higher risk of experiencing gastrointestinal bleeding than the general population. This type of bleeding accounts for 4% of deaths in hemophilia patients. In addition to common causes of gastrointestinal bleeding, hemophilia patients can also develop intramural bowel hematomas, which occur in 4.85% of patients with severe hemophilia. However, most

^{1-3,5}Department of General Surgery, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India

⁴Department of Emergency Medicine, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India

Corresponding Author: Jyoti Bansal, Department of General Surgery, Kasturba Medical College, Manipal, Manipal Academy of Higher Education, Manipal, Karnataka, India, Phone: +91 9027126809, e-mail: J24Bansal@gmail.com

How to cite this article: Bansal J, Kedage V, Shenoy KR, *et al.* Surgeon's Approach to Spontaneous Small Bowel Intramural Hematoma: A Case Series of Three Cases. *J Indian Med Assoc* 2026;124(7):54–58.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from all the patients for publication of the case report details and related images.

cases can be resolved with factor replacement and conservative management.

Elevated levels of prothrombin time (PT) and activated partial thromboplastin time (APTT), as well as prolonged

© The Author(s). 2026 Open Access. This article is distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<https://creativecommons.org/licenses/by-nc/4.0/>). This license permits non-commercial use, distribution, and reproduction in any medium, provided the original author and source are credited, a link to the license is included, and any changes are indicated.

international normalized ratios, are signs that are characteristic of the condition. Early diagnosis is critical to prevent unnecessary bowel damage. However, this condition is not always considered during the initial evaluation of patients presenting with acute abdomen. In this report, we present three cases of spontaneous nontraumatic small bowel hematoma that presented as acute abdomen. Two of the cases were due to this rare, and possibly increasing, complication of warfarin therapy, while the third case was a rare occurrence in patients with severe hemophilia.

CASE DESCRIPTIONS

Case 1

The first case was a 58-year-old male with a history of aortic valve replacement, on warfarin 4 mg twice a day and T clopidogrel 75 mg once a day in the background of underlying hypertension, taking T metoprolol 25 mg OD. He presented with complaints of abdominal pain, constipation and bilious vomiting for 4 days. Interestingly, 10 days back, he had an episode of atrial fibrillation, which settled on amiodarone infusion, following which he was started on 200 mg amiodarone daily. Patient is a smoker since more than 20 years and smoked 5 pack years.

Abdominal pain was initially in the periumbilical region, which became diffuse, associated with complaints of constipation for 3 days, but was passing flatus accompanied by vomiting, which was nonprojectile and was bilious. There were no complaints of loose stools, fever, hematemesis, hematuria or any other bleeding manifestations.

During the examination of the abdomen, there was distension along with tenderness in the lower left quadrant, with rebound tenderness in the same area. An abdominal CT scan was performed (Fig. 1), and the results showed jejunal loops in the left lumbar region, which had a thickened wall (maximum thickness of 1.5 cm) that was edematous and circumferential. There were a few areas showing hypoenhancement of the walls. The scan also revealed moderate hyperdense free fluid in the left lumbar region, which extended into the pelvis. This fluid was likely to be hemoperitoneum. Superior mesenteric artery shows a nonenhancing eccentric soft tissue filling defect, approximately

2 cm distal to its origin, causing around 35–40% luminal stenosis; however, it showed contrast opacification.

But no specific diagnosis was provided by the radiologist in the report. Blood examination revealed: CRP: 80.33 mg/dL with elevated PT: >120 seconds (normal, 9.4–12.5 seconds); and APTT: >120 seconds (normal, 28.6–38.6 seconds) with INR not recordable.

In view of univocal radiological evidence and deranged laboratory parameters, seeing the clinical picture with features of peritonitis, the patient was taken up for emergency laparotomy, but prior to that, his anticoagulation was promptly reversed with 4 FFPs and vitamin K transfusion, following which a repeat coagulation profile was APTT: 61.6 seconds, PT: 30.7 seconds, and INR–2.8.

Intraoperatively, it was noticed that there were 2 liters of blood in the abdominal cavity with small intestine hematomas at three different sites (as shown in Figs 2 and 3). These sites were approximately 15 cm, 40 cm, and 80 cm from the duodenojejunal flexure. After administering 100% oxygen, the segments located at 40 cm and 80 cm regained peristalsis, and pulsation in the mesenteric vessels was observed. However, the segment at 15 cm

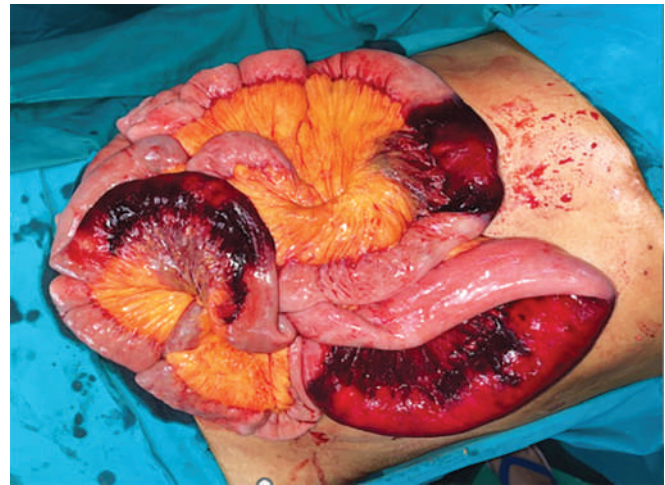


Fig. 2: Intraoperative photograph of the small bowel/jejunum showing hematoma at three sites with mesenteric and small bowel changes

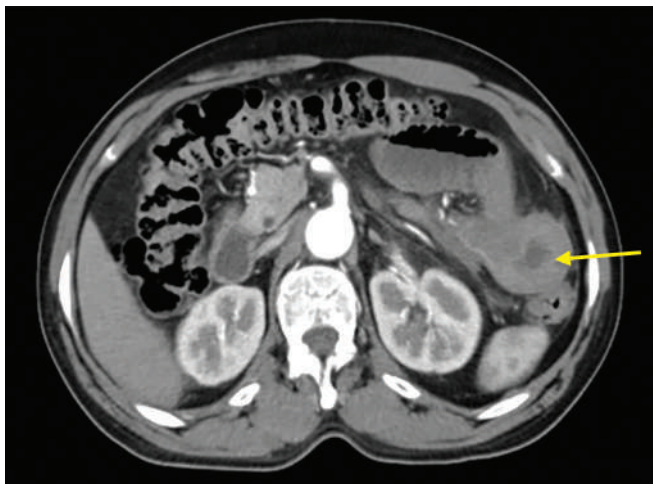


Fig. 1: Jejunal loop in the left lumbar region showing circumferential edematous wall thickening



Fig. 3: Cut section of the bowel loop that did not regain peristalsis or show promising color change after administration of 100% oxygen and warm saline mop resuscitation



Fig. 4: Hyperdense, nonenhancing area measuring $9.9 \times 7.0 \times 7.7$ cm (CC $\times$ TR $\times$ AP) showing wall thickening and intramural hematoma with luminal obstruction

did not regain peristalsis and was therefore resected. A side-to-side hand-sewn anastomosis was performed. The resected part was opened, and an intramural hematoma was observed (as shown in Fig. 2). This part was sent for histopathology, and the results showed focal denudation of intestinal villi overlying the lamina propria, extensive areas of hemorrhage, dense lymphoplasmacytic, hemosiderin-laden macrophages, and congested vessels.

After considering all the scenarios and reports, we came to the conclusion that the patient had a spontaneous small bowel intramural hematoma with transmigration of bacteria from the bowel, causing peritonitis. He had an uneventful postoperative period and was restarted on oral anticoagulation on the 7th postoperative day.

Case 2

A 31-year-old female with a history of rheumatic heart disease and mitral valve replacement in 2018 on warfarin 2 mg OD, presented to the emergency department with complaints of abdominal pain, vomiting, and black tarry stools for 2 days. Pain abdomen was insidious in onset, colicky type, diffusely present over the abdomen. No aggravating or relieving factors.

During the examination, the patient showed diffuse tenderness all over the abdomen, but no rigidity. Per-rectal examination revealed no evidence of bleeding or melena. Blood tests revealed a PT of 94.9, an INR of 10, and an Hb of 7.7 gm/dL. Based on the available information, a CT scan of the abdomen was conducted, which revealed a long segment of homogeneously enhancing circumferential wall thickening, measuring up to 1.1 cm, involving the distal ileal loops and ileocecal junction. There was no luminal narrowing or proximal dilatation, and no evidence of pneumoperitoneum or active arterial contrast extravasation was found (Fig. 4).

After reviewing the patient's medical reports, the team decided to keep the patient on NPO to rest the bowel. We also administered four units of FFP and one unit of PRBC to address elevated PT/INR and low hemoglobin levels. A UGI-scopy was conducted to rule out any causes of GI bleeding, but the results came back normal. Once her abdominal pain subsided, she was started on an oral diet. Anticoagulation was restarted after 4 days.

Case 3

A 31-year-old male with a history of hemophilia A (von Willebrand disease type 3) came to the emergency department with complaints of abdominal pain for the past week. He did not experience vomiting, constipation, or melena. The pain started slowly, was dull and diffuse. During the examination, tenderness was observed mainly around the lower quadrants, with no guarding or rigidity. Lab results showed APTT: 47, PT/INR: 11/1.8. An abdominal CECT scan was performed, which revealed a hyperdense nonenhancing area (hyperdense on plain study) measuring approximately $9.9 \times 7.0 \times 7.7$ cm [craniocaudal $\times$ transverse $\times$ anteroposterior (CC $\times$ TR $\times$ AP)] in the infraumbilical region. The adjacent bowel loops showed mild bowel wall thickening, which was seen abutting this hyperdense area.

Further investigation revealed a factor VIII assay of 3.8% and a von Willebrand factor level of less than 1%. As a result, the patient was treated with a transfusion of 2,500 units of von Willebrand factor and 2,000 units of factor VIII. The patient was put on bowel rest and given intravenous (IV) fluids. Gradually, the patient was able to eat and drink normally. Repeat factor VIII assay showed an improvement of 68% (50–150). The patient made a full recovery and was discharged on the sixth day. The follow-up period was uneventful.

DISCUSSION

In 1904, Sutherland³ documented a nontraumatic intramural hematoma in the small bowel of a child with Henoch–Schönlein purpura, resulting in intussusception. However, the inaugural account of intramural intestinal hematoma dates back to 1838, when McLoughlan reported a postmortem discovery in a man whose cause of death was attributed to “dehydration and bowel obstruction,” linked to a “false aneurysm.” The first radiological depiction emerged more than a century later when Liverud reported a case involving the jejunum.⁴ Spontaneous small bowel hematoma is an infrequent condition, with a higher likelihood of occurrence in the presence of abdominal trauma. According to research conducted in Switzerland, the only available data on the estimated incidence of spontaneous small bowel hematoma related to anticoagulation suggests that it affects 1 in 2,500 anticoagulated patients annually.⁵

Despite its infrequency, the reported cases of spontaneous small bowel hematoma have seen an increase. This can be attributed to advancements in current image-based diagnostic methods and the growing prevalence of patients undergoing anticoagulation therapy. Other recognized causes include hemophilia, von Willebrand disease, idiopathic thrombocytopenic purpura, lymphoproliferative diseases, collagenosis, vasculopathies, and peptic ulcers.

