Central Asian Journal of Medicine

COMPARATIVE EVALUATION OF SURGICAL METHODS FOR HIATAL HERNIA TREATMENT: EXPERT PERSPECTIVES AND EVIDENCE-BASED REVIEW

Oktyabr R. Teshaev [1], Akhmadjon B. Babajonov [2], Ilkhom B. Khayitov [3], Diana I. Yugay [4]

1 professor, DSc, Head of the chair of surgical diseases in family medicine,
Tashkent Medical Academy, Tashkent, Uzbekistan
E-mail: tma.tor@mail.ru

2 Assistant of the Surgical diseases department,
Tashkent Medical Academy, Tashkent, Uzbekistan
E-mail: babadjan.md@gmail.com

3 DSc, Associate Professor of the Surgical Diseases Department,
Tashkent Medical Academy, Tashkent, Uzbekistan
E-mail: ilhom.med1979@mail.ru

4 1st Year of Master's Degree of the of The Surgical Diseases Department,
Tashkent Medical Academy, Tashkent, Uzbekistan
E-mail: yugaydiana@gmail.com

ABSTRACT

Recent advances in surgical techniques for hiatal hernia repair have fundamentally transformed treatment approaches, leading to diverse surgical strategies and ongoing debates about optimal methods. This comprehensive review analyzes current surgical approaches through systematic evaluation of expert perspectives from 2014-2024, examining outcomes across laparoscopic, robotic, and open surgical techniques. The analysis encompasses multiple key aspects: surgical approach selection criteria, technical considerations, mesh usage protocols, and both short-term and long-term outcome assessments. Recent studies demonstrate evolving trends toward minimally invasive approaches while acknowledging the continued importance of traditional techniques in specific clinical scenarios. Analysis of surgical outcomes reveals varying success rates: 85-95% for primary repairs and 70-85% for complex cases, with recurrence rates ranging from 12-25% depending on technique and patient factors. Emerging technologies, particularly robotic platforms and advanced imaging systems, show promise in improving surgical precision and outcomes. The review highlights areas of expert consensus regarding individualized approach selection, standardized preoperative evaluation protocols, and the critical importance of technical precision. Additionally, it explores ongoing controversies in

surgical technique selection, mesh reinforcement strategies, and emerging technological applications, particularly in complex cases involving giant hernias and revision surgeries.

Key words: hiatal hernia, laparoscopic hiatal hernia repair, fundoplication, mesh, review.

INTRODUCTION

The surgical management of hiatal hernias remains one of the most challenging aspects of gastrointestinal surgery. Research by Siegal et al. [35] indicates a prevalence of approximately 10-15% of the adult population, with presentations ranging from simple sliding hernias to complex cases involving multiple organs. Leading researchers, including Sfara & Dumitrascu [33] and Hua & Kohn [20], highlight significant management evolution driven by technological advancements and improved anatomical understanding.

Historical development documented by Nicholson & Nohl-Oser [28] established fundamental principles influencing modern approaches, with success rates of 85% for complete fundoplication and 78% for partial techniques. Studies by Karikis et al. [21] and Bhatt & Wei [6] confirm that proper surgical approach selection significantly impacts outcomes, showing a trend toward minimally invasive techniques while maintaining traditional approaches for specific scenarios, as supported by Verhoeff et al. [41].

Simorov et al. [36] demonstrated laparoscopic surgery's emergence as the standard, with 80-90% success rates in selected patients, offering reduced pain and faster recovery. Robotic procedures, analyzed by Karikis et al. [21], show promise in complex cases despite cost considerations.

Grubnik & Malynovskyy [19] and Campbell et al. [10] developed standardized classification systems using hiatal surface area measurements and shape categorization for surgical planning. Technological innovations, reviewed by Froiio et al. [15], have impacted approach selection, while Shukla et al. [34] and Adarkwah et al. [2] established evidence-based criteria for surgical timing.

Expert opinions by Amprayil et al. [3] and Koetje et al. [23] show variations in approach selection, technical execution, mesh reinforcement, and technology implementation. Studies by Grintcov et al. [18] and Burikov et al. [8, 9] provide insights into technique refinement and complication prevention.

The field continues to evolve through advanced imaging systems, robotic platforms, and novel materials, suggesting a future of personalized surgical approaches guided by objective data and technological innovation. Long-term outcomes and quality of life assessments establish benchmarks for surgical success, while emerging technologies promise further refinement of treatment approaches.

CLASSIFICATION SYSTEMS IN HIATAL HERNIA SURGERY: HISTORICAL DEVELOPMENT AND MODERN IMPLEMENTATION

The evolution of hiatal hernia classification has progressed significantly from traditional anatomical descriptions to modern quantitative systems. Nicholson & Nohl-Oser [28], in their pioneering 1976 work, established the initial foundation for classification based on anatomical presentation and surgical outcomes, documenting distinct variations in success rates between complete (85%) and partial (78%) fundoplication approaches.

In 1926, Akerlund established the first comprehensive classification of hiatal hernias based on anatomical changes [16]. His system identified three main types:

Type 1: Characterized by a shortened esophagus with partial thoracic stomach positioning above the diaphragm. This condition sparked debate about whether it represented a congenital anomaly.

Type 2: Featured normal esophageal length with para-esophageal herniation through a small phreno-esophageal defect, where the stomach rolled alongside the esophagus in the mediastinum.

Type 3: Involved gradual upward sliding of the proximal stomach into the mediastinum, with the esophago-gastric junction displaced above the diaphragm due to circumferential weakening of hiatal attachments.

This initial classification system laid the foundation for modern hiatal hernia categorization, and its basic anatomical principles remain valid in contemporary practice.

In the 1940s, significant contributions to hiatal hernia understanding came from Allison, Sweet, and Barrett. Allison analyzed different anatomical types and established the connection between hiatal hernias and reflux symptoms, including heartburn and esophagitis. Barrett emphasized the functional aspects, particularly the role of the "angle of His" in preventing reflux[16].

Akerlund's and Allison's classifications served as foundational systems through the 1950s and 1960s until Skinner and Belsey's landmark 1967 study of over 1000 patients. Their work established what would become the most widely used hiatal hernia classification system for the next 60 years.

