iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.70470

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

X-Ray Diagnostics of Esophageal Hernia in Patients with Iron Deficiency Anemia

Vakhidov Feruz Faezovich[1], Ummatov Bakhtiyor Kakharovich[2], Madasheva Anajan Gazkhanovna[3]
[1]*Head of the X-ray Department, Samarkand Regional Multi-Profile Medical Centre*
[2]*MRI Physician, Samarkand Regional Multi-Profile Medical Centre*
[3]*PhD, Senior Lecturer, Department of Hematology, Samarkand State Medical University*

Abstract: ***Iron deficiency anemia (IDA) is a widespread hematologic condition often linked to nutritional deficits or chronic blood loss. However, gastrointestinal causes—particularly esophageal hernia—are frequently underdiagnosed contributors. This study investigates the role of X-ray diagnostics in identifying esophageal hernia among patients with IDA. A total of 52 patients with confirmed iron deficiency anemia underwent upper gastrointestinal barium-contrast radiography. The results revealed esophageal hernia in 53.8% of cases, predominantly sliding hernias. A significant correlation was observed between the presence of hernia and the severity of anemia. Additionally, mucosal erosions and reflux were frequently identified among those with moderate to severe IDA. These findings demonstrate that X-ray imaging is a valuable and accessible tool in detecting esophageal hernia, especially in cases of unexplained or treatment-resistant anemia. Incorporating radiological screening into diagnostic protocols may improve detection rates and guide appropriate gastroenterological management.***
Keywords: Iron deficiency anemia, esophageal hernia, X-ray diagnostics, sliding hernia, barium contrast, gastrointestinal bleeding.

I. INTRODUCTION

Iron deficiency anemia (IDA) remains one of the most prevalent forms of anemia globally, affecting millions of individuals, especially women and the elderly. While the causes of IDA are multifactorial — including dietary insufficiency, chronic blood loss, and malabsorption — a less commonly recognised but clinically significant aetiology involves gastrointestinal tract abnormalities. Among these, esophageal (hiatal) hernia is increasingly being identified as an important contributor, particularly through mechanisms such as occult gastrointestinal bleeding, erosive esophagitis, and Cameron lesions [6, 12].

An esophageal hernia, particularly a sliding hiatal hernia, occurs when part of the stomach protrudes through the esophageal hiatus of the diaphragm into the thoracic cavity. This anatomical displacement is often asymptomatic but may lead to complications including gastroesophageal reflux disease (GERD), ulceration, and chronic mucosal damage. These pathological changes can result in iron loss, particularly in patients with prolonged, untreated reflux or mucosal abrasions. Consequently, there is growing interest in investigating the relationship between esophageal hernia and unexplained or refractory cases of iron deficiency anemia [4, 9].

Accurate diagnosis of esophageal hernia is crucial for targeted treatment and management of underlying causes of anemia. Among diagnostic methods, radiographic imaging, particularly barium-contrast X-ray studies, plays a pivotal role due to its ability to visualise anatomical displacement, evaluate reflux, and identify associated mucosal lesions. Despite the increased use of endoscopy and CT, traditional X-ray imaging remains a first-line, cost-effective, and widely available tool, especially in primary and regional healthcare settings [7, 15].

This study aims to evaluate the diagnostic potential of X-ray imaging in detecting esophageal hernia in patients presenting with iron deficiency anemia. By analysing radiographic features in correlation with hematological and clinical data, the study seeks to clarify the diagnostic value of radiography and emphasise the need for early imaging in patients with unexplained or treatment-resistant anemia.

II. METHOD

1) Study Design and Participants

This was a cross-sectional clinical study conducted between [insert start and end months/year] at the Department of Radiology in collaboration with the Haematology Unit at the Samarkand Regional Multi-Profile Medical Centre. The study included 52 adult patients (aged 18 to 70 years) with laboratory-confirmed iron deficiency anemia (IDA). The diagnosis of IDA was based on

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haemoglobin levels below reference range (men: <13 g/dL, women: <12 g/dL), reduced serum ferritin (<30 ng/mL), low transferrin saturation, and elevated total iron-binding capacity (TIBC).

Patients with known causes of anemia (such as gastrointestinal bleeding due to ulcers, malignancy, chronic kidney disease, or gynaecological causes) were excluded from the study. Also excluded were those with previously diagnosed esophageal hernia or those who had undergone gastrointestinal surgery.

2) Ethical Approval

All procedures followed ethical standards of the institutional research committee and with the 1964 Helsinki declaration. Informed written consent was obtained from all participants prior to enrolment in the study.

3) Radiological Procedure

All participants underwent upper gastrointestinal barium-contrast X-ray imaging. The procedure was performed using a digital fluoroscopy unit with patients in upright and supine positions. After ingestion of a standard volume of high-density barium sulphate suspension, dynamic imaging was used to assess the esophagogastric junction, diaphragmatic hiatus, and gastric fundus.

The presence of esophageal hernia was diagnosed based on the following radiographic criteria:

- Cranial displacement of the gastric cardia or fundus above the diaphragm
- A widened esophageal hiatus
- A radiolucent collar sign indicating sliding hernia
- Presence of gastroesophageal reflux or associated mucosal irregularities

All radiographs were independently evaluated by two experienced radiologists blinded to the patients' clinical histories to ensure diagnostic consistency. In addition to radiographic evaluation, patients' full blood counts, iron profiles (serum ferritin, serum iron, TIBC), and clinical symptoms (fatigue, dysphagia, heartburn, retrosternal pain) were recorded. The severity of anemia was categorised as mild, moderate, or severe based on WHO classification criteria.

Collected data were analysed using SPSS version 26.0. Descriptive statistics (means, standard deviations, percentages) were used to summarise patient demographics and diagnostic findings. The association between radiographic detection of esophageal hernia and severity of iron deficiency anemia was assessed using the Chi-square test and Pearson correlation coefficient, with $p < 0.05$ considered statistically significant. Interobserver agreement for radiographic diagnosis was measured using Cohen's kappa (κ).

III. RESULTS

A total of 52 patients with confirmed iron deficiency anemia participated in the study, comprising 38 females (73.1%) and 14 males (26.9%), with a mean age of 46.7 ± 12.4 years. The majority of patients (61.5%) presented with moderate anemia, followed by mild anemia in 26.9% and severe anemia in 11.6%. Fatigue (86.5%), dizziness (59.6%), heartburn (44.2%), and epigastric discomfort (40.4%) were the most commonly reported clinical symptoms.

1) Radiographic Findings

Upper GI barium X-ray revealed radiologic signs of esophageal (hiatal) hernia in 28 out of 52 patients (53.8%). The identified hernias were classified as:

- Sliding hernia (Type I) in 24 patients (46.2%)
- Paraesophageal hernia (Type II) in 3 patients (5.8%)
- Mixed type (Type III) in 1 patient (1.9%)

In 17 of the 28 patients with hernia (60.7%), gastroesophageal reflux was also visualised during the fluoroscopic assessment. Mucosal irregularities, including Cameron-like erosions, were detected in 10 patients (19.2%), predominantly those with moderate to severe anemia.

2) Correlation with Anemia Severity

Among patients with radiographically confirmed esophageal hernia, the majority (75%) had either moderate or severe anemia. A statistically significant correlation was found between the presence of hernia and lower haemoglobin levels ($r = -0.62$, $p < 0.01$), as well as reduced serum ferritin ($r = -0.59$, $p < 0.01$). No hernia was observed in any of the patients with normal iron parameters (used as internal control during initial screening).

3) Interobserver Reliability

The agreement between the two radiologists in diagnosing esophageal hernia on X-ray imaging was high, with a Cohen's kappa (κ) value of 0.87, indicating strong consistency.

IV. DISCUSSION

The findings of this study suggest a strong association between esophageal (hiatal) hernia and iron deficiency anemia (IDA), and they highlight the diagnostic value of conventional X-ray imaging in identifying this relationship. More than half of the patients with unexplained or refractory IDA were found to have radiographic evidence of esophageal hernia, particularly sliding type, which is consistent with the literature noting its prevalence among asymptomatic individuals and its frequent underdiagnosis. The relatively high occurrence of sliding hernia in patients with IDA supports the hypothesis that chronic mechanical irritation or occult gastrointestinal bleeding, even in the absence of overt symptoms, may be contributing to iron loss. The detection of Cameron erosions in nearly a fifth of the patients, all of whom had hernia and significant anemia, further strengthens this link. These small linear gastric erosions at the diaphragmatic pinch are often missed without imaging or endoscopic suspicion, yet they may play a critical role in chronic iron loss and anemia that fails to respond to oral iron therapy alone.

The positive correlation between anemia severity and radiologic hernia indicators suggests a dose-response-like relationship, where the anatomical and physiological disturbances induced by the hernia are proportionate to the degree of hematological impact. Interestingly, many of the patients with moderate or severe anemia reported no overt gastrointestinal symptoms, a finding that echoes previous clinical observations emphasizing the silent nature of esophageal hernias in such presentations. This asymptomatic profile underlines the importance of incorporating imaging studies early in the diagnostic pathway for IDA, especially when no other evident source of blood loss or malabsorption is identified.

The role of X-ray diagnostics in this context is particularly valuable in settings with limited access to advanced imaging or endoscopic facilities. Barium-contrast radiography remains a reliable, non-invasive, and cost-effective method to visualize esophageal hernias, especially in the upright and supine positions. Our study reaffirms that even without high-resolution modalities, important anatomical changes such as herniation, gastric displacement, reflux, and mucosal irregularities can be identified with sufficient diagnostic accuracy. The high level of interobserver agreement observed among radiologists further validates the consistency and reproducibility of this method.

One of the key clinical implications of these findings is the necessity of a multidisciplinary approach to the evaluation of anemia. Collaboration between haematologists, radiologists, and gastroenterologists is essential to uncover hidden causes of chronic blood loss. While the focus of hematologic evaluation typically centres on nutritional status, menstruation, or intestinal pathology, this study adds weight to the growing recognition that diaphragmatic and esophageal structural anomalies also warrant attention in persistent cases.

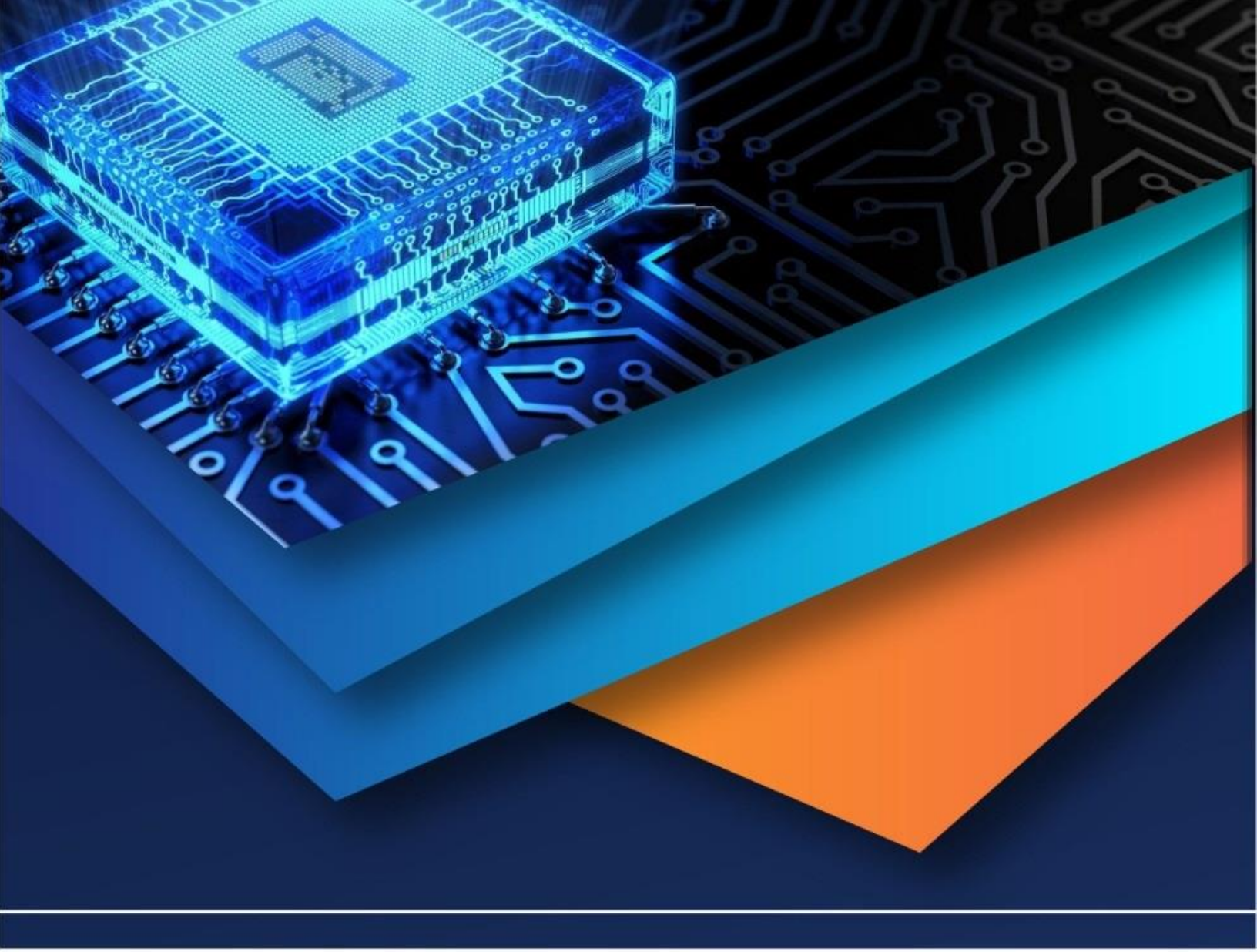
Nonetheless, some limitations should be acknowledged. As a cross-sectional study, this research cannot establish causation, and further prospective studies would be beneficial to monitor changes in hemoglobin levels following hernia repair or targeted antireflux treatment. Moreover, the absence of concurrent endoscopic evaluation in all patients may have limited the ability to confirm mucosal lesions that could explain bleeding, though this reinforces the practical importance of X-ray diagnostics where more invasive tools are unavailable. Additionally, the sample size, while sufficient for trend analysis, may not reflect wider population diversity and warrants expansion in future studies.

In conclusion, this study demonstrates that conventional X-ray imaging is an effective diagnostic tool for detecting esophageal hernia in patients with iron deficiency anemia, especially in those with unexplained or treatment-resistant forms. The high prevalence of radiologically confirmed hernia among anemic patients underscores the need for routine upper gastrointestinal imaging in diagnostic protocols. These findings should prompt clinicians to consider structural gastrointestinal causes more routinely and to utilise accessible radiological assessments that can directly impact patient management, particularly in resource-constrained healthcare environments.

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