In up to 85% of cases involving spontaneous intramural gastrointestinal tract hematoma due to oral anticoagulation, the small bowel is affected, with the jejunum being the most commonly impacted region. This stands in contrast to post-traumatic findings, where the duodenum is more frequently affected.⁶ According to a study,⁷ when it comes to medicines causing small intestine small bowel hematoma, warfarin was found to be the most commonly associated agent (73.8%). The symptoms can range from mild abdominal pain to severe acute abdominal pain or even intestinal obstruction. Some

patients may also experience gastrointestinal bleeding due to a ruptured hematoma.⁸ In certain cases, there may be indicators of peritoneal irritation that could signal the emergence of more serious issues such as necrosis, perforation, or hemoperitoneum. Typically, the time between the onset of symptoms and seeking medical help can range from 2 to 4 days.

It is important to consider the possibility of an intestinal hematoma as a potential cause of sudden abdominal pain in individuals who have previously undergone warfarin therapy and have a prolonged INR value. The timeframe for the emergence of acute abdominal symptoms following warfarin use can range from 8 days to 132 months.

Intramural hematoma of the gastrointestinal tract is a rare and serious bleeding issue that can occur in individuals with hemophilia. It is important to identify this condition quickly and provide clotting factor concentrates in a timely manner in order to manage the issue effectively and ensure the best possible outcomes for the patient. Most cases can be treated through medical management, including transfusion of factor VIII. In situations where surgery is required, hematoma evacuation is recommended over bypass surgery, unless the individual is experiencing severe intestinal injury or perforation.

In abdominal CT scans, diagnostic results typically show thickening of the small bowel wall without any obstruction in the mesenteric blood vessels. The identifiable features usually include narrowing of the intestinal tract, circumferential thickening of the bowel wall, and obstruction of the lumen. Additionally, around 40% of cases also show the presence of a hematoma, which results in increased density within the intestinal lumen.⁹

If patients experience complications due to warfarin therapy, surgery can be avoided with appropriate intervention by experienced surgeons. Conservative treatment can be effective, but doctors must rule out other complications that may require surgery. Older patients should be warned of the risks of not following their treatment plan. Coagulation parameters should be closely monitored, and targeted PT and APTT values should be within the normal ranges during warfarin therapy. The INR on warfarin therapy should be between 2.0 and 3.5, but may be between 3.0 and 4.5. If the patient shows signs of deterioration, timely surgical intervention with bowel resection must still be considered.

As per the available literature, there have been 33 instances of intramural hematoma in the gastrointestinal tract since 1964 in patients with hemophilia, as reviewed by Katsumi et al.¹⁰ in 2006. The most frequent cause is the rupture of the terminal arteries as they enter the intestinal wall's muscle layer. The bleeding separates the wall between the muscularis mucosae and the muscle layers while keeping the mucosa's viability intact. This collection underlines the possibility of submucosal hematomas occurring in the gastrointestinal tract of hemophiliac patients, with or without prior injury, in addition to common issues such as gastrointestinal bleeding and hemarthrosis. Moreover, they may also experience intracranial hematomas or hematuria.

CONCLUSION

Intramural spontaneous hematoma in the small intestine is commonly caused by oral anticoagulants. Small bowel

intramural hematoma, mimicking ischemic bowel disease, is a rare complication of warfarin therapy, especially in patients with an acute abdomen. It should be considered in hemophilia patients with atypical abdominal pain resembling intestinal obstruction. Close monitoring of coagulation parameters is crucial to prevent such complications. Prolonged INR values in patients with abdominal pain suggest this condition. Surgical exploration is reserved for cases with diagnostic uncertainty or complications such as perforation, hemorrhage, suspected ischemia, or peritonitis. Future studies on anticoagulation therapy are necessary to understand the pathogenesis of warfarin-associated intramural hematoma.

PATIENT CONSENT FOR PUBLICATION

Written informed consent was obtained from all patients for publication of their clinical details and accompanying images. All efforts have been made to protect patient anonymity.

ACKNOWLEDGMENTS

The authors sincerely thank the Department of General Surgery, Kasturba Medical College, Manipal Academy of Higher Education, Manipal, for their support in the management of these patients and preparation of this manuscript.

AUTHOR CONTRIBUTIONS

Jyoti Bansal: Conceptualization, patient management, data collection, literature review, writing – original draft, writing – review & editing.

Vijayendra Kedage: Patient management, supervision, critical review and editing of the manuscript.

Kallya Rajgopal Shenoy: Conceptualization, supervision, manuscript review and editing.

Manasa U: Data collection, literature review, manuscript review and editing.

AI USE DECLARATION

The authors used OpenAI to assist with language editing and grammar improvement. All scientific content, interpretation of clinical data, conclusions, and final manuscript review were performed by the authors, who take full responsibility for the accuracy and integrity of the manuscript.

REFERENCES

1. Mittel R, Spero JA, Lewis JH, et al. Patterns of gastrointestinal hemorrhage in hemophilia. *Gastroenterology* 1985;88:515–522. DOI: 10.1016/0016-5085(85)90515-3
2. Hou SW, Chen CC, Chen KC, et al. Sonographic diagnosis of spontaneous intramural small bowel hematoma in a case of warfarin overdose. *J Clin Ultrasound* 2008;36:374–376. DOI: 10.1002/jcu.20442
3. Sutherland GA. Intussusception and Henoch's purpura. *Br J Dis Child* 1904;1:23–28.
4. Liverud K. Hematoma of the jejunum with subileus. *Arch Radiol* 1948;30:163.
5. Altintoprak F, Dikicier E, Akyüz M, et al. A retrospective review of patients with non-traumatic spontaneous intramural hematoma. *Turk J Gastroenterol* 2013;24:392–399. DOI: 10.4318/tjg.2013.0697
6. Bettler S, Montani S, Bachmann F. Incidence of intramural digestive system hematoma in anticoagulation: epidemiologic study and

- clinical aspects of 59 cases observed in Switzerland (1970–1975). *Schweiz Med Wochenschr* 1983;113:630–636. PMID: 6603015.
7. Abbas MA, Collins JM, Olden KW. Spontaneous intramural small-bowel hematoma: imaging findings and outcome. *AJR Am J Roentgenol* 2002;179(6):1389–1394. DOI: 10.2214/ajr.179.6.1791389
 8. Kang EA, Han SJ, Chun J, et al. Clinical features and outcomes in spontaneous intramural small bowel hematoma: cohort study and literature review. *Intest Res* 2019;17(1):135–143. DOI: 10.5217/ir.2018.00085
 9. Veldt BJ, Haringsma J, Florijn KW, et al. Coumarin-induced intramural hematoma of the duodenum: case report and review of the literature. *Scand J Gastroenterol* 2011;46(3):376–379. DOI: 10.3109/00365521.2010.531484
 10. Katsumi A, Matsushita T, Hirashima K, et al. Recurrent intramural hematoma of the small intestine in a severe hemophilia A patient with a high titer of factor VIII inhibitor: a case report and review of the literature. *Int J Hematol* 2006;84:166–169. DOI: 10.1532/IJH97.06053

Sjögren's Syndrome Unveiled—Hypokalemia and Distal Renal Tubular Acidosis as Diagnostic Precursors: A Case Series

Varun A¹, Pravin Selvam S², Kirubhakaran K³, Ranga Bashyam SR⁴

Received on: 03 March 2024; Accepted on: 30 June 2025; Published on: 10 July 2026

ABSTRACT

Sjögren's syndrome, an autoimmune disorder affecting the exocrine glands, presents usually with sicca syndrome. However, renal involvement is uncommon. Renal involvement in Sjögren's syndrome presents with tubulointerstitial damage, glomerulonephritis, and distal renal tubular acidosis (dRTA). In this case series, we present five cases that presented with varying clinical manifestations but had hypokalemia as a unifying electrolyte abnormality, which, when evaluated further, ended up as distal renal tubular acidosis due to Sjögren's syndrome.

Keywords: Case report, Distal renal tubular acidosis, Hypokalemia, Sjögren's syndrome.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0026

INTRODUCTION

Primary Sjögren's syndrome (pSS) is a chronic autoimmune disease characterized by infiltration of the lacrimal and salivary glands by lymphocytes and plasma cells. While pSS primarily affects exocrine glands, however, Sjögren's syndrome can manifest across multiple organ systems, leading to a diverse array of clinical manifestations, and renal involvement is increasingly recognized. In addition to the classic sicca symptoms, our case series highlights the broad spectrum of clinical presentations associated with SS. These manifestations, ranging from neuromuscular impairment to reproductive dysfunction, illustrate the complexity of SS pathology and the challenges in diagnosis and management.¹

Renal dysfunction in pSS often manifests as tubulointerstitial nephritis, characterized by lymphocytic infiltration of renal tubules and interstitium. One of the prominent renal manifestations in pSS is renal tubular acidosis (RTA), primarily distal RTA (dRTA). dRTA in pSS is clinically significant as it can lead to electrolyte imbalances, particularly hypokalemia, due to impaired acid-base regulation. The underlying pathophysiology linking dRTA and pSS is believed to be renal tubular dysfunction secondary to interstitial nephritis; however, the exact mechanism remains incompletely understood. Previous studies have highlighted the significance of renal dysfunction in primary Sjögren's syndrome. In this context, exploring varying clinical presentations and outcomes in our case series may provide valuable insights into the relationship between dRTA and pSS, contributing to a deeper understanding of their interconnected pathophysiology. Understanding the diverse clinical manifestations of Sjögren's syndrome is essential for prompt recognition and comprehensive management. By elucidating these manifestations within the context of our case series, we aim to contribute to the existing body of knowledge surrounding Sjögren's syndrome, ultimately facilitating improved patient care and outcomes.²⁻⁵

¹⁻⁴Department of General Medicine, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka Missions Research Foundation (DU), Salem, Tamil Nadu, India

Corresponding Author: Varun A, Department of General Medicine, Vinayaka Mission's Kirupananda Variyar Medical College and Hospitals, Vinayaka Missions Research Foundation (DU), Salem, Tamil Nadu, India, Phone: +91 83444 40701, e-mail: varunarumugham@yahoo.com

How to cite this article: Varun A, Pravin SS, Kirubhakaran K, et al. Sjögren's Syndrome Unveiled—Hypokalemia and Distal Renal Tubular Acidosis as Diagnostic Precursors: A Case Series. *J Indian Med Assoc* 2026;124(7):59–62.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patients for publication of the case report details and related images.

CASE DESCRIPTIONS

Case 1

A 21-year-old previously healthy female arrived at the casualty department reporting weakness of all four limbs and difficulty in breathing, which had developed over the past two days. The weakness initially affected her lower limbs before progressing upwards, accompanied by increasing respiratory distress. Notably, there was no history of preceding fever, bladder or bowel disturbances, or any recent medication intake. Upon examination, the patient appeared alert and cooperative, with normal vitals. However, she exhibited profound weakness in all extremities, with power of 0/5 in lower limbs and 1/5 in upper limbs, with a single breath count of <6. An electrocardiogram (ECG) conducted at the bedside revealed QTc prolongation,

prompting further investigation. Laboratory analysis revealed a critically low serum potassium level of 1.7 mEq/L, consistent with hypokalemia. An initial diagnosis of hypokalemic paralysis was established, and the patient promptly received intravenous potassium replacement therapy, resulting in profound improvement in her clinical status. Subsequent investigations aimed at elucidating the underlying cause of hypokalemia unveiled findings suggestive of renal potassium loss, indicative of distal renal tubular acidosis (dRTA). Further antibody testing supported the diagnosis of Sjögren's syndrome. To address the acid-base imbalance associated with dRTA, the patient was initiated on oral sodium bicarbonate and potassium chloride supplementation. With this tailored therapeutic approach, the patient demonstrated marked clinical improvement and was subsequently placed on regular follow-up to monitor her response to treatment and disease progression.^{6,7}

Case 2

A 36-year-old female presented with a two-day history of severe abdominal pain predominantly over the loins, which she had experienced on multiple occasions in the past. Imaging studies revealed bilateral nephrocalcinosis, prompting further evaluation. Laboratory investigation revealed hypokalemia, and subsequent urine analysis indicated renal potassium loss, consistent with a diagnosis of distal renal tubular acidosis (dRTA). Concurrently, antibody testing revealed positive results for Sjögren's syndrome, implicating an autoimmune etiology underlying the renal abnormalities. She was treated with oral citrate; potassium chloride and sodium bicarbonate replacement therapy were initiated. The patient was scheduled for regular follow-up appointments to monitor her renal function and response to therapy.⁸

Case 3

During a routine health check-up, a 36-year-old female was incidentally found to have hypokalemia. Further evaluation for the cause of hypokalemia revealed renal potassium loss, indicative of distal renal tubular acidosis (dRTA). Interestingly, upon detailed clinical history-taking, the patient reported symptoms of dyspareunia frequently, prompting consideration of sicca symptoms. Subsequent antibody testing confirmed the presence of Sjögren's syndrome, underscoring the association between autoimmune disorders and renal manifestations. Symptomatic management with lubricants was advised to address the dyspareunia, while ongoing monitoring was planned to assess the response to treatment and disease progression.

Case 4

A 29-year-old obese female presented for the evaluation of primary infertility. Thyroid function tests revealed subclinical hypothyroidism, which was consistent with the findings of Hashimoto's thyroiditis as evidenced by the elevated levels of thyroid-stimulating hormone (TSH) and antithyroid peroxidase (anti-TPO) antibodies. Subsequently, laboratory investigations unveiled hypokalemia, prompting further evaluation for any underlying renal abnormalities. Urine analysis revealed renal potassium loss, suggestive of distal renal tubular acidosis (dRTA),

and antibody testing confirmed the presence of Sjögren's syndrome, highlighting the association between autoimmune thyroid disorders and systemic autoimmune diseases. Given the interplay between autoimmune conditions, a multidisciplinary approach was adopted for comprehensive management.⁷

Case 5

A 45-year-old female presented with a 1-year history of progressive joint pain involving multiple joints. Despite the absence of findings indicating rheumatoid arthritis, the persistence and progression of arthralgia prompted further investigation. Laboratory analysis revealed low potassium levels, indicating distal renal tubular acidosis (dRTA) caused by renal potassium loss. Moreover, subsequent antibody testing confirmed the diagnosis of Sjögren's syndrome, indicating an underlying autoimmune etiology. Thus, the discovery of Sjögren's syndrome alongside dRTA highlights how autoimmune diseases can affect various parts of the body. This shows why it is crucial to take a thorough approach when diagnosing and treating them. Regular follow-up appointments were scheduled to monitor treatment response and disease progression, ensuring comprehensive care for the patient's condition.⁶

DISCUSSION

This case series provides valuable insights into the close relationship between renal tubular dysfunction and Sjögren's syndrome. Distal RTA emerges as a significant feature among patients with Sjögren's syndrome, affecting a significant percentage of individuals within this population. From an epidemiological standpoint, Sjögren's syndrome demonstrates a high incidence, with a remarkable 9:1 female-to-male ratio. This autoimmune condition affects around 30–40% of patients systemically, presenting a diagnostic challenge due to its diverse clinical manifestations. While sicca symptoms, including dry eyes and dry mouth, are typical features, the presence of renal tubular dysfunction, as seen in this case series, further complicates the clinical presentation.⁴

In the presented cases, hypokalemia, a common consequence of distal RTA, prompted thorough evaluation and management. Case 1 depicts a young female presenting with hypokalemic quadriparesis, highlighting the association between distal RTA and Sjögren's syndrome. Similarly, case 2 illustrates the co-occurrence of nephrocalcinosis and distal RTA in a patient with Sjögren's syndrome, emphasizing the need for meticulous assessment in cases of renal involvement. Furthermore, case 3 highlights the significance of considering Sjögren's syndrome in patients with unexplained hypokalemia and dyspareunia, demonstrating the varied clinical presentations of this autoimmune condition. Cases 4 and 5 further elucidate the diverse manifestations linked to Sjögren's syndrome. Case 4 demonstrates the association between Hashimoto's thyroiditis and distal RTA, while Case 5 showcases Sjögren's syndrome presenting as nonerosive arthritis. These findings emphasize the importance of a comprehensive diagnostic approach, encompassing rheumatological, nephrological, and neurological evaluations, to ensure timely recognition and management of the systemic complications (Table 1).^{7,9,10}

Table 1: Case series overview

Case	Age (years)	Chief complaints and preliminary diagnosis	Vitals (HR, BP, RR, SpO ₂)	ECG	Serum potassium (mEq/L)	Serum magnesium (mg/dL)	Urine potassium (mEq)	Urine K/Cr ratio	ABG pH	Anion gap	Urine pH	Antibody testing	Schirmer's test	Lip biopsy	Other investigations	Treatment	Outcome
1	21	Weakness, dyspnea (hypokalemic paralysis)	PR: 96/min, BP: 110/70 mm Hg, RR: 22/min, SpO ₂ : 98% on room air	QTc prolongation	1.7	2.1	40	17.3	7.21	Positive	Alkaline	ANA: positive, anti-SS-A/Ro: positive, anti-SS-B/La: positive	RE: 2 mm in 5 minutes, LE: 3 mm in 5 minutes (positive)	Lymphocytic infiltration in minor salivary glands	Nerve conduction study was positive, anti-Smith and anti-dsDNA were negative	Oral sodium bicarbonate, syrup potassium chloride	Marked improvement, regular follow-up
2	36	Severe abdominal pain (nephrocalcinosis)	PR: 80/min, BP: 130/80 mm Hg, RR: 18/min, SpO ₂ : 96% on room air	QTc prolongation	2.8	1.9	28	16.1	7.33	Positive	Alkaline	ANA: negative, anti-SS-A/Ro: positive, anti-SS-B/La: positive	RE: 4 mm in 5 minutes, LE: 3 mm in 5 minutes (positive)	Negative	CT abdomen showed nephrocalcinosis	Oral citrate, potassium and sodium bicarbonate replacement and on regular follow-up	No further episodes and on regular follow-up
3	36	Routine health check-up (retrospectively dyspnea)	PR: 72/min, BP: 120/70 mm Hg, RR: 16/min, SpO ₂ : 97% on room air	QTc prolongation	3.2	2.3	32	15.4	7.31	Positive	Alkaline	ANA: negative, anti-SS-A/Ro: positive, anti-SS-B/La: positive	RE: 3 mm in 5 minutes, LE: 5 mm in 5 minutes (positive)	Negative	Nil	Symptomatic management with lubricants	Advised regular follow-up
4	29	Infertility (Hashimoto's thyroiditis)	PR: 88/min, BP: 118/78 mm Hg, RR: 20/min, SpO ₂ : 95% on room air	No QTc prolongation	3.0	2.2	26	29.6	7.27	Positive	Alkaline	ANA: positive, anti-SS-A/Ro: positive, anti-SS-B/La: positive	Negative	Negative	Elevated levels of TSH and anti-TPO antibodies	Oral potassium supplements	Patient on follow-up with endocrinologist
5	45	Arthralgia (seronegative arthritis)	PR: 70/min, BP: 125/75 mm Hg, RR: 15/min, SpO ₂ : 98% on room air	QTc prolongation	2.9	1.8	32	19.6	7.21	Positive	Alkaline	ANA: positive, anti-SS-A/Ro: positive, anti-SS-B/La: positive	RE: 4 mm in 5 minutes, LE: 4 mm in 5 minutes (positive)	Negative	RA factor and anti-CCP were negative, joint X-ray: non-erosive arthritis	Analgesics	Advised regular follow-up

ABG, arterial blood gas; ANA, antinuclear antibody; BP, blood pressure; CCP, cyclic citrullinated peptide; CT, computed tomography; dsDNA, double-stranded DNA; ECG, electrocardiogram; HR, heart rate; LE, left eye; PR, pulse rate; QTc, corrected QT interval; RA, rheumatoid arthritis; RE, right eye; RR, respiratory rate; SpO₂, oxygen saturation; SS-A/Ro, Sjögren's syndrome A antigen/Ro; SS-B/La, Sjögren's syndrome B antigen/La; TPO, thyroperoxidase; TSH, thyroid-stimulating hormone.

CONCLUSION

In summary, these cases provide valuable insights into the complex interplay between renal tubular dysfunction and autoimmune diseases, particularly Sjögren's syndrome. They underscore the necessity of a collaborative approach among different medical specialties to deliver comprehensive patient care. Moving forward, continued research is essential to further elucidate the underlying mechanisms and refine treatment strategies. By enhancing our understanding of these conditions, we can improve diagnostic accuracy and develop more effective interventions tailored to individual patient needs. Ultimately, this case series underscores our commitment to improving patient outcomes and quality of life through a multidisciplinary approach and ongoing scientific exploration. Sjögren's Syndrome with Hypokalemia and Distal Renal Tubular Acidosis

PATIENT CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient for the publication of their clinical details.

ACKNOWLEDGMENT

Nil.

AUTHOR CONTRIBUTIONS

Patient management: VA, PSS; Data collection: VA, PSS; Writing – original draft: VA; Writing – review & editing: KK, RBSR; Supervision: RBSR. All authors have read and agreed to the published version of the manuscript.

REFERENCES

1. Gerster JC, Tami G, Guillemin L, et al. Renal involvement in primary Sjögren's syndrome. Apropos of 3 cases with membranoproliferative glomerulonephritis and review of the literature. *Rev Rhum Mal Osteoartic* 1992;59(10):645–651. PMID: 1294907.
2. Ioannidis JP, Vassiliou VA, Moutsopoulos HM. Long-term risk of mortality and lymphoproliferative disease and predictive classification of primary Sjögren's syndrome. *Arthritis Rheum* 2002;46(3):741–747. DOI: 10.1002/art.10221
3. Ramos-Casals M, Solans R, Rosas J, et al. Primary Sjögren's syndrome in Spain: clinical and immunologic expression in 1010 patients. *Medicine (Baltimore)* 2008;87(4):210–219. DOI: 10.1097/MD.0b013e318181e979
4. Patel R, Shahane A. The epidemiology of Sjögren's syndrome. *Clin Epidemiol* 2014;6:247–255. DOI: 10.2147/CLEP.S47399
5. Voulgarelis M, Tzioufas AG. Pathogenetic mechanisms in the initiation and perpetuation of Sjögren's syndrome. *Nat Rev Rheumatol* 2010;6(9):529–537. DOI: 10.1038/nrrheum.2010.106
6. Tseng MH, Chen YC, Ho YP, et al. Primary Sjögren's syndrome is associated with renal tubular acidosis and hypokalemia. *J Clin Med* 2018;7(10):321. DOI: 10.3390/jcm7100321
7. Shah S, Zand L. Autoimmune thyroiditis in a patient with Sjögren's syndrome and hypokalemic paralysis. *Case Rep Med* 2018;2018:5795414. DOI: 10.1155/2018/5795414.
8. Koo SK, Kim YG, Lee CK, et al. Risk factors of renal tubular dysfunction in patients with primary Sjögren's syndrome. *Int J Rheum Dis* 2016;19(12):1322–1329. DOI: 10.1111/1756-185X.12844
9. Hansen A, Lipsky PE, Dörner T. Immunopathogenesis of primary Sjögren's syndrome: implications for disease management and therapy. *Curr Opin Rheumatol* 2005;17(5):558–565. DOI: 10.1097/01.bor.0000172801.56744.c3
10. Mariette X, Criswell LA. Primary Sjögren's syndrome. *N Engl J Med* 2018;378(10):931–939. DOI: 10.1056/NEJMc1702514

From Puncture to Pathology—Chronic Hand Swelling Unmasked as Atypical Mycobacterial Tenosynovitis: A Case Report

Gaurab Ranjan Chaudhuri¹, Akhilesh Humnekar², Rudrakshi Mahaldar³, Sourabh Shankar Chakraborty⁴, Saurabh Raj⁵, Shrimoyee Roy⁶, Mainak Mallik⁷

Received on: 13 June 2025; Accepted on: 14 October 2025; Published on: 10 July 2026

ABSTRACT

Granulomatous inflammation of the musculoskeletal system caused by nontuberculous mycobacteria (NTM) is a rare clinical entity that often poses a diagnostic challenge due to its insidious onset and nonspecific symptoms. We present the case of a 48-year-old immunocompetent woman who developed a chronic, progressively enlarging swelling over the palmar aspect of her right hand, extending into the third digit. The symptoms began following the unsterile puncture of a painless vesicle on the dorsum of her right middle finger. The patient subsequently received multiple local corticosteroid injections from an unqualified practitioner, which provided only temporary relief. She later underwent two incision and drainage procedures at a peripheral center for a suspected abscess; however, both revealed minimal purulent material and no definitive diagnosis. On clinical examination, the swelling was firm, nontender, and associated with a flexion deformity of the middle finger. Imaging and fine-needle aspiration cytology (FNAC) suggested a tenosynovial giant cell tumor (TSGCT). Surgical exploration revealed a lesion arising from the flexor tendon sheath. Complete excision of the mass was performed, and histopathological examination confirmed necrotizing granulomatous inflammation with the presence of acid-fast bacilli (AFB), consistent with NTM infection. Tendon reconstruction using a palmaris longus graft was successfully carried out, leading to satisfactory functional recovery. This case underscores the importance of considering atypical mycobacterial infections in chronic hand swellings, especially in the absence of systemic features and highlights the significance of timely biopsy and functional reconstruction.

Keywords: Case report, Granulomatous inflammation, Hand infection, Mycobacterial tenosynovitis, Tendon reconstruction, Tenosynovial giant cell tumor.

Journal of the Indian Medical Association (2026): 10.5005/jima-11070-0028

INTRODUCTION

Granulomatous inflammation is a distinct histopathological response, typically arising from chronic infections or foreign bodies.¹ While this type of inflammation is well-recognized in pulmonary and lymphatic systems, its presence in musculoskeletal structures is relatively uncommon.² Among various causes, mycobacterial infections—both tuberculous and nontuberculous—are prominent contributors, though often underdiagnosed due to nonspecific clinical features and a chronic course.³

Nontuberculous mycobacteria (NTM), such as *Mycobacterium marinum*, *M. kansasii*, and *M. haemophilum*, are known to cause soft tissue infections through direct inoculation, especially in individuals with frequent exposure to aquatic environments or repeated local trauma.^{3,4}

The “fish-tank granuloma” condition represents a well-described manifestation of *M. marinum* infections. These pathogens commonly affect the hand and wrist and typically present as tenosynovitis. However, due to their chronic and indolent progression, they are frequently mistaken for benign tumors, such as giant cell tumors of the tendon sheath (GCTTS).⁴

The diagnosis is often challenging and delayed. A high index of suspicion is required, especially in treatment-resistant or atypical chronic hand swellings. MRI provides detailed insights into soft tissue structures and the extent of involvement, while histopathological and microbiological evaluations are definitive.⁵

^{1,2,4,6,7}Department of Burns and Plastic Surgery, All India Institute of Medical Sciences, Kalyani, West Bengal, India

^{3,5}Department of General Surgery, All India Institute of Medical Sciences, Kalyani, West Bengal, India

Corresponding Author: Rudrakshi Mahaldar, Department of General Surgery, All India Institute of Medical Sciences, Kalyani, West Bengal, India, Phone: +91 91499 50438, e-mail: rudrakshimahaldar@gmail.com

How to cite this article: Chaudhuri GR, Humnekar A, Mahaldar R, *et al.* From Puncture to Pathology—Chronic Hand Swelling Unmasked as Atypical Mycobacterial Tenosynovitis: A Case Report. *J Indian Med Assoc* 2026;124(7):63–67.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

To date, fewer than 100 cases of NTM tenosynovitis involving the hand have been documented globally, with very few mimicking tenosynovial giant cell tumors (TSGCTs). This case adds to the limited pool of literature and emphasizes the diagnostic confusion it may cause in clinical practice. We present a rare granulomatous tenosynovitis masquerading as a TSGCT, highlighting diagnostic challenges and functional surgical management.

CASE DESCRIPTION

A 48-year-old right-handed woman presented with a gradually progressive, mildly painful (visual analog scale of 3/10) swelling over the palmar aspect of her right hand, extending into the middle finger. 6 years prior, she had noticed the sudden appearance of a painless vesicle on the dorsum of the same finger. She punctured the lesion at home using an unsterile needle, following which she developed localized pain, swelling, and restricted mobility of the affected finger. She subsequently consulted a local unlicensed practitioner who administered multiple local corticosteroid injections, resulting in temporary symptomatic relief. However, she was lost to follow-up during the COVID-19 pandemic. Over time, the symptoms recurred, and she presented to a local hospital on two occasions, where incision and drainage were performed for a presumed abscess. Only minimal seropurulent material was obtained during each intervention.

Despite these procedures, the patient developed a progressively enlarging, firm, nontender, noncompressible swelling of the middle finger, accompanied by a dull, aching pain. Over the ensuing months, she developed a flexion contracture involving both the proximal and distal

interphalangeal joints of the finger. She denied any systemic symptoms such as fever, weight loss, or lymphadenopathy. The patient was immunocompetent, with no history of tuberculosis exposure, immunosuppressive medication use, or known immunodeficiency. Routine laboratory investigations, including hematological and biochemical profiles, were within normal limits.

Magnetic resonance imaging (MRI) of the right hand revealed a well-defined soft tissue mass arising from the flexor tendon sheath of the third digit, with intermediate signal intensity on T1-weighted images and heterogeneous hyperintensity on T2-weighted images. The lesion showed moderate contrast enhancement, suggesting a diagnosis of a TSGCT (Fig. 1).

Fine-needle aspiration cytology (FNAC) from the lesion yielded spindle-shaped mononuclear cells with moderate cytoplasm and occasional multinucleated giant cells. No features of malignancy or atypia were seen. A provisional diagnosis of TSGT was made, and surgical excision was planned.

Surgical Management

Under regional anesthesia and tourniquet control, a volar Brunner's incision was made over the palm and extended to the third digit. Careful dissection preserving the closely related neurovascular bundle revealed a well-encapsulated mass arising from the tendon sheath of the flexor digitorum profundus (FDP) of the third digit (Fig. 2). The mass extended distally and was densely adherent to the surrounding pulleys and tendon tissue. The involved portion of the tendon, along with the A1 and A2 pulleys, was excised due to dense adhesion and chronic inflammatory involvement.

An 8 cm tendon defect was created postexcision. To bridge the defect, a tendon graft was harvested from the ipsilateral palmaris longus tendon (Fig. 3). The graft was used to reconstruct the FDP tendon, and pulley reconstruction was carried out using the grafted tendon and local fascial slings (Fig. 4). Meticulous hemostasis was achieved, and the wound was closed in layers.

Postoperative Course

The postoperative period was uneventful. Wound healing was satisfactory, with good granulation and no signs of infection



Fig. 1: Coronal T1-weighted magnetic resonance image of the right hand showing the suspected mass lesion

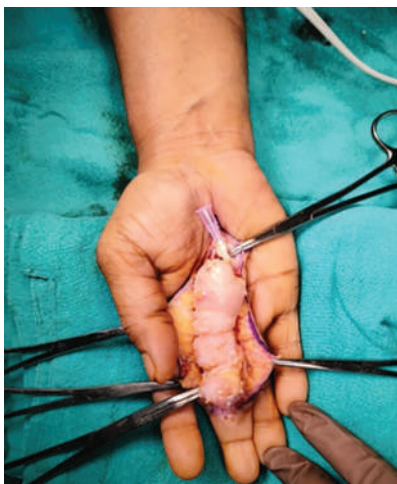


Fig. 2: Mass arising from the tendon sheath of the flexor tendons after careful dissection and preservation of the neurovascular bundles



Fig. 3: Right palmaris longus tendon graft harvested for an 8 cm postexcisional tendon defect

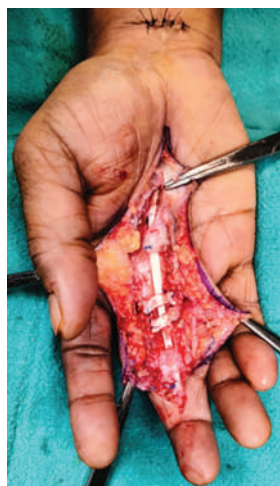


Fig. 4: Reconstruction of the A1 and A2 pulleys with the harvested palmaris longus graft



Fig. 6: Postoperative wound healed well on postoperative day 45



Fig. 5: Postoperative wound healing well on postoperative day 4

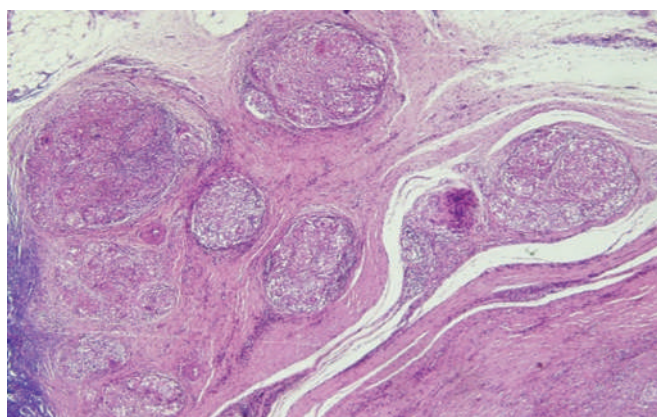


Fig. 7: Histopathological findings showing large areas of necrosis with Langhans-type multinucleated giant cells using hematoxylin and eosin stain under 40× magnification

or dehiscence at postoperative days 4 and 45 (Figs 5 and 6). Histopathological examination of the excised mass revealed extensive areas of caseating necrosis surrounded by epithelioid cells, Langhans-type giant cells, and lymphoplasmacytic infiltration (Figs 7 and 8). Although the cartridge-based

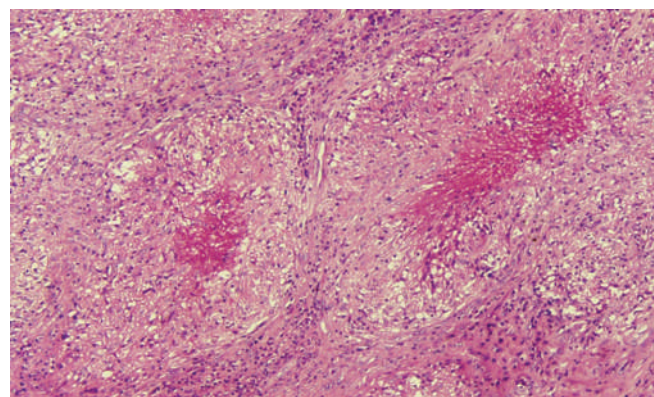


Fig. 8: Histopathological findings showing large areas of necrosis with Langhans-type multinucleated giant cells using hematoxylin and eosin stain under 100× magnification

nucleic acid amplification test (CBNAAT) could not detect any mycobacterial tuberculous bacilli, Ziehl–Neelsen staining demonstrated the presence of acid-fast bacilli (AFB).

A diagnosis of nontubercular mycobacterial necrotizing granulomatous tenosynovitis was made. Though culture was unavailable, the findings strongly suggest a mycobacterial infection. An infectious disease specialist was consulted, and the patient was initiated on multidrug antimycobacterial therapy, including rifampicin, ethambutol, and clarithromycin, pending culture sensitivity.

The patient underwent a structured physiotherapy and rehabilitation program starting from the second postoperative week. Active and passive range-of-motion exercises were gradually introduced under the supervision of the Department of Physical Medicine and Rehabilitation.

By the end of 6 weeks, the patient had regained near-complete flexion of all digits and could perform functional hand grips. Although formal grip strength measurement was not conducted, functional recovery was assessed clinically through finger flexion-extension range, ability to make a complete fist, and opposition to the thumb. The patient could carry out daily activities such as buttoning clothes and holding utensils, indicating satisfactory functional use. Overall, the patient achieved an estimated 90–95% improvement in hand function compared to preoperative status. Although formal grip strength testing was not performed,

Table 1: Clinical timeline of the case

Time point	Clinical event/intervention
~6 years before presentation	Acute onset, painless vesicle on the dorsum of the middle finger of the right hand, punctured by the patient and treated with local steroids
~5 years before presentation	Underwent the first incision and drainage
~4.5 years before presentation	Underwent a second incision and drainage
Over the next 3 years	Progressive, mildly painful swelling over the palm and third digit; developed flexion deformity and restricted extension
At presentation (48-year-old F)	Firm, nontender, 7 × 2 cm swelling; no systemic symptoms; MRI suggested TSGCT
Preoperative evaluation	FNAC showed spindle cells and occasional giant cells without atypia; provisional diagnosis: TSGCT
Day of surgery	Surgical excision via volar Brunner's incision; excised mass and affected pulleys; 8 cm tendon defect bridged with palmaris longus graft and fascial slings
Postoperative day 4	Satisfactory wound healing with no infection
Postoperative day 45	Continued good healing; no dehiscence or complications
Week 2 postoperatively	Initiation of structured physiotherapy and hand rehabilitation.
Week 6 postoperatively	Near-complete flexion restored; functional grip and activities of daily living possible (e.g., holding utensils, buttoning).
Posthistopathology (after surgery)	Histopathology: Necrotizing granulomatous inflammation with Langhans-type giant cells; Ziehl–Neelsen stain positive for AFB.
Postdiagnosis	Started on antimycobacterial therapy (rifampicin, ethambutol, clarithromycin) under infectious disease consultation; diagnosis: necrotizing granulomatous tenosynovitis (likely NTM).
Ongoing	Continues on follow-up with compliance to medication and physiotherapy; functional recovery maintained.

functional recovery was supported by a Disabilities of the Arm, Shoulder, and Hand (DASH) score of 10, indicating minimal residual disability.

The patient continues to be on follow-up and is compliant with both medications and physiotherapy (Table 1).

DISCUSSION

Granulomatous tenosynovitis is an uncommon chronic inflammatory condition affecting tendon sheaths, typically caused by *Mycobacterium tuberculosis* or nontuberculous mycobacteria (NTM) such as *M. marinum*, *M. kansasii*, and *M. intracellulare*.^{1–3} These organisms are usually introduced through minor trauma, invasive procedures, or corticosteroid injections, especially in individuals with environmental exposures or compromised local immunity. In our patient, prior paronychia and local steroid use likely facilitated the entry of atypical mycobacteria by disrupting local immune barriers.

Clinically, the disease follows a slow, progressive course that can delay diagnosis. Patients often present with painless swelling, reduced range of motion, or stiffness. Due to its indolent nature, granulomatous tenosynovitis can mimic neoplastic conditions such as TSGCT, which may appear similar on imaging and fine-needle aspiration cytology (FNAC).^{4–6} Other important differentials include sarcoid tenosynovitis and fungal infections. A high index of suspicion is thus necessary in persistent or treatment-refractory swellings.

Magnetic resonance imaging (MRI) helps delineate the extent of the lesion and tendon sheath involvement,⁵ though it lacks specificity. Histopathological examination remains the diagnostic gold standard, typically revealing necrotizing granulomas with Langhans-type giant cells and caseation. Microbiological confirmation using Ziehl–Neelsen staining to detect AFB is essential.⁷ In our case, although Ziehl–Neelsen staining was positive, polymerase chain reaction (PCR) or culture-based methods were not performed due to limited diagnostic resources. This prevented

definitive species identification, which could have optimized antimicrobial therapy duration and drug selection. Molecular diagnostics, if available, would enable targeted treatment, especially distinguishing between TB and specific NTM infections.

NTM infections involving the hand are rare but increasingly reported. *M. intracellulare*, for instance, has been associated with the presence of “rice bodies”—fibrinous aggregates within the tendon sheath—characteristic of chronic inflammation.^{8,9} Unfortunately, in many low-resource settings, routine tissue culture and PCR-based assays are unavailable, contributing to underdiagnosis or misdiagnosis.³

Surgical excision remains the cornerstone of treatment, particularly when vital structures such as tendons and pulleys are affected. In our patient, extensive excision of the flexor tendon was required due to necrosis and adhesions. A palmaris longus autograft was used to bridge the defect—an effective and well-established reconstructive option in hand surgery.^{10,11} Pulley reconstruction using fascial slings and a structured rehabilitation protocol contributed to the favorable functional recovery.

Antimycobacterial therapy must be guided by the suspected pathogen. Our patient received empirical therapy with rifampicin, ethambutol, and clarithromycin—covering both tubercular and NTM organisms. Collaboration with infectious disease specialists is essential, as treatment typically lasts 6–12 months, depending on clinical response.

This case highlights the diagnostic challenges and therapeutic nuances of mycobacterial tenosynovitis, emphasizing the role of multidisciplinary care, early tissue diagnosis, and resource-aware management strategies in optimizing outcomes.

CONCLUSION

This case emphasizes the importance of public awareness regarding sterile techniques, even for minor skin injuries, and highlights the clinician's responsibility to consider infectious etiologies when

evaluating chronic hand swellings. Such infections often present with nonspecific symptoms and may mimic benign soft tissue tumors, leading to misdiagnosis, delayed treatment, and potentially avoidable complications, including unnecessary amputation. Early tissue biopsy, supported by histopathological and microbiological evaluation, is essential for identifying atypical infections. Timely involvement of infectious disease specialists aids in guiding appropriate antimicrobial therapy. In cases with structural involvement, surgical excision and tendon reconstruction can result in good functional recovery. Quantifying postoperative outcomes adds further value to such reports. This case reinforces the need for multidisciplinary collaboration and heightened clinical suspicion in managing rare infectious mimickers of musculoskeletal tumors.

PATIENT CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient for publication of the clinical details and images.

ACKNOWLEDGMENTS

The authors duly acknowledge AIIMS Kalyani for providing all in-house facilities for patient management.

AUTHOR CONTRIBUTIONS

Patient management: GR, AH, RM, SSC; Data collection: RM, SAR, SHR; Writing – original draft: RM, SAR, MM; Writing – review & editing: GR, AH.

AI Use DECLARATION

No artificial intelligence (AI) tools, except Grammarly for grammatical error correction, were used in the preparation of this manuscript.

REFERENCES

1. Malisetan T, Harmon SR, Reyes M, et al. Nontuberculous mycobacterial flexor tenosynovitis of the wrist and hand. *Cureus* 2024;16(4):e58716. DOI: 10.7759/cureus.58716
2. Bhandari N, Perdomo W, Rudinskaya A, et al. Nontuberculous mycobacterial infection mimicking inflammatory tenosynovitis: a real head scratcher. *Cureus* 2021;13(12):e20845. DOI: 10.7759/cureus.20845
3. Moestrup PG, Stilling M, Wejse CM, et al. *Mycobacterium marinum*: a challenging cause of protracted tenosynovitis. *Antibiotics (Basel)* 2022;12(3):629. DOI: 10.3390/antibiotics12030629
4. Kwan M, Tupler R. Recurrent nontuberculous mycobacterial tenosynovitis. *Ochsner J* 2021;21(1):86–89. DOI: 10.31486/toj.19.0010
5. Hodgson RJ, O'Connor PJ, Grainger AJ. Tendon and ligament imaging. *Br J Radiol* 2012;85(1016):1157–1172. DOI: 10.1259/bjr/34786470
6. Lee YH, Kim DH, Park JK, et al. Granulomatous tenosynovitis mimicking giant cell tumour: a diagnostic challenge. *Arch Plast Surg* 2020;47(2):175–178. DOI: 10.5999/aps.2019.00568
7. Chang CY, Abzug JM. Nontuberculous mycobacterial infections of the hand. *J Hand Surg Am* 2017;42(4):294–301. DOI: 10.1016/j.jhsa.2016.11.025
8. Tian Y, Zhou HB, Yi K, et al. Idiopathic tenosynovitis with multiple rice bodies: review emphasizing mycobacterial and tuberculous causes. *World J Clin Cases* 2022;10(32):11908–11920. DOI: 10.12998/wjcc.v10.i32.11908
9. Samba KN, Leopold KG, Mensah KS. Tenosynovitis with rice bodies from atypical mycobacterial infection: a diagnostic pitfall. *Open J Rheumatol Autoimmune Dis* 2016;6(2):45–50. DOI: 10.4236/ojra.2016.62007
10. Saeed A, Narayan N, Karmiris N, et al. *Mycobacterium szulgai* Infection after Carpal Tunnel Release Requiring Extensive Debridement and ALT Flap Reconstruction. *J Hand Microsurg* 2020;13(4):252–254. DOI: 10.1055/s-0040-1709215
11. Teoh LC, Lee KC. Reconstruction of flexor tendon defects using palmaris longus tendon grafts: a clinical review. *J Hand Surg Asian Pac Vol* 2018;23(3):371–376. DOI: 10.1142/S2424835518500448

LipStaT: A Smile-transformational Surgery

Aditi Chaturvedi¹, Amit Bhardwaj²

Received on: 03 October 2024; Accepted on: 17 November 2024; Published on: 10 July 2026

ABSTRACT

Gummy smiles (GSs), which are defined as excessive gum showing when smiling, can cause people's emotional and visual discomfort. GS surgery, a cosmetic operation intended to alleviate this problem, has become noticeably more popular recently. Lip repositioning is a technique that has become popular recently, either by itself or in combination with other strategies. In certain cases, it provides a less complex and more straightforward option to more involved surgical procedures, with a satisfactory and visually pleasing camouflage effect and a lower risk of complications following surgery. This case study demonstrates how a lip repositioning treatment can effectively cure a patient who has excessive gum exposure.

The lip lining was anchored to the gum line immediately following a partial-thickness strip of the mucosa lining in the maxillary buccal vestibule—while conserving the labial frenulum—that was cut. We intended to show lip repositioning as a profitable, less invasive procedure for resolving any unevenness and curbing excessive gum exposure. With a 12-month follow-up, we looked for a solution that would minimize the likelihood of the problem recurring while providing long-lasting results over time.

Keywords: Case report, Excessive gingival display, Gummy smiles, Lip-repositioning technique, Orthognathic surgery.

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0041

INTRODUCTION

Excessive gingival display (EGD), also referred to as “gummy smile (GS),” is an aberration that stems due to the maxillary gingiva being exposed excessively when smiling.¹ Greater gingiva than 1.5–2 mm² is indicative of it. Although the amount of variation that is considered unfavorable varies among populations, an excess of more than 3 mm is typically allowed worldwide.^{1–3} While a single disparity may be the cause of EGD, numerous variables generally work in concert to produce the condition. A precise identification of the etiological variables is required in order to determine the optimal course of treatment. Gingival enlargement, excessive lip mobility, insufficient maxillary lip length, and bony maxillary excess represent a few of the characteristics that might induce EGD.⁴

To alleviate a GS, a number of techniques have been used to restore the dentogingival connection. These include nonsurgical procedures such as botulinum toxin treatment, maxillary teeth intrusion, orthodontic gingival margin leveling, lip repositioning, and crown lengthening operations.⁵ Orthognathic surgery is used to treat vertical maxillary excess, and orthognathic intrusion is used to treat anterior dentoalveolar extrusion. However, in situations where there is only a slight vertical disparity, the outcomes occasionally outweigh the costs, intrusiveness, and postoperative morbidity of the surgery.⁶

In 1973, cosmetic surgeons Rubinstein and Kostianovsky published the first description of lip realignment. This was later embraced by dentists after it was enhanced in 2006 by Rosenblatt and Simon. It offers a long-lasting, conservative surgical approach along with a less invasive EGD procedure. By narrowing the upper vestibule, the therapy aims to lessen the negative effects of smiling on the zygomaticus minor, levator anguli, orbicularis oris, and levator labii superioris muscles. This article's goal is to provide a thorough explanation of the lip repositioning technique, which minimizes GSs through a quick surgical operation.⁷

¹Division of Anesthesia, Centre for Dental Education and Research, All India Institute of Medical Sciences, Delhi, India

²Department of Periodontology, Faculty of Dental Sciences, SGT University, Gurugram, Haryana, India

Corresponding Author: Aditi Chaturvedi, Division of Anesthesia, Centre for Dental Education and Research, All India Institute of Medical Sciences, Delhi, India, Phone: +91 8130605556, e-mail: chaturvediaditi50@gmail.com

How to cite this article: Chaturvedi A, Bhardwaj A. LipStaT: A Smile-transformational Surgery. *J Indian Med Assoc* 2026;124(7):68–72.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

CASE DESCRIPTION

The primary issue of a 32-year-old female patient who had visited the outpatient periodontology and oral implantology department of the SGT Dental College and Research Institute was that she showed too much gum tissue when she smiled and spoke. The patient did not disclose any past medical, dental, or drug allergy history.

Upon extraoral assessment, the lips were competent and the face was bilaterally symmetrical. An intraoral examination revealed a gingival show of 4–6 mm during speech. A dynamic smile raised the gingival show by up to 10 mm (Figs 1 and 2 and Table 1). It had been established that the gingiva's consistency, color, texture, and contour were all typical. To do a comprehensive clinical evaluation, the classification system for excessive gingival appearance has been utilized.

An extensive intraoral examination of the patient revealed that all of the crown measurements coincided (Fig. 3). Thus, EGD (A) was disregarded. Since the patient did not have gingival hypertrophy, EGD (C) was thus ruled out. EGD (D) and EGD (E) were ruled out even



though there was no maxillary lip hypermobility and the maxillary lip length was found to be sufficient (Tables 2 and 3 and Fig. 4).



Fig. 1: Preoperative image of the dynamic smile



Fig. 2: Preoperative image of a smile showing a high smile line and a wide smile extending to first molars on either side

There was a vertical maxillary surplus of 8 mm when the face was divided into three equal thirds, from trichion to glabella (upper 1/3rd), glabella to subnasale (middle 1/3rd), and subnasale to menton (lower 1/3rd). LipStaT was established when a bony maxillary excess was observed with a discrepancy of 0.5–0.7 mm that was less than 2°. EGD (B) was most likely the final diagnosis (Figs 5 and 6). All



Fig. 3: Normal length of the crown

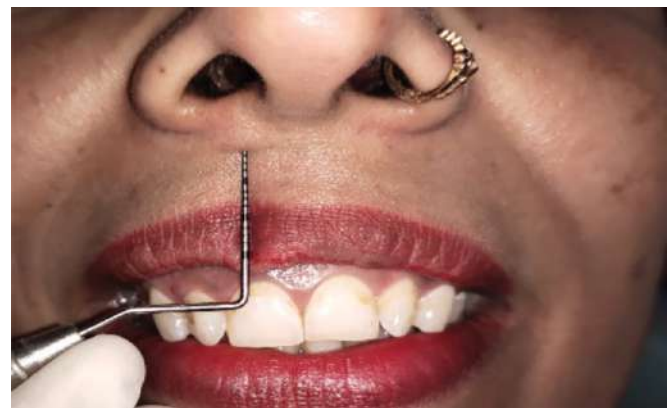


Fig. 4: Normal length of the lip

Table 1: Treatment options for GS

Treatment modality	Description	Advantages	Disadvantages
Botox injections	Injection of botulinum toxin to the muscles of the upper lip to minimize gum exposure	Minimum downtime, noninvasive, and transient results	In severe cases, there may be limited effectiveness, numerous sessions required, and possibly short-lived results
Crown lengthening	Surgery to reveal more of the tooth crown by removing extra gum tissue	Long-lasting outcomes, suitable for moderate to severe situations	Invasive process, risk for postoperative discomfort, extended recovery time
Lip repositioning	Surgical modification of the upper lip to restrict movement and hide the gums	Long-lasting outcomes, particularly in severe situations	Invasive, may cause asymmetry in the lips, take longer to heal, and need a skilled surgeon
Orthodontic treatment	Aligning the upper jaw and realigning teeth using braces or clear aligners	Long-term benefits for oral health; long-term drawbacks	Needs time commitment, potential case limitations, and a lack of stand-alone treatment
Gingival contouring	Reshaping gum tissue with a scalpel or laser to achieve a more harmonious ratio of gum to tooth	The quick process with minimal discomfort	There is a chance of gum sensitivity, a range of results, and suitability for certain situations
Surgical jaw correction	Orthognathic surgery is aimed at lessening excessive gum exposure by realigning the upper jaw	It addresses underlying skeletal problems and provides a complete treatment	Extremely invasive, has a long recovery period, and calls for skilled surgeons

Table 2: Classification of altered passive eruption

Type	Description	Treatment
1A	Osseous crest apical to the cementoenamel junction Adequate amount of attached gingiva gingival margin incisal to CEJ	Gingivectomy
1B	Osseous crest at CEJ Adequate amount of attached gingiva gingival margin incisal to CEJ	Gingivectomy and osseous surgery
2A	Osseous crest at CEJ Inadequate amount of attached gingiva gingival margin incisal to CEJ	Apically positioned flap
2B	Osseous crest at CEJ Inadequate amount of attached gingiva gingival margin incisal to CEJ	Apically positioned flap and osseous surgery

Table 3: Vertical maxillary excess classification

Type	Description	Treatment
I	2–4 mm	Orthodontic intrusion only Orthodontics and periodontics and restorative therapy
II	4–8 mm	Periodontics and restorative therapy orthognathic surgery
III	8+ mm	Orthognathic surgery with or without adjunctive periodontal therapy and restorative therapy

**Fig. 5:** Normal crown measurements (Right Profile)

things considered, the LipStaT procedure was the recommended path of action. Before surgery, the patient was referred for a blood examination. Values were discovered to be within the range.

The patient was shown the course of treatment in its entirety. Shortly after informed consent was obtained, standard skin preparation with a 10% povidone-iodine solution was carried out, and temporary draping was finished. The administered local anesthetic had been sufficient. The protocol calls for removing 8–10 mm of tissue to remove twice as much gingival display. A surgical marker has been used to indicate the boundaries of the surgical incision zone. Additionally, the midline was marked. The horizontal extent of the dynamic grin indicated the expansion of the inferior boundary laterally, culminating at the mucogingival junction (Fig. 7). Using a 15-number Bard-Parker (BP) blade, partial-thickness incisions

**Fig. 6:** Normal crown measurements (Left Profile)**Fig. 7:** Superior and inferior borders marked**Fig. 8:** Excised tissue

were made along the superior and inferior borders. These were connected at the posterior side by vertical incisions that extended from the right first premolar to the left first premolar (Fig. 8).

The targeted mucosa was removed by partial-thickness dissection, exposing the connective tissue beneath (Fig. 9). Initially, the interrupted sutures were secured at the midline using 4–0 nonresorbable silk sutures. The main suture was placed halfway



Fig. 9: Removal of excess mucosa



Fig. 10: Midline suture placed, repositioning the lip's midline

between the distal part of the incision and the midline (Fig. 10). Then, more sutures were inserted about 3 mm apart to approach the margins of the wound (Fig. 11).

POSTOPERATIVE INSTRUCTIONS

Analgesics, ibuprofen (600–800 mg every 6–8 hours), and 0.12% chlorhexidine gluconate twice a day for 2 weeks were given. After the first twenty minutes, it was suggested to provide cold compression using an ice pack every twenty minutes. During the first 10–14 days after surgery, the patient was instructed to speak and smile without moving their lips too much to prevent manipulation or actual physical injury to the surgical site. The gingival display measured 10 mm before surgery and 4 mm following it. Except for the patient's little strain at the suture site during the first week, none of the problems were reported. During the second month's follow-up appointments, the recovery was deemed adequate (Figs 12 and 13). Upon the patient's follow-up one year later, there were no concerns communicated by the patient (Fig. 14).



Fig. 11: Equidistant sutures placed



Fig. 12: Postoperative picture taken after 2 months

DISCUSSION

A person's maxillary central incisor crowns and the 1 mm of pink gingiva that is connected are visible when they smile. Two to three millimeters of exposed gingiva may be considered acceptable as long as it is not visibly noticeable. When a patient smiles, their gingiva is less noticeable because most of them have a "gum-wing" appearance on the lower edge of their upper lip. A significant gingival area is visible in those with a high lip line, which may lead to GS.⁸ By limiting the retraction of the elevator smile muscles (zygomaticus minor, levator anguli oris, orbicularis oris, and levator labii superioris), lip repositioning aims to surgically cure unesthetic GS. This reduces vestibule size and muscle pull, which in turn reduces gingival show when smiling. In the literature on plastic surgery, Rubinstein and Kostianovsky provided the first thorough description of lip relocation in 1973. Litton and Fournier⁹ later suggested lip repositioning as a method of treating EGD for short upper lips. This has not been a dental procedure, but rather a plastic surgery implementation. A plastic surgeon views the smile as including the lips and the muscles of the face, whereas a



Fig. 13: Postoperative picture taken after 2 months



Fig. 14: Postoperative picture taken after 12 months

dentist views it as including the teeth and gums together with the other anatomical aspects of the face. A smile would be incomplete without the ideal balance between the pink gums and white teeth.¹⁰

The lip-repositioning technique has benefits over other GS correction methods, such as being easy to use, safe, and effective, with surgical outcomes that remain attractive and stable even after

recovery. It is not recommended that those with excessive maxillary prominence (EGD) undergo lip realignment. Consequently, a sufficient diagnosis had to have been established before applying the aforementioned strategy

CONCLUSION

Within the field of periodontal plastic surgery, controlling lip mobility with surgical lip repositioning is a valid and practical substitute method for treating a GS.

PATIENT CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient for publication of clinical details and images.

ACKNOWLEDGMENT

Nil.

AUTHOR CONTRIBUTIONS

Patient management: Aditi Chaturvedi, Amit Bhardwaj.

Data collection: Aditi Chaturvedi, Amit Bhardwaj.

Writing – original draft: Aditi Chaturvedi, Amit Bhardwaj.

Review & editing: Aditi Chaturvedi, Amit Bhardwaj.

AI USE DECLARATION

No AI tools were used in the preparation of this manuscript.

REFERENCES

- Humayun N, Kolhatkar S, Souiyas J, et al. Mucosal coronally positioned flap for the management of excessive gingival display in the presence of hypermobility of the upper lip and vertical maxillary excess: a case report. *J Periodontol* 2010;81(12):1858–1863. DOI: 10.1902/jop.2010.100292
- Ribeiro-Júnior NV, Campos TV, Rodrigues JG, et al. Treatment of excessive gingival display using a modified lip repositioning technique. *Int J Periodontics Restorative Dent* 2013;33(3):309–315. DOI: 10.11607/prd.1325
- Jacobs PJ, Jacobs BP. Lip repositioning with reversible trial for the management of excessive gingival display: a case series. *Int J Periodontics Restorative Dent* 2013;33(2):169–175. DOI: 10.11607/prd.1483
- Gabrić Pandurić D, Blašković M, Brozović J, et al. Surgical treatment of excessive gingival display using lip repositioning technique and laser gingivectomy as an alternative to orthognathic surgery. *J Oral Maxillofac Surg* 2014;72(2):4041–4051. DOI: 10.1016/j.joms.2013.10.016
- Abdullah WA, Khalil HS, Alhindi MM, et al. Modifying gummy smile: a minimally invasive approach. *J Contemp Dent Pract* 2014;15(6):821–826. DOI: 10.5005/jp-journals-10024-1625
- Bhola M, Fairbairn PJ, Kolhatkar S, et al. LipStaT: the lip stabilization technique—indications and guidelines for case selection and classification of excessive gingival display. *Int J Periodontics Restorative Dent* 2015;35(4):549–559. DOI: 10.11607/prd.2059
- Tawfik OK, El-Nahass HE, Shipman P, et al. Lip repositioning for the treatment of excess gingival display: a systematic review. *J Esthet Restor Dent* 2018;30(2):101–112. DOI: 10.1111/jerd.12352
- Chopra P, Kapoor S, Karhana P. LipStaT: know where, when and how? *J Clin Diagn Res* 2019;13(10):05–07. DOI: 10.7860/JCDR/2019/42195.13239
- Litton C, Fournier P. Simple surgical correction of the gummy smile. *Plast Reconstr Surg* 1979;63(3):372–373. DOI: 10.1097/00006534-197903000-00014
- AlJasser RN. A modified approach in lip repositioning surgery for excessive gingival display to minimize postsurgical relapse: a randomized controlled clinical trial. *Diagnostics (Basel)* 2023;13(4):716. DOI: 10.3390/diagnostics13040716

The Use of 3D Printing in Anatomy: Advancements, Applications, and Future Directions

Preeti Sonje

Journal of the Indian Medical Association (2026); 10.5005/jima-11070-0031

Dear Sir,

3D printing (3DP) in medicine is a new-age concept that the medical fraternity is gravitating toward. The technique used most commonly is called additive manufacturing (AM), in which the 3D model is constructed layer by layer. The significance of 3DP in anatomy lies in its use for medical, educational, and research purposes. Basic anatomical models to patient-specific models can be generated via 3DP. Some applications of 3DP in anatomy are as follows:

- Anatomical models for education: 3D models for education in medical and dental education are replacing cadavers. Their advantages include improved visualization, accessibility, and customization of models for rare conditions, e.g., bones and inner ear bones.
- Surgical planning and simulation: 3DP helps in planning complex surgeries by creating patient-specific anatomical models. Using 3DP replicas of human tissues and organs for practice reduces risks in real surgeries, e.g., brain and skull models before neurosurgeries.
- Prostheses and implants: Customized prosthetics or patient-specific prosthetics improve fit and functionality. Bioprinting and organ replication are future possibilities for creating functional human tissues and organs using 3DP, for example, knee meniscus, heart valve, spinal disc, cartilage tissues, bone, and artificial ear.
- Patient communication: Personalized 3D models can help surgeons communicate with patients and better explain the surgical procedure and medical condition to them.

Benefits of 3DP include:

- Customization: Tailor-made models for better understanding, diagnosis, and treatment.
- Cost efficiency: Once considered a very costly method, today, 3DP costs have been reduced tremendously. Printed versions of the heart, vertebrae, and other organs are being sold for US\$ 10.¹
- Improved learning: Enhanced visualization leads to better learning in medical schools, for example, with middle ear bones, sinuses, and ventricles of the brain. Some authors have advocated that all medical schools should have 3DP machines.²

The challenges and limitations of 3DP are:

- Technical challenges include accuracy and material limitations.
- Cost and accessibility: The initial cost of acquiring the machine might be high.
- Ethical concerns exist regarding biological tissues and organs being generated in this way.

Department of Anatomy, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India

Corresponding Author: Preeti Sonje, Department of Anatomy, Dr. D. Y. Patil Medical College, Hospital and Research Centre, Pune, Maharashtra, India, Phone: +91 8975781889, e-mail: Preeti.Sonje@dpu.edu.in

How to cite this article: Sonje P. The Use of 3D Printing in Anatomy: Advancements, Applications, and Future Directions. *J Indian Med Assoc* 2026;124(7):73.

Source of support: Nil

Conflict of interest: None

Prospects of 3DP:

- Bioprinting and tissue engineering involve this technique.
- Virtual reality and augmented reality, combined with 3DP products, enhance studies and surgical training.
- Innovations in materials will replace surgical prostheses and models.
- Regulatory development: Laws are evolving to integrate 3DP into medicine.

It can be concluded that 3DP, like any other technique and intervention, has its pros and cons. Its feasibility and cost should be carefully weighed before its use.

ACKNOWLEDGMENT

I express my sincere thanks to Dr A Rekha Madam, Dean of my institute to encourage me to write about this topic.

AUTHOR CONTRIBUTIONS

Conceptualization, writing – original draft, review & editing, final approval: by Dr Preeti Sonje.

AI USE DECLARATION

No AI tools were used in the preparation of this manuscript.

REFERENCES

1. Smith CF, Tollemache N, Covill D, et al. Take away body parts! An investigation into the use of 3D-printed anatomical models in undergraduate anatomy education. *Anat Sci Educ* 2018;11(1):44–53. DOI: 10.1002/ase.1718
2. Balestrini C, Campo-Celaya T. With the advent of domestic 3-dimensional (3D) printers and their associated reduced cost, is it now time for every medical school to have their own 3D printer? *Med Teach* 2016;38(3):312–313. DOI: 10.3109/0142159X.2015.1060305



INDIAN
MEDICAL
ASSOCIATION

दो टीके जिंदगी के

Gaen



**DO TEEKE
ZINDAGI KE**



**Phase II HPV Vaccination Project of
Indian Medical Association
&
Federation of Obstetric and Gynaecological
Societies of India (FOGSI)**

**Supported by American Cancer Society
&
Cancer Foundation of India**

- A Commitment to eliminate Cervical Cancer from India
- A Training program to educate 50,000 Physician Members of IMA
- A free online training program to educate with certification



Dr. Dilip Bhanushali
Imm. Past National President
IMA



Dr. Anilkumar J Nayak
National President
IMA



Dr. Ketan Desai
Chief Patron,
Past President
IMA, WMA & MCI



Dr. Sarbari Dutta
Hony Secretary General
IMA



Dr. Piyush Jain
Hony Finance Secretary
IMA



Dr. Sunita Tandulwadkar
President, FOGSI



Dr. Suvarna Khadilkar
Secretary General, FOGSI



Dr. Nomeeta Shiv Gupta
National Coordinator,
HPV Vaccination Project



Dr. Priya Ganesh Kumar
National Convenor,
HPV Vaccination Project



IMA EMPLOYMENT AND CAREER FACILITATION BUREAU

*An Indian Medical Association Initiative
for IMA Life & JDN Members*



ZERO
Registration
Charges

Domestic
&
International
Opportunities



**For Free Registration
Click here**



Visit: www.imacareers4doctors.com

Scan to Register



Dr. Dilip Bhanushali
Imm Past National President



Dr. Anilkumar J Nayak
National President



Dr. Ketan Desai
Chief Patron,
Past President
IMA, WMA & MCI



Dr. Sarbari Dutta
Hony Secretary General



Dr Piyush Jain
Hony Fin. Secretary

DR. JOSEPH BENAVENT

CHAIRMAN, IMA ECFB
9447182041, 9497948975 (whatsapp)
benavenjoseph@yahoo.com

DR. SHITIJ BALI

HONY SECRETARY, IMA ECFB
9910755660
shitij.bali@yahoo.com

DR. MUNISH PRABHAKAR

HONY. FINANCE SECRETARY, IMA ECFB
9810305329
munishmona@gmail.com

DR ABUL HASAN

MEMBER, IMA ECFB
9843025300
erodecityhospital@gmail.com

Email : info@imacareers4doctors.com



**INDIAN
MEDICAL
ASSOCIATION**

Redevelopment of IMA HQs Building Construction in full swing

Income Tax Deduction under 80G

Every Contribution Counts!



322823482316706@CNRB

Name on Bank: IMA NEW BUILDING

Bank : Canara Bank

Account No. : 110162316706

IFCS Code : CNRB0019067

Branch : C R Building, Delhi



SCAN TO DONATE



Dr. Dilip Bhanushali
Imm. Past National President



Dr. Anilkumar J Nayak
National President



Dr. Ketan Desai
Chief Patron,
Past President
IMA, WMA & MCI



Dr. Sarbari Dutta
Hony Secretary General



Dr Piyush Jain
Hony Finance Secretary

DR. VINAY AGGARWAL

CHAIRMAN, IMA BUILDING COMMITTEE

DR. RAJAN SHARMA

VICE CHAIRMAN, IMA BUILDING COMMITTEE

DR. SHITIJ BALI

CONVENOR, IMA BUILDING COMMITTEE

JIMA Editorial Advisory Board Members (National & International)



Dr Ved Prakash Mishra
Maharashtra



Dr V K Monga
Delhi



Dr Natwar Sharda
Madhya Pradesh



Dr TN Ravisankar
Tamil Nadu



Dr Hiren Kothari
Gujarat



Dr Sunil Katyal
Punjab



Dr Shashank R Joshi
Maharashtra



Dr B Sridhar
Tamil Nadu



Dr Sasidharan K
Kerala



Dr S Srinivas
Karnataka



Dr K A Sreevilasan
Kerala



Dr G Narsimulu
Telangana



Dr Garlapati N Kishore
Andhra Pradesh



Dr Ashok Sharda
Rajasthan



Dr Devendra Pd Singh
Bihar



Dr Ajoy Kumar Singh
Jharkhand



Dr Ajay Goverdhan
Chhattisgarh



Dr Sandeep Kalra
Haryana



Dr Mahendra D Chauhan
Gujarat



Dr Anil S Pachnekar
Maharashtra



Dr Arvind Jain
Madhya Pradesh



Dr Jayanta Kr Panda
Orissa



Dr Danila Chhunthang
Meghalaya



Dr Satyajit Borah
Assam



Dr Anil Mahajan
Jammu & Kashmir



Dr Pradeep Singh
Uttar Pradesh



Dr Asim Kumar Sarkar
Bengal



Dr Dilip Kr Dutta
Bengal



Dr Apurba Ghosh
Bengal



Dr Anil Kr B Patil
Maharashtra



Dr Surajit Bhattacharyya
Uttar Pradesh



Dr Ananda Bagchi
Bengal



Dr Alok Pandit
Bengal



Dr Kaushik Lahiri
Bengal



Dr Golokbehari Maji
Bengal



Dr Amit Ghose
Bengal



Dr Makhan Lal Saha
Bengal



Dr Vijay Kumar
Uttar Pradesh



Dr Purusottam Chatterjee
Bengal



Dr Bhaskar Pal
Bengal



Dr Nandini Chatterjee
Bengal



Dr Diptendra Sarkar
Bengal



Dr Subir Gangopadhyay
Bengal



Dr Krishnendu Nandi
Bengal



Dr Sanjoy Giri
Orissa



Dr Anupama Bahadur
Uttarakhand



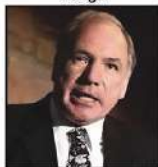
Dr Madhab Ray
USA



Dr Sibaprasad Ray
Chaudhury USA



Dr WJW Nunoo-Mensah
London



Dr Colin Robertson
UK



Dr Gautamananda Roy
UK



Dr Narimantas E Samalavicius
Lithuania



Prof Roman Jaeschke
Canada



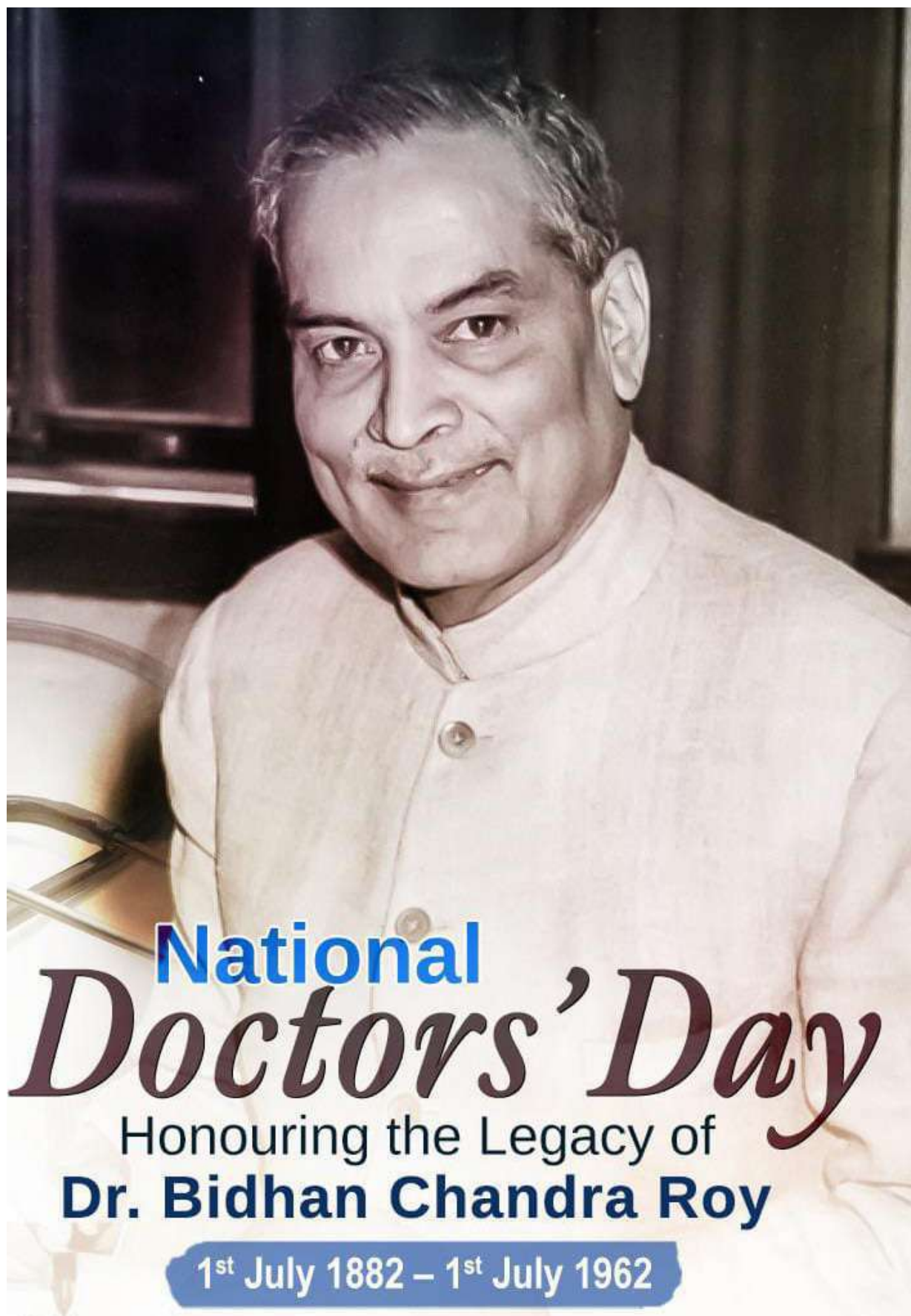
Dr Ricardo Escalante
Venezuela



Dr Serene Perkins
USA



Dr Prakhar Dasgupta
UK



National *Doctors' Day*

Honouring the Legacy of
Dr. Bidhan Chandra Roy

1st July 1882 – 1st July 1962



Gabapin⁺ NT

100
200
300
400*

Gabapentin 100/200/300/400 mg + Nortriptyline 10 mg Tablets

— Evidence, Experience, Excellence —

Gabapin⁺

100
300*
400*
600
800

Gabapentin Tabs/Caps*

— The Neuralgia Expert —

Gabapin⁺-ME

100
300

Gabapentin 100/300 mg + Methylcobalamin 500 mcg Tabs

Regenerates nerve + Relieves pain

Gabapin⁺ SR

450
600

Gabapentin Sustained Release 450/600mg Tabs

— Sustains Smile in Life —

With best compliments

Cilapam[®]

Escitalopram 5/10/15/20 mg Tabs

PLUS 5/10/15/20 LS 5/10/15/20 FL FN

Paxonil[®]

Paroxetine PR 12.5/25/37.5 mg Tablet

PLUS 12.5 PLUS 25 LS 12.5 LS 25

dupaX[™]

Duloxetine 20/30/40 mg Tablets

P 20/50 20/75 30/75

MAGDEP[™] C

Magnesium Bisglycinate-1206mg, (Chelated Magnesium)
eq. to Elemental Magnesium-170mg, Co-Enzyme Q10 (Ubidecarenone)- 75mg,
Riboflavin- 0.8mg, Pyridoxine Hydrochloride (Vitamin B6)-2.4mg, Vitamin D3 600 IU

Cognitru[®]

SOFTGEL CAPSULES

L-Carnitine 200 mg, DHA 200 mg, Folic Acid 300 mcg & Vitamin D3 400 IU

Metmax[®]

Benfotamine 200 mg + Mecobalamin 1500 mcg +
Folic Acid 1.5 mg + ALA 200 mg + Myo-inositol 100 mg +
Chromium Picolinate 200 mcg + Pyridoxine 3 mg Tablets

CD3 Calcium Carbonate 500 mg + Vitamin D3 2000 IU
+ ALA 200 mg + Benfotamine 200 mg + Mecobalamin 1.5 mg + Inositol 100 mg
+ Chromium Picolinate Eq. to Chromium 200 mcg + Folic Acid 1.5 mg + Pyridoxine 3 mg

CALDRAN max[®]

Undenatured Type II Collagen-40 mg, Calcium Lysinate 835 mg,
Vitamin C 30 mg, Magnesium Oxide 30 mg,
Zinc Oxide 7.5 mg, Manganese Sulphate 1.8 mg,
Copper Sulphate 0.5 mg, Cholecalciferol 260 IU

PYGLO[™]

Piracetam 800 mg + Citicoline 500 mg Tablets

ALTONil[™]

Melatonin 3/5/10 mg Tabs

PLUS Melatonin 3/5/10 mg + Clonazepam 0.5 mg Tablets LS Melatonin 3/5/10 mg + Clonazepam 0.25mg Tablets

SR Melatonin Bilayered 6/10/20 mg Tablets Oral Spray Melatonin 1.5 mg/Spray (30 ml)

Syrup Melatonin 3 mg/5 ml (100 ml)

Alteus