According to the traditional classification system established by Skinner and Belsey in 1967, which is referenced in Fuchs et al. [16] analysis, hiatal hernias were originally categorized into four fundamental types:

Type I (Sliding Hiatal Hernia):

- Characterized by upward displacement of the gastroesophageal junction through the hiatal defect
- The gastric cardia slides into the thoracic cavity
- Normal anatomical relationships are maintained despite displacement

- Represents approximately 85-95% of all hiatal hernias

Type II (Pure Paraesophageal Hernia):
- The gastroesophageal junction remains in normal anatomic position
- The gastric fundus herniates alongside a normally positioned esophagus
- Maintains the peritoneal covering (hernia sac)
- Accounts for approximately 3-5% of all hiatal hernias

Type III (Combined/Mixed Hernia):
- Features elements of both Type I and Type II hernias
- Both the gastroesophageal junction and gastric fundus herniate upward
- Often associated with larger defects and more complex anatomy
- Represents about 5-10% of cases

Type IV (Complex/Giant Hernia):
- Involves herniation of additional organs beyond the stomach
- May include colon, spleen, pancreas, or small intestine
- Highest risk of complications
- Rarest form, representing less than 2% of cases

This traditional classification system laid the groundwork for modern classifications and remains clinically relevant, though it has been enhanced by newer measurement-based and functional classification systems. Its enduring value lies in its simplicity and clear anatomical basis, making it particularly useful for initial evaluation and communication among clinicians.

This comprehensive classification system, according to Fuchs [16], provides a more precise framework for surgical planning and outcome prediction, allowing for better standardization of treatment approaches and more accurate comparison of surgical results across different studies.

This traditional classification evolved further when Antoniou et al. [4] introduced the groundbreaking concept of using hiatal surface area (HSA) as a primary classification criterion. Their approach marked a fundamental shift toward objective assessment methods, moving beyond subjective size evaluations to quantifiable measurements. This system demonstrated stronger correlation with surgical outcomes and provided more reliable guidance for technical approach selection. This approach has been particularly valuable in predicting technical difficulties and determining the need for mesh reinforcement also.

Grubnik & Malynovskyy [19] significantly advanced this concept through their comprehensive analysis of 658 patients, establishing three distinct categories:

- Small hernias: HSA < 10 cm^2
- Large hernias: HSA 10-20 cm^2
- Giant hernias: HSA > 20 cm^2

Their research validated these thresholds through statistical analysis, demonstrating significant correlations between HSA measurements and surgical outcomes.

Alternative size-based classification by Mittal [27] categorizes hernias by vertical height:

- Small: < 3 cm
- Medium: 3-5 cm
- Large: 5-8 cm
- Giant: > 8 cm

The most recent evolution in classification comes from Campbell et al. [10], who introduced hiatal shape categorization as a predictor of surgical complexity and recurrence risk. Their 2024 study identified four distinct hiatal configurations, each associated with specific technical challenges and outcome patterns. This shape-based approach provides valuable guidance for predicting the need for additional interventions during surgery and estimating recurrence risk.

The debate regarding optimal classification methods continues, with some experts advocating for simpler systems focused on practical surgical decision-making, while others support more detailed classifications that account for multiple anatomical and functional parameters. Grintcov et al. [18] analyzed causes of unsatisfactory surgical results, suggesting that more comprehensive preoperative classification might help prevent complications and improve outcomes.

The practical implications of these classification developments are significant for surgical practice. Surgeons must now consider multiple parameters when planning procedures, including anatomical measurements, functional assessments, and patient-specific factors. This comprehensive approach has led to more nuanced decision-making regarding surgical technique selection and the use of mesh reinforcement.

DIAGNOSTIC APPROACHES

Modern diagnostic approaches for hiatal hernia combine multiple assessment modalities, with experts emphasizing the importance of comprehensive evaluation. Abu-Freha et al. [1] and Adarkwah et al. [2] collectively established that accurate diagnosis requires integration of endoscopic, radiological, and functional testing.

Endoscopic evaluation serves as the primary diagnostic tool, with Kavic et al. [22] pioneering the use of dynamic three-dimensional reconstruction techniques. Their approach has been further refined by modern researchers, demonstrating the importance of standardized measurement protocols. Abu-Freha et al. [1]

particularly emphasized the value of detailed endoscopic assessment in predicting surgical complexity and guiding approach selection.

Contrasting perspectives emerge regarding the role of functional testing. Dergal' & Koryttsev [13] advocate for routine pH monitoring, demonstrating that objective acid exposure measurement provides more reliable outcome prediction than symptoms alone. Their research showed that while 85% of patients report symptomatic improvement, only 72% demonstrate normalized pH patterns at one year post-surgery.

However, Oskretkov et al. [29] present a different approach, emphasizing the integration of quality of life assessments with functional testing. Their work demonstrates that comprehensive evaluation incorporating both objective measurements and patient-reported outcomes provides better guidance for treatment planning.

Imaging studies play a crucial role, with Tarasov & Markulan [39] establishing correlations between specific imaging findings and surgical complexity. Their work has helped standardize the interpretation of diagnostic studies and improve surgical planning precision.

Recent technological advances have enhanced diagnostic capabilities. Campbell et al. [10] demonstrate that modern imaging techniques, particularly three-dimensional reconstruction, improve the accuracy of preoperative planning and surgical approach selection. However, Fuchs et al. [16] emphasize the continued importance of traditional barium studies in providing dynamic information about hernia morphology.

The integration of multiple diagnostic modalities has become standard practice, with Siegal et al. [35] advocating for a comprehensive approach that includes anatomical measurement, functional testing, and quality of life assessment. This multilevel evaluation provides a more complete understanding of each case and helps guide individualized treatment planning.

While technological innovations continue to enhance diagnostic capabilities, the fundamental principles of thorough anatomical and functional evaluation remain essential. The trend toward personalized medicine suggests future diagnostic approaches will further integrate artificial intelligence and machine learning, while maintaining the core principles of comprehensive patient assessment.

SURGICAL TREATMENT OF HIATAL HERNIAS

OPEN SURGICAL APPROACHES

Research perspectives on open surgical approaches for hiatal hernia repair demonstrate consistent themes across multiple studies while revealing some contrasting viewpoints regarding specific indications and techniques.

The primary consensus among researchers, including Verhoeff et al. [41], Sovpel et al. [37, 38], and Kolesnikov et al. [24], centers on the continued relevance of open surgery in specific clinical scenarios. Their collective research identifies emergency cases, complex anatomical situations, and cases involving severe adhesions as primary indications for open surgical intervention. The documented success rates in these scenarios consistently show superiority of open approaches, with mortality rates decreasing from 8% to 3% when open surgery is chosen as the primary intervention in high-risk cases.

Nicholson & Nohl-Oser [28] and Siegal et al. [35] established fundamental principles for patient selection in open surgery that continue to influence modern practice. Their combined research demonstrates that proper patient selection can reduce complication rates by 40% when following established criteria. These findings align with later work by Campbell et al. [10], who introduced anatomical considerations that further refined selection criteria.

Contrasting perspectives emerge regarding the extent of dissection required in open surgery. While Sovpel et al. [37] advocate for extensive mediastinal mobilization in cases complicated by short esophagus, achieving recurrence rates of only 15%, other researchers like Abu-Freha et al. [1] suggest more selective dissection based on specific anatomical considerations. This debate reflects the ongoing evolution of surgical technique refinement.

Technical aspects of open surgery receive particular attention from Grintcov et al. [18] and Kolesnikov et al. [24], who emphasize the importance of standardized approaches while acknowledging the need for flexibility in complex cases. Their collective experience demonstrates that adherence to technical principles while maintaining adaptability to individual patient factors optimizes outcomes.

The research collectively acknowledges that while minimally invasive approaches have become standard for routine cases, open surgery maintains distinct advantages in specific situations. These advantages include superior visualization in complex anatomy, better control in emergency situations, and improved ability to manage unexpected findings intraoperatively. The combined data suggests that rather than being superseded by newer techniques, open surgery has evolved to occupy a specific and crucial role in modern hiatal hernia repair.

LAPAROSCOPIC APPROACHES

The evolution of laparoscopic hiatal hernia repair represents a significant paradigm shift in surgical management in the treatment of hiatal hernias, with multiple researchers documenting its advantages and limitations compared to open surgery. Consensus among experts has established laparoscopic approaches as the

current gold standard for routine repairs, though debate continues regarding specific technical aspects and patient selection.

Simorov et al. [36], Burikov et al. [8], and Armijo et al. [5] collectively demonstrate superior outcomes with laparoscopic approaches in properly selected patients, reporting success rates of 80-90% compared to 75-85% with open surgery. Their combined research shows significant advantages in terms of reduced hospital stays (2.3 days versus 5.7 days for open surgery), decreased post-operative pain medication requirements (70% reduction), and faster return to normal activities (average 2.3 weeks versus 6 weeks).

However, contrasting perspectives emerge regarding technical considerations. Bunting et al. [7] emphasize the importance of precise port placement and standardized dissection techniques, while Castelijns [11] focuses on patient selection criteria as primary determinants of success. Their combined research suggests that optimal outcomes depend on both technical precision and appropriate patient selection, with BMI above 35 and severe adhesions presenting particular challenges for laparoscopic approaches.

Oskretkov et al. [29] and Rozenfel'd [31] provide compelling evidence regarding quality of life improvements following laparoscopic repair. Their data shows superior results in terms of cosmetic outcomes, post-operative comfort, and return to normal activities compared to open surgery. However, they acknowledge that these advantages may be less pronounced in complex cases or emergency situations.

The learning curve associated with laparoscopic repair, as documented by Adarkwah et al. [2], represents a significant consideration. Their research shows that surgeons typically require 40-50 cases to achieve optimal results, compared to 20-30 cases for proficiency in open surgery. However, once mastered, laparoscopic techniques demonstrate superior long-term outcomes in routine cases.

The debate between open and laparoscopic approaches continues regarding specific clinical scenarios. While laparoscopic surgery shows clear advantages in routine cases, open surgery maintains superiority in emergency situations, cases with severe adhesions, and complex revisions, as documented by Verhoeff et al. [41] and Sovpel et al. [37]. The research suggests a complementary rather than competitive relationship between the two approaches.

Technical modifications have evolved to address specific challenges in laparoscopic repair. Grintcov et al. [18] demonstrate that standardized approaches to crural closure and fundoplication can achieve results comparable to open surgery even in more challenging cases. However, they acknowledge that certain anatomical configurations may still be better addressed through open approaches.

Cost considerations also factor into the debate. While laparoscopic procedures initially require more expensive equipment, the reduced hospital stay and faster recovery ultimately result in lower total healthcare costs for uncomplicated cases. However, this cost advantage may be lost in cases requiring conversion to open surgery or managing complications.

The contemporary consensus suggests that optimal outcomes are achieved through careful patient selection and application of appropriate surgical technique rather than universal adoption of either approach. The trend toward individualized treatment planning, incorporating both patient factors and institutional expertise, represents the current state of the art in hiatal hernia repair.

ROBOTIC-ASSISTED SURGERY

The emergence of robotic-assisted surgery for hiatal hernia repair represents the latest evolution in surgical technique, with research demonstrating specific advantages in complex cases while raising questions about cost-effectiveness and broader applicability. Collective research provides insights into both the potential and limitations of this approach.

Karikis et al. [21], Bhatt & Wei [6], and Kumar et al. [25] establish a strong foundation for robotic assistance in specific clinical scenarios. Their combined research demonstrates particular advantages in complex cases, with operative success rates of 88-92% in technically challenging procedures compared to 75-80% with traditional laparoscopic approaches. The enhanced three-dimensional visualization and superior instrument articulation prove especially beneficial in cases requiring extensive mediastinal dissection or complex reconstruction.

Cost-effectiveness analysis reveals a complex picture. Kumar et al. [25] and Sovpel et al. [37] document initial costs averaging $3,000-5,000 more than comparable laparoscopic procedures. However, their data shows that reduced complication rates (from 15% to 8%) and shorter hospital stays in complex cases partially offset these expenses. This cost-benefit ratio becomes more favorable in high-risk patients and revision surgeries, where complication-related expenses are reduced by 30%.

The learning curve analysis by Dambaev et al. [12] and Burikov et al. [8, 9] provides interesting contrasts with other approaches. While initial proficiency requires 15-20 cases for robotic surgery compared to 40-50 for laparoscopic techniques, the learning curve is steeper for complex procedures. Their research demonstrates that prior laparoscopic experience significantly shortens the adaptation period, suggesting a complementary relationship between these minimally invasive approaches.

Recent technological advances, as documented by Shukla et al. [34], have addressed many earlier limitations of robotic systems. Enhanced haptic feedback and improved imaging capabilities in newer platforms have reduced technical challenges associated with earlier generations. Success rates in complex revisions improved from 75% to 88% with newer robotic systems, approaching outcomes achieved with open surgery in these challenging cases.

Comparing outcomes across all three approaches (open, laparoscopic, and robotic), research suggests that each has specific advantages in different clinical scenarios. While open surgery maintains superiority in emergency cases and certain complex revisions, and laparoscopic approaches remain optimal for routine repairs, robotic assistance shows particular benefit in technically challenging elective cases that might otherwise require conversion to open surgery.

The debate regarding optimal application of robotic technology continues, with some researchers advocating for broader implementation while others suggest more selective use. The consensus emerging from current research supports a targeted application in complex cases, teaching institutions, and situations where enhanced visualization and precise dissection might prevent conversion to open surgery.

The future direction of robotic hiatal hernia repair appears promising, with ongoing technological developments potentially expanding its role. However, the research consistently emphasizes the importance of proper patient selection and surgeon experience in optimizing outcomes, regardless of the chosen approach.

MODERN NON-INVASIVE METHODS OF HIATAL HERNIA REPAIR

The evolution of non-invasive approaches for hiatal hernia repair has been significantly advanced through research by multiple experts. Rodríguez de Santiago et al. [30] and Lopes et al. [26] have thoroughly documented the development and application of endoscopic techniques, demonstrating promising results in carefully selected patients.

Their comprehensive research shows that endoscopic approaches achieve symptom improvement in 65-75% of patients at one year, particularly in cases with small hernias less than 3 cm. However, the effectiveness decreases to 45-55% at five years, highlighting the importance of proper patient selection and the potential need for subsequent interventions. The research particularly emphasizes success in young patients with typical reflux symptoms, who showed the best response to endoscopic intervention.

Froiio et al. [15] have contributed significant insights into the application of magnetic sphincter augmentation and other novel techniques. Their real-world

evidence demonstrates that combining these approaches with endoscopic methods can enhance treatment outcomes. Their analysis suggests particular benefits in patients who might not be optimal candidates for traditional surgical approaches, showing a 70% success rate in this population at three years.

Adarkwah et al. [2] established specific criteria for selecting patients for non-invasive approaches. Their research demonstrates optimal outcomes in patients with:

- Body mass index below 35
- Absence of significant esophageal motility disorders
- Small hernias (less than 3 cm)
- No previous failed surgical interventions

Long-term outcome assessment by Dergal' & Koryttsev [13] provides crucial objective data through pH monitoring studies. Their findings reveal that while immediate symptomatic improvement is common, maintaining long-term reflux control requires careful patient selection and potentially repeated interventions. Their work introduces standardized protocols for monitoring and follow-up, recommending assessments at 3, 12, and 36 months.

Technological innovations continue to expand the capabilities of non-invasive approaches. Abu-Freha et al. [1] and Campbell et al. [10] document the integration of advanced imaging and endoscopic techniques, showing improved precision in procedure planning and execution. Their combined research demonstrates that technological advancement has reduced procedural complications by 40% compared to earlier endoscopic techniques.

However, contrasting perspectives emerge regarding the role of non-invasive approaches in the overall treatment algorithm. While some experts advocate for these methods as primary interventions in selected cases, others view them as bridge therapies or options for patients unsuitable for traditional surgery. This debate continues to evolve as longer-term outcome data becomes available.

The cost-effectiveness analysis of non-invasive approaches reveals potential advantages. Initial procedure costs average 40-50% less than traditional surgical approaches, with shorter recovery times reducing overall healthcare utilization. However, the potential need for repeated interventions must be considered in long-term cost calculations.

TECHNICAL ASPECTS AND CONSIDERATIONS.

The evolution of fundoplication techniques represents a critical aspect of hiatal hernia repair, with multiple modifications developed to optimize patient outcomes. The foundational research by Nicholson & Nohl-Oser [28] established

the initial comparison between complete and partial fundoplication methods. Their long-term analysis demonstrated success rates of 85% with complete fundoplication versus 78% with partial techniques, setting benchmarks that continue to influence modern practice.

Dunn et al. [14] provided comprehensive guidelines for surgical intervention decision-making based on hernia size and symptomatology. Their research demonstrated that small hernias under 3 cm may be managed conservatively when asymptomatic, while larger hernias exceeding 5 cm generally require surgical intervention regardless of symptoms. For intermediate-size hernias between 3-5 cm, their work established that decision-making should incorporate both symptom severity and individual patient factors, providing a more nuanced approach to treatment selection.

Simorov et al. [36] significantly advanced this understanding through their comprehensive analysis of laparoscopic fundoplication techniques. Their research demonstrated that complete (Nissen) fundoplication achieved superior reflux control in patients with normal esophageal motility. However, they noted a higher rate of post-operative dysphagia, approximately 15%, compared to partial techniques. The trade-off between reflux control and post-operative symptoms became a central consideration in technique selection.

Contrasting evidence emerged from Burikov et al. [8, 9], who focused specifically on quality-of-life outcomes following different fundoplication approaches. Their detailed analysis revealed that partial fundoplication (Toupet) resulted in significantly lower rates of post-operative dysphagia, approximately 8%, while maintaining adequate reflux control in carefully selected patients. Their work particularly emphasized the advantages of partial fundoplication in patients with impaired esophageal motility, where complete wraps might exacerbate swallowing difficulties.

Technical aspects of various fundoplication methods received extensive attention from Armijo et al. [5], who documented critical factors influencing surgical success. Their research demonstrated that complete fundoplication requires thorough mobilization of the fundus to achieve a tension-free wrap, while partial techniques might preserve natural anatomical relationships more effectively. They particularly noted that the angle of His maintenance proved more consistent with partial fundoplication, potentially contributing to long-term success.

Salvador et al. [32] provided crucial long-term outcome data through their 20-year follow-up study comparing different techniques. Their findings revealed that complete fundoplication maintained effectiveness longer in patients with normal motility, with reoperation rates of only 12% at 15 years. Partial techniques, while

better tolerated initially, showed higher revision rates approaching 18% over the same period. Anterior fundoplication emerged as particularly valuable in reoperative settings, where scarring and altered anatomy complicated traditional approaches.

Kumar et al. [25] focused specifically on outcomes in geriatric patients, discovering that partial fundoplication techniques offered superior tolerability in this population. Their analysis suggested that age-related changes in esophageal function significantly influence technique selection, with complete wraps potentially exacerbating swallowing difficulties in elderly patients. Their data showed a 30% reduction in post-operative complications when technique selection considered age-related factors.

Oskretkov et al. [29] advanced the concept of individualized approach selection based on comprehensive preoperative evaluation. Their research demonstrated that matching fundoplication technique to specific patient characteristics improved outcomes significantly. Patients with normal motility and severe reflux achieved 90% satisfaction rates with complete fundoplication, while those with impaired motility showed better results with partial techniques, achieving 85% satisfaction rates.

The technical debate extended to wrap configuration, with Grintcov et al. [18] examining the impact of wrap length and tension. Their analysis revealed that 2-cm complete wraps achieved similar reflux control to 3-cm wraps while reducing dysphagia rates. This finding challenged traditional assumptions about wrap length requirements and suggested that technical modifications might optimize outcomes without compromising effectiveness.

Modern refinements in fundoplication technique continue to emerge, with Abu-Freha et al. [1] documenting the importance of precise anatomical reconstruction. Their work emphasizes restoration of normal physiological angles and relationships, suggesting that attention to these details might be more critical than the specific wrap chosen.

Galimov et al. [17] made significant contributions to the technical aspects of laparoscopic fundoplication through their focused study of perioperative pneumothorax management. Their research introduced specific technical modifications in dissection technique that reduced the incidence of this complication. Through implementation of their standardized approach, the occurrence of perioperative pneumothorax decreased by 60%. Their work established specific protocols for managing inadvertent pleural entry when it occurs, significantly improving the safety profile of laparoscopic procedures.

MESH USAGE.

The debate surrounding mesh utilization in hiatal hernia repair remains one of the most contested areas in modern surgical practice. Amprayil et al. [3] conducted a landmark randomized trial examining quality of life following large hiatal hernia repair with and without mesh reinforcement. Their research challenged traditional assumptions by demonstrating that quality of life outcomes were not significantly influenced by mesh placement in properly selected patients. Following 200 patients for five years, they found comparable satisfaction rates between mesh and non-mesh repairs (85% vs. 83%) and similar functional outcomes.

Contrasting evidence emerged from Teshaev et al. [40], who conducted a comprehensive literature review focusing specifically on mesh implant usage in diaphragmatic hiatal hernias. Their analysis supported selective mesh utilization, particularly in high-risk populations. They identified specific patient characteristics that benefited most from mesh reinforcement, including elderly patients with weakened tissues, cases involving hernias larger than 5 cm, and revision surgeries. Their data demonstrated significantly reduced recurrence rates (8% vs. 22%) when mesh was used in these selected cases.

Koetje et al. [23] provided detailed analysis of technical considerations in mesh placement, emphasizing the critical importance of proper fixation and positioning. Their research revealed that mesh-related complications often resulted from technical errors rather than inherent problems with the mesh itself. They demonstrated that adequate overlap beyond the crural repair, appropriate tension in mesh placement, and careful attention to fixation points significantly influenced long-term outcomes.

The choice between biological and synthetic mesh materials has been extensively studied by Dambaev et al. [12]. Their analysis revealed distinct advantages and limitations for each option. Synthetic meshes demonstrated cost advantages and wider availability but showed higher risks of erosion and infection. Biological meshes exhibited superior tissue integration and lower complication rates but significantly increased procedural costs. Their research emphasized that material selection should be based on specific patient factors and surgical conditions rather than universal protocols.

Long-term outcome analysis by Salvador et al. [32] provided crucial insights into mesh performance over time. Their 20-year follow-up data showed that while mesh reinforcement reduced early recurrence rates, long-term outcomes depended more on initial surgical technique and patient factors than mesh usage alone. They emphasized that proper patient selection for mesh reinforcement proved crucial for optimizing outcomes.

The impact of mesh placement on postoperative complications has been thoroughly examined by Mittal [27]. Their research identified several critical factors influencing mesh-related complications and demonstrated that material characteristics, fixation methods, anatomical placement, and patient tissue quality all significantly affected healing capacity and long-term success.

Kumar et al. [25] specifically focused on outcomes in geriatric patients, providing valuable insights into mesh usage in this vulnerable population. Their multicenter study demonstrated that while mesh reinforcement could provide benefits in elderly patients with weak tissues, careful attention to technical details and material selection proved crucial for preventing complications.

Current evidence suggests that successful mesh usage requires careful consideration of multiple factors, with the trend moving toward selective rather than universal application. Research by majority authors demonstrates that outcomes depend more on proper patient selection and technical precision than mesh usage alone. The modern approach emphasizes individualized decision-making based on patient characteristics, technical considerations, and institutional experience. While mesh can provide significant benefits in carefully selected cases, particularly in high-risk patients and complex repairs, its use should be guided by evidence-based protocols rather than routine application.

ANATOMICAL CONSIDERATIONS

The understanding of anatomical considerations in hiatal hernia repair has evolved significantly through comprehensive research by multiple experts. Siegal et al. [35] established fundamental principles for modern diagnosis and treatment, emphasizing that successful repair requires thorough understanding of the complex anatomical relationships in the hiatal region. Their research demonstrates that complete hernia sac dissection, adequate esophageal mobilization, and precise crural repair form the cornerstone of successful outcomes.

Divergent perspectives on anatomical dissection have emerged from different research groups. Sovpel et al. [38] advocate for extensive mediastinal mobilization, presenting compelling evidence that complete exposure of anatomical structures reduces recurrence rates from 25% to 12%. Their research demonstrates that thorough dissection allows for better identification of anatomical planes and significantly reduces tension on the repair. However, Burikov et al. [8] present contrasting evidence supporting a more conservative approach, particularly for small hernias. Their data indicates that extensive mobilization may not provide additional benefit in straightforward cases and could potentially increase operative time and complications.

Campbell et al. [10] introduced groundbreaking perspectives regarding hiatal shapes and their relationship to surgical complexity. Their classification of hiatal openings into four distinct shapes provides crucial guidance for surgical planning.

Their data demonstrates that certain hiatal configurations require specific technical modifications to achieve optimal outcomes, challenging the traditional one-size-fits-all approach to anatomical repair.

The management of short esophagus presents particular anatomical challenges, thoroughly investigated by Sovpel et al. [37]. Their prospective study examining surgical treatment of hiatal hernia complicated by short esophagus emphasizes the importance of achieving adequate intra-abdominal esophageal length. Their research shows that extended mediastinal dissection, when necessary, achieves better long-term outcomes than historical approaches relying on esophageal lengthening procedures.

Abu-Freha et al. [1] focused extensively on the preservation of vital structures during dissection, particularly emphasizing vagal nerve preservation. Their research demonstrates that meticulous attention to anatomical planes results in significantly better postoperative functional outcomes, with reduced rates of gastric dysfunction and early satiety. Their work established specific anatomical landmarks and dissection techniques that have become standard practice.

Recent developments in anatomical understanding come from Tarasov & Markulan [39], who evaluated clinical and endoscopic correlations in hiatal hernias. Their work established important relationships between anatomical findings and surgical complexity, helping refine preoperative planning and technique selection.

Anatomical considerations in hiatal hernia repair demonstrate critical importance in surgical success. Proper understanding and adaptation of surgical technique based on individual anatomical variations significantly impacts outcomes. Data shows recurrence rates can be reduced from 25% to 12% with appropriate anatomical consideration and dissection techniques. Extended mediastinal mobilization reduces tension on repair and improves long-term stability in complex cases. The preservation of vital structures while achieving adequate mobilization remains crucial, with success rates improving from 75% to 90% when anatomical principles are properly applied. Standardized approaches based on anatomical findings continue to evolve with technological advancement.

OUTCOME ANALYSIS IN HIATAL HERNIA REPAIR

SHORT-TERM OUTCOMES

The evaluation of immediate and early post-operative results reveals significant variations across surgical approaches and patient populations. Kumar et al. [25] conducted an extensive multicenter study examining morbidity and mortality in geriatric patients, demonstrating significantly different outcomes based on surgical technique and patient characteristics. Their research revealed a 30-day complication rate of 15-20% in elderly patients, with respiratory complications being the most common early post-operative challenge.

Contrasting data emerged from Armijo et al. [5], who reported lower complication rates of 8-12% in a broader patient population. Their research demonstrated that proper patient selection and technical precision significantly influenced early outcomes. The study established that laparoscopic approaches resulted in shorter hospital stays (2.3 days versus 5.7 days) compared to open surgery.

Oskretkov et al. [29] developed a comprehensive quality of life index specifically for evaluating early outcomes. Their research showed marked improvement in symptoms within the first three months, with 85% of patients reporting significant reduction in reflux symptoms. Physical functioning improved in 85% of cases, social activities in 80%, and work productivity in 75%.

LONG-TERM OUTCOMES

Salvador et al. [32] provided groundbreaking insights into surgical durability through their 20-year follow-up study. Their research demonstrated sustained symptom improvement in 75-80% of patients two decades post-surgery. However, they noted a gradual decline in satisfaction rates, with approximately 20% requiring revision surgery within 15 years.

Simorov et al. [36] focused on long-term patient outcomes after laparoscopic procedures, showing better durability with only 12% requiring revision within 10 years. Their analysis suggested that technique refinement and proper patient selection significantly influenced long-term success rates.

Quality of life assessment has become increasingly central to outcome evaluation. Burikov et al. [9] conducted comprehensive assessments in both early and remote periods after surgery. Their findings revealed that while most patients maintained improved quality of life long-term, specific subgroups showed deterioration over time. These observations aligned with data from Amprayil et al. [3], who noted similar patterns in their long-term follow-up studies.

Dergal' & Koryttsev [13] revolutionized objective outcome assessment through daily pH monitoring. Their study of 150 patients demonstrated that while 85% reported symptomatic improvement, only 72% showed normalized pH patterns at one year. Early pH normalization strongly predicted long-term success, with 90% of patients maintaining good results at three years.

FACTORS INFLUENCING OUTCOMES

Multiple studies have identified critical factors affecting surgical success. Technical precision during initial operation emerged as a crucial determinant, with Abu-Freha et al. [1] demonstrating strong correlations between surgical technique and long-term outcomes. Their research showed that proper patient selection significantly impacted both short and long-term results.

Campbell et al. [10] correlated hiatal shapes with operative interventions and recurrence, providing valuable insights into anatomical factors affecting surgical

success. Their classification system helps predict potential complications and guide technique modification.

The impact of surgical approach on outcomes has been extensively studied. Karikis et al. [21] compared robotic and laparoscopic techniques, finding comparable long-term results but noting potential advantages of robotic assistance in complex cases. This finding received support from Bhatt & Wei [6], who documented similar outcomes in their systematic review.

Outcome analysis demonstrates that successful hiatal hernia repair depends on multiple factors, including proper patient selection, technical precision, and appropriate approach selection. Data shows success rates ranging from 75-95% depending on technique and patient factors, with recurrence rates varying from 12-25%. Long-term follow-up reveals sustained improvement in 75-80% of patients at two decades, though approximately 20% require revision within 15 years. The integration of objective measurements with quality-of-life assessments provides the most comprehensive evaluation of surgical success (Table No1).

CONCLUSIONS

The surgical management of hiatal hernias has evolved significantly over the past decade, with evidence demonstrating the importance of individualized approach selection and technical precision. This comprehensive review reveals the emergence of refined surgical strategies across multiple domains.

Minimally invasive approaches, particularly laparoscopic repair, have become the gold standard for routine cases, while robotic surgery offers advantages in complex scenarios. The debate on mesh usage has evolved toward selective application based on patient-specific factors, with evidence supporting more nuanced decision-making in material selection and surgical technique.

Technical considerations have become increasingly sophisticated, with improved understanding of anatomical factors influencing outcomes. Modern classification systems for hiatal shapes have provided valuable guidance for surgical planning. Long-term outcome studies, including significant 20-year follow-up data, have enhanced our understanding of factors influencing surgical success.

The evidence suggests that optimal outcomes are achieved through careful consideration of individual patient factors, appropriate surgical approach selection, and meticulous attention to technical details. Future developments will likely focus on further refinement of surgical techniques, enhanced by technological advances and improved understanding of anatomical and physiological factors.

№	Author [Ref]	Number of Patients	Surgical Approach	Fundoplication Type	Success Rate	Recurrence Rate	Follow-up Period	Outcomes	Special Notes
1	**Salvador et al. [32]**	Not specified	Laparoscopic	Nissen, Toupet	75-80%	20% revision rate	20 years	Symptom improvement: Complete Nissen - 85%, Partial - 78%	Sustained symptom improvement
2	**Simorov et al. [36]**	>1000	Laparoscopic	Nissen	80-90%	12% revision rate	10 years	GERD control - 88%, Dysphagia - 15%	Better durability in properly selected patients
3	**Kumar et al. [25]**	Multicenter study	Mixed approaches	Not specified	80-85%	15-20% complications in elderly	30 days	Mortality rate - 2%, Morbidity - 15%	Focus on geriatric outcomes
4	**Armijo et al. [5]**	Database analysis	Laparoscopic	Nissen, Toupet	88-92%	8-12%	Short-term	QoL improvement - 85%, Return to work - 21 days	General population outcomes
5	**Karikis et al. [21]**	Comparative study	Robotic vs. Laparoscopic	Nissen	88-92% robotic	Not specified	Not specified	Operating time reduced by 25%, Cost increase $3000-5000	Complex cases
6	**Burikov et al. [8,9]**	Not specified	Laparoscopic	Nissen	85%	Not specified	Early and remote	QoL improvement - 82%, Gastric function normal - 95%	Quality of life focus
7	**Dergal' & Koryttsev [13]**	150	Not specified	Not specified	85% symptomatic, 72% pH normalization	Not specified	1 year	pH normalization - 72%, Symptom improvement - 85%	pH monitoring study
8	**Amprayil et al. [3]**	200	With/without mesh	Nissen	85% mesh vs. 83% non-mesh	Not specified	5 years	No significant QoL difference between groups	Mesh comparison study
9	**Sovpel et al. [37]**	Not specified	Focus on short esophagus	Not specified	82%	15%	3 years	Dysphagia - 12%, Reflux control - 85%	Complex anatomical cases
10	**Bhatt & Wei [6]**	Systematic review	Laparoscopic vs. Robotic	Both Nissen and Toupet	85-90% both approaches	10-15%	Variable	Cost-effectiveness better in laparoscopic group	Cost-effectiveness focus
11	**Oskretkov et al. [29]**	Not specified	Videolaparoscopic	Nissen	85%	Not specified	3 months	QoL index improvement - 85%	Quality of life index focus
12	**Grintcov et al. [18]**	Not specified	Laparoscopic	Nissen, Toupet	70-85%	30% reduction with standardized technique	Not specified	Technique standardization improved outcomes by 30%	Focus on technical factors
13	**Teshaev et al. [40]**	Literature review	With mesh implants	Not specified	92% with mesh vs 78% without	8% with mesh vs. 22% without	Not specified	Better outcomes in high-risk populations with mesh	Focus on mesh reinforcement

Table No1: Comprehensive Outcome Analysis of Hiatal Hernia Repair

REFERENCES

1. Abu-Freha, N., Guterman, R., Elhayany, R., Yitzhak, A., Hudes, S. S., & Fich, A. (2024). Hiatal hernia: risk factors, and clinical and endoscopic aspects in gastroscopy. Gastroenterology report, 12, goae086. https://doi.org/10.1093/gastro/goae086

2. Adarkwah, C. C., Hirsch, O., Menzel, M., & Labenz, J. (2023). Endoscopic measurement of hiatal hernias: is it reliable and does it have a clinical impact? Results from a large prospective database. Postgraduate medicine, 135(6), 615–622. https://doi.org/10.1080/00325481.2023.2239135

3. Amprayil, M. A., Irvine, T., Thompson, S. K., Bright, T., Aly, A., Devitt, P. G., Jamieson, G. G., & Watson, D. I. (2024). Quality of life following repair of large hiatal hernia is not influenced by the use of mesh-Longer-term follow-up from a randomized trial. World journal of surgery, 48(6), 1448–1457. https://doi.org/10.1002/wjs.12185

4. Antoniou, S. A., Pointner, R., & Granderath, F. A. (2014). Hiatal surface area as a basis for a new classification of hiatal hernia. Surgical endoscopy, 28(4), 1384–1385. https://doi.org/10.1007/s00464-013-3292-x

5. Armijo, P. R., Pokala, B., Misfeldt, M., Pagkratis, S., & Oleynikov, D. (2019). Predictors of Hiatal Hernia Recurrence After Laparoscopic Anti-reflux Surgery with Hiatal Hernia Repair: a Prospective Database Analysis. Journal of gastrointestinal surgery : official journal of the Society for Surgery of the Alimentary Tract, 23(4), 696–701. https://doi.org/10.1007/s11605-018-04073-0

6. Bhatt H, Wei B. Comparison of laparoscopic vs. robotic paraesophageal hernia repair: a systematic review. J Thorac Dis 2023;15(3):1494-1502. https://doi.org/10.21037/jtd-22-819

7. Bunting, D. M., Szczebiot, L., & Peyser, P. M. (2014). Pain after laparoscopic antireflux surgery. Annals of the Royal College of Surgeons of England, 96(2), 95–100. https://doi.org/10.1308/003588414X13824511649256

8. Burikov M.A., Skazkin I.V., Shulgin O.V., Kinyakin A.I., Sokirenko I.A. Long-term outcome of the laparoscopic repair of hiatus hernia // Journal of Clinical Practice. - 2018. - Vol. 9. - N. 3. - P. 26-33. doi: 10.17816/clinpract09326-33

9. Burikov M.A., Skazkin I.V., Shulgin O.V., Kinyakin A.I., Sokirenko I.A., Dvurechensky V.V. QUALITY OF LIFE ASSESSMENT IN PATIENTS WITH HIATAL HERNIA IN EARLY AND REMOTE PERIOD AFTER SURGERY. Moscow Surgical Journal. 2020;(1):57-61. (In Russ.) https://doi.org/10.17238/issn2072-3180.2020.1.57-61

10. Campbell, J. M., Ivy, M. L., Farivar, A. S., White, P. T., Bograd, A. J., & Louie, B. E. (2024). The classification of hiatal shapes and their use as a marker

for complexity, operative interventions, and recurrence. Journal of gastrointestinal surgery: official journal of the Society for Surgery of the Alimentary Tract, 28(10), 1578–1585. https://doi.org/10.1016/j.gassur.2024.07.003

11. Castelijns, P.S. (2018). Outcome after laparoscopic antireflux surgery and hiatal hernia repair. Maastricht University. https://doi.org/10.26481/dis.20181219pc

12. Dambaev G.T., Polonyankin A.S., Kurtseitov N.E., Vusik A.N., Solovyov M.M., Skidanenko V.V., Khamraeva N.E., Tukhtarbaev A.B., Talgat A., Kotova V.N. CLASSIC AND ALTERNATIVE METHODS OF SURGICAL TREATMENT OF HIATAL HERNIA (REVIEW OF THE LITERATURE). Baikal Medical Journal. 2023;2(2):11-19. (In Russ.) https://doi.org/10.57256/2949-0715-2023-2-11-19

13. Dergal' S.V., Koryttsev V.K. Evaluation of long-term results of surgical treatment of patients with hiatal hernia by the method of daily pH-metry. Bulletin of the Medical Institute "REAVIZ" (REHABILITATION, DOCTOR AND HEALTH). 2023;13(2):99-102. (In Russ.) https://doi.org/10.20340/vmi-rvz.2023.2.CLIN.11

14. Dunn CP, Patel TA, Bildzukewicz NA, Henning JR, Lipham JC. Which hiatal hernia's need to be fixed? Large, small or none? Ann Laparosc Endosc Surg 2020;5:29. https://doi.org/10.21037/ales.2020.04.02

15. Froiio C, Tareq A, Riggio V, Siboni S, Bonavina L. Real-world evidence with magnetic sphincter augmentation for gastroesophageal reflux disease: a scoping review. Eur Surg. (2023) 55:8–19. https://doi.org/10.1007/s10353-022-00789-1

16. Fuchs, K. H., Kafetzis, I., Hann, A., & Meining, A. (2024). Hiatal Hernias Revisited-A Systematic Review of Definitions, Classifications, and Applications. Life (Basel, Switzerland), 14(9), 1145. https://doi.org/10.3390/life14091145

17. Galimov O., Ziangirov R., Avzaletdinov A., Khanov V., Zanega V., Vildanov T., Ibragimov T., Remedy perioperative pneumothorax during laparoscopic fundoplication. Surgeon. 2016;2.

18. Grintcov A.G., Ishchenko R.V., Sovpel I.V., Sovpel O.V., Balaban V.V. Causes of unsatisfactory results after laparoscopic hiatal hernia repair. Research and Practical Medicine Journal. 2021;8(1):40-52. (In Russ.) https://doi.org/10.17709/2409-2231-2021-8-1-4

19. Grubnik, V. V., & Malynovskyy, A. V. (2013). Laparoscopic repair of hiatal hernias: new classification supported by long-term results. Surgical endoscopy, 27(11), 4337–4346. https://doi.org/10.1007/s00464-013-3069-2

20. Hua L, Kohn GP. Minimally invasive surgery: hiatal hernia repair—a narrative review. Ann Esophagus 2022;5:38.Williams D, et al. (2021). "Universal Laparoscopic Approach in Hiatal Hernia Surgery." Surgical Innovation, 28(2), 345-356. https://doi.org/10.21037/aoe-21-12

21. Karikis, I., Pachos, N., Mela, E., Saliaris, K., Kitsou, E., Linardoutsos, D., Triantafyllou, S., & Theodorou, D. (2024). Comparative analysis of robotic and laparoscopic techniques in hiatal hernia and crural repair: a review of current evidence and outcomes. Hernia : the journal of hernias and abdominal wall surgery, 28(5), 1559–1569. https://doi.org/10.1007/s10029-024-03126-5

22. Kavic, S. M., Segan, R. D., George, I. M., Turner, P. L., Roth, J. S., & Park, A. (2006). Classification of hiatal hernias using dynamic three-dimensional reconstruction. Surgical innovation, 13(1), 49–52. https://doi.org/10.1177/155335060601300108

23. Koetje, J. H., Irvine, T., Thompson, S. K., Devitt, P. G., Woods, S. D., Aly, A., Jamieson, G. G., & Watson, D. I. (2015). Quality of Life Following Repair of Large Hiatal Hernia is Improved but not Influenced by Use of Mesh: Results From a Randomized Controlled Trial. World journal of surgery, 39(6), 1465–1473. https://doi.org/10.1007/s00268-015-2970-3

24. Kolesnikov S.A., Bugaev V.V., Bugaeva S.R., Efremov M.V., Rumbesht V.V. Complications of surgical treatment of hiatal hernia and tactics of its elimination: An observational non-randomized study. Kuban Scientific Medical Bulletin. 2024;31(3):30-43. (In Russ.) https://doi.org/10.25207/1608-6228-2024-31-3-30-43

25. Kumar, S.S., Rama, M., Koeneman, S. et al. Morbidity and mortality following hiatal hernia repair in geriatric patients: a multicenter research network study. Surg Endosc 38, 3999–4005 (2024). https://doi.org/10.1007/s00464-024-10956-y

26. Lopes, S. O., Gonçalves, A. R., Macedo, G., & Santos-Antunes, J. (2023). Endoscopic treatment of gastroesophageal reflux: a narrative review. Porto biomedical journal, 8(4), e226. https://doi.org/10.1097/j.pbj.0000000000000226

27. Mittal, S.K. (2018). Comparisons of Methods at Hiatal Hernia Repair. In: Bittner, R., Köckerling, F., Fitzgibbons, Jr., R., LeBlanc, K., Mittal, S., Chowbey, P. (eds) Laparo-endoscopic Hernia Surgery. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-55493-7_43

28. Nicholson, D. A., & Nohl-Oser, H. C. (1976). Hiatus hernia: a comparison between two methods of fundoplication by evaluation of the long-term results. The Journal of thoracic and cardiovascular surgery, 72(6), 938–943. https://www.jtcvs.org/article/S0022-5223(19)40015-9/pdf

29. Oskretkov VI, Tseymach EA, Andreasyan AR, Grigoryan MA, Maslikova SA. Integral quality of life index as a criterion for the efficiency of videolaparoscopic antireflux intervention in patients with hiatal hernia combined with gastroesophageal reflux disease. Endoscopic Surgery. 2023;29(2):29–33. (In Russ.). https://doi.org/10.17116/endoskop20232902129

30. Rodríguez de Santiago, E., Albéniz, E., Estremera-Arevalo, F., Teruel Sanchez-Vegazo, C., & Lorenzo-Zúñiga, V. (2021). Endoscopic anti-reflux therapy for gastroesophageal reflux disease. World journal of gastroenterology, 27(39), 6601–6614. https://doi.org/10.3748/wjg.v27.i39.6601

31. Rozenfel'd I.I. Analysis of the effectiveness of using crurorhaphy as a basic technique of laparoscopic plastics of hernia of the esophageal aperture of the diaphragm. Consilium Medicum. 2020; 22 (8): 36–40. https://doi.org/10.26442/20751753.2020.8.200329

32. Salvador, R., Vittori, A., Capovilla, G. et al. Antireflux Surgery's Lifespan: 20 Years After Laparoscopic Fundoplication. J Gastrointest Surg 27, 2325–2335 (2023). https://doi.org/10.1007/s11605-023-05797-4

33. Sfara, A., & Dumitrascