e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2025; 17(8); 1222-1227

Original Research Article

Impact of Malnutrition and Anemia on Hernia Surgery Outcomes: Etiology, perioperative Optimization Strategies, and Tailored ERAS Protocols for Tribal Adults

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Received: 01-06-2025 / Revised: 16-07-2025 / Accepted: 19-08-2025

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Conflict of interest: Nil

Abstract:

Hernia surgery is one of the most common surgical procedures worldwide, yet outcomes in tribal adults are often compromised by underlying malnutrition and anemia. These conditions, prevalent due to chronic food insecurity, cultural dietary practices, parasitic infestations, and poor healthcare access, significantly increase perioperative risks. Malnutrition impairs wound healing and immune defense, while anemia reduces tissue oxygenation, collectively leading to higher rates of intraoperative instability, postoperative complications, recurrence, and mortality. This paper explores the etiology of malnutrition and anemia in tribal populations, their impact on hernia surgery outcomes, and the importance of perioperative optimization. Strategies such as nutritional assessment, iron therapy, protein and micronutrient supplementation, and community-based interventions are emphasized. Furthermore, the role of tailored Enhanced Recovery After Surgery (ERAS) protocols—adapted to tribal contexts with locally accessible dietary modifications, culturally sensitive counseling, and community health worker follow-up—is highlighted. Bridging cultural, economic, and systemic barriers through government and NGO initiatives is essential for sustainable improvement. Addressing malnutrition and anemia through targeted perioperative strategies and customized ERAS pathways can significantly enhance surgical outcomes for tribal adults undergoing hernia repair, while also promoting long-term health equity.

Keywords: Hernia surgery, Malnutrition, Anemia, Tribal health.

Introduction

Hernia repair is one of the most frequently performed surgical procedures worldwide, with inguinal hernia alone accounting for more than 20 million operations annually.[1] In low- and middle-income countries, including India, the burden of hernia is particularly significant due to delayed presentation, limited access to surgical care, and a high prevalence of comorbid conditions that complicate outcomes. The successful management of hernia surgery depends on operative technique and the patient's overall health and nutritional status.[2]

Among tribal populations, malnutrition and anemia emerge as dual risk factors that adversely affect surgical outcomes. Malnutrition impairs wound healing, compromises immune function, and increases the risk of infection and recurrence. Anemia, prevalent in resource-limited communities, reduces oxygen delivery to tissues, heightening the risk of intraoperative complications and poor postoperative recovery.[2] When these two conditions coexist, they create a compounded vulnerability that significantly influences perioperative morbidity and mortality.[2]

The roots of malnutrition and anemia in tribal adults lie in a complex interplay of socioeconomic, dietary, and healthcare access determinants. Tribal communities often face chronic food insecurity,

subsisting on diets low in protein and micronutrients. Traditional dietary patterns, seasonal scarcity, and cultural food taboos further exacerbate deficiencies.[3] Limited access to healthcare services delays diagnosis and management of nutritional deficiencies and anemia, while parasitic infestations, chronic infections, and substance use contribute additional risk. Collectively, these factors create a fragile baseline health status that predisposes tribal adults to poor surgical outcomes.[3] Given this background, it becomes essential to examine the unique challenges faced by tribal patients undergoing hernia surgery. Addressing malnutrition and anemia preoperatively, alongside adapting perioperative care to cultural and logistical realities, may improve surgical success rates and long-term quality of life. Therefore, it is interesting to evaluate how malnutrition and anemia affect hernia surgery outcomes and propose tailored perioperative strategies, including ERAS modifications, for tribal populations.

Etiology of Malnutrition and Anemia in Tribal Adults: Malnutrition and anemia in tribal adults arise from multiple overlapping factors, including diets low in protein and iron with seasonal food insecurity, socio-cultural influences such as food taboos and gender-based disparities, and poor access to healthcare, leading to limited screening and delayed treatment.[4] Parasitic infestations like hookworm, along with chronic infections such as malaria and tuberculosis, further aggravate nutritional depletion.[4] Additionally, widespread alcohol and tobacco use impair nutrient absorption and utilization, collectively creating a high-risk baseline health status that adversely impacts surgical outcomes.[4]The etiology of malnutrition and anemia in tribal adults is shown in Table 1.

Table 1: Etiology of Malnutrition and Anemia in Tribal Adults

Category	Specific Factors	Mechanism/Pathophysiology	Impact on Tribal Adults
Dietary Causes[5]	Low protein intake (cereals, coarse grains as staple)	Insufficient amino acids → impaired collagen synthesis, poor wound healing	Chronic protein-energy malnutrition, delayed recovery post-surgery
	Iron-poor diet (low meat, green leafy vegetables)	Reduced dietary iron intake and poor bioavailability	High prevalence of iron-deficiency anemia
	Seasonal food insecurity (rain-fed agriculture, migration for labor)	Cyclical starvation periods → calorie and micronutrient deficits	Periodic exacerbations of undernutrition
Socio-cultural Influences[6]	Food taboos (restrictions in pregnancy, lactation, illness)	Exclusion of iron/protein-rich foods	Increased maternal anemia and malnutrition
	Gender-based disparities in food distribution	Women often eat last and least	Higher rates of anemia in tribal women
	Preference for traditional beverages (fermented drinks) over milk/eggs	Reduced protein and calcium intake	Weak musculoskeletal health, frailty
Healthcare Access Issues[7]	Limited screening for anemia/malnutrition	Absence of routine hemoglobin checks or anthropometry	Late detection of nutritional deficiencies
	Poor availability of supplements (iron, folic acid, multivitamins)	Inconsistent coverage of government nutrition programs	Persistent community-wide anemia
	Lack of nutrition counseling and health literacy	Low awareness about a balanced diet and hygiene	Failure to adopt preventive measures
Parasitic Infestations & Chronic Infections[8]	Hookworm infestation (barefoot farming, poor sanitation)	Chronic intestinal blood loss	Iron-deficiency anemia resistant to diet alone
	Malaria (endemic in forested tribal regions)	Hemolysis, chronic inflammation	Severe anemia and recurrent illness
	Tuberculosis & chronic infections	Inflammatory cytokines impair iron utilization (“anemia of chronic	Worsened baseline anemia, increased

		disease")	catabolism
Substance Use[9]	Alcohol	Impaired absorption of folate, B12, and iron; liver damage	Macrocytic and mixed anemia, micronutrient deficiency
	Tobacco (smoked/chewed)	Oxidative stress, reduced appetite, impaired healing	Increased surgical complications, poor recovery
Environmental & Occupational Factors[9]	Heavy manual labor without adequate nutrition	Increased metabolic demand unmet by intake	Fatigue, frailty, and higher hernia recurrence risk
	Poor sanitation and unsafe water	Recurrent diarrhea, worm infestations	Malabsorption and chronic undernutrition

Impact of Malnutrition and Anemia on Hernia Surgery Outcomes: A patient's baseline nutritional and hematological status plays a decisive role in the outcome of hernia surgery. In tribal adults, malnutrition and anemia commonly coexist, leading to compounded vulnerabilities across the perioperative period. Preoperatively, malnourished patients often exhibit frailty, reduced muscle mass, and poor physiological reserves, impairing their ability to withstand surgical stress.[10] Anemia further limits oxygen delivery to tissues, increasing the risk of perioperative instability and reduced tolerance to anesthesia. Intraoperatively, fragile tissue planes, higher bleeding tendencies, and anesthetic risks complicate surgical repair. In contrast, the tissue quality available for mesh fixation is frequently suboptimal, predisposing to technical difficulties and early recurrence.[11]

The postoperative phase is particularly critical, as malnutrition and anemia substantially heighten the risk of wound-related complications such as infection, seroma, and hematoma. Protein and micronutrient deficiencies hinder collagen synthesis, angiogenesis, and immune defense, leading to delayed wound healing and poor mesh integration.[12] Consequently, higher recurrence rates, prolonged hospital stays, and increased readmission are frequently observed in this population. In severe cases, especially in emergency presentations or when compounded by chronic infections, mortality can occur.[13] These adverse outcomes highlight the need for targeted nutritional and hematological optimization before surgery and underscore the importance of tailored perioperative strategies in tribal populations to reduce complications and improve surgical success.[13]

Perioperative Optimization Strategies: Effective perioperative optimization is central to improving hernia surgery outcomes in tribal adults burdened by malnutrition and anemia. The first step is systematic preoperative nutritional assessment, using validated tools such as the Malnutrition Universal Screening Tool (MUST) and the Nutritional Risk Screening (NRS-2002) scale, in conjunction with hemoglobin estimation.[14] These assessments help identify high-risk individuals who require targeted interventions before surgery.[15] Correction of anemia should follow a structured approach—oral or parenteral iron supplementation for mild to moderate cases, considering blood transfusion in severe anemia or emergency settings. Simultaneously, it is crucial to identify and treat underlying etiologies, including hookworm infestation, malaria, and chronic infections, which perpetuate anemia in tribal populations.[15]

Nutritional interventions must enhance protein and micronutrient intake, which are essential for wound healing and immune competence. Affordable and locally acceptable protein sources such as eggs, pulses, and soy should be incorporated into preoperative dietary planning, supplemented by iron, folate, vitamin B12, and vitamin C to correct common deficiencies. In severely undernourished adults, ready-to-use therapeutic foods (RUTF) provide a practical option for rapid nutritional rehabilitation.[16]

Beyond individual-level management, community-level interventions—such as tribal health outreach programs, nutritional education, and prehabilitation models led by community health workers—are critical for long-term impact. Integrating these measures into perioperative care not only improves surgical safety and recovery but also contributes to breaking the cycle of malnutrition and poor surgical outcomes prevalent in tribal regions.[16]

Enhanced Recovery After Surgery (ERAS) Protocols: Enhanced Recovery After Surgery (ERAS) protocols are widely recognized as evidence-based frameworks to improve perioperative outcomes by minimizing surgical stress, optimizing physiological function, and accelerating recovery.[17] In hernia surgery, standard ERAS components include patient education, preoperative optimization, minimally invasive surgical techniques, multimodal analgesia, judicious fluid management, early mobilization,

and early initiation of oral feeding.[17] These measures reduce complications, shorten hospital stay, and improve patient satisfaction. However, in tribal populations, applying conventional ERAS protocols presents several challenges, including limited access to preoperative nutritional supplements, low health literacy, cultural barriers to dietary modification, and inadequate postoperative follow-up infrastructure.[18]

To address these barriers, ERAS must be tailored to the tribal context. Preoperatively, routine anemia screening should be prioritized, with supplementation strategies designed around locally available and culturally acceptable foods. Counseling in the native language can improve patient understanding and adherence. Intraoperatively, minimally invasive approaches should be used where feasible, though resource constraints may necessitate adaptation, with careful fluid management being universally applicable.[19] Postoperatively, early initiation of feeding with locally accepted, protein-rich foods can encourage compliance, while strict infection-prevention practices are critical in environments where sanitation may be poor. Follow-up care can be strengthened by training community health workers to monitor recovery and reinforce compliance with dietary and wound care instructions.[20]Integrating certain traditional practices—such as herbal adjuncts for appetite stimulation—may also enhance patient acceptance of ERAS principles if safe. Thus, a culturally sensitive and resource-adapted ERAS model holds promise for improving surgical outcomes in tribal adults undergoing hernia repair.[21]

Special Considerations in Tribal Populations: A range of socio-demographic and systemic barriers often complicates surgical care for tribal adults. Limited healthcare access remains a critical issue, as many tribal communities reside in remote regions with inadequate transport, under-resourced facilities, and a scarcity of trained surgical staff.[22] This leads to delayed presentation of hernia cases, with many patients seeking care only after significant complications arise. Economic barriers further exacerbate the problem, as tribal families frequently lack the financial means for nutritional supplementation, preoperative optimization, or even transportation to surgical centers. These constraints often result in incomplete perioperative care and higher rates of morbidity.[23]

Cultural beliefs and mistrust of formal healthcare systems also play a central role. Traditional healers are often the first point of contact, and misconceptions regarding surgery may delay or prevent acceptance of operative treatment. Addressing these challenges requires sustained efforts in community sensitization and health education, ensuring that patients and their families understand the importance of nutritional preparation, timely surgical intervention, and postoperative care.[24] Government programs such as the National Health Mission and NGO-led outreach initiatives can bridge these gaps by providing nutritional support, subsidized surgical services, and follow-up through community health workers. By combining medical, economic, and cultural strategies, healthcare providers can enhance surgical acceptance, optimize outcomes, and build trust in tribal communities.[25]

Future Directions and Research Gaps: Despite growing recognition of the impact of malnutrition and anemia on surgical outcomes, there remains a significant gap in high-quality evidence specifically addressing tribal populations. Most existing studies focus on general surgical cohorts, with limited stratification by ethnicity, socioeconomic status, or nutritional burden.[26] There is a pressing need for prospective studies that evaluate the effect of correcting anemia and malnutrition before hernia surgery in tribal adults, including randomized trials of nutritional supplementation, iron therapy, and deworming protocols.[27] Such evidence would provide a stronger basis for perioperative guidelines tailored to this vulnerable group. Similarly, there is an urgent requirement to design and validate tribal-specific ERAS guidelines that account for local dietary habits, cultural practices, and resource constraints.[27]

Another key research gap lies in the scarcity of long-term outcomes data, particularly on hernia recurrence rates, chronic pain, and quality of life after surgery in tribal communities. Understanding these dimensions is critical for assessing the disease's true burden and the' success of interventions.[28]

Additionally, innovative service delivery models such as telemedicine consultations and mobile health camps can play a transformative role in bridging the access gap. Yet, their integration into tribal health systems remains underexplored. Future research should evaluatesuch approaches' feasibility, cost-effectiveness, and community acceptance. Addressing these gaps will improve surgical outcomes and contribute to broader health equity for tribal populations.[29]

Conclusion

Malnutrition and anemia substantially compromise the safety and effectiveness of hernia surgery in tribal adults, contributing to higher rates of complications, recurrence, and delayed recovery. Addressing these challenges requires early identification, targeted nutritional and hematological optimization, and culturally adapted ERAS protocols that align with local realities.

Strengthening community engagement, healthcare access, and research tailored to tribal populations will improve surgical outcomes and advance health equity.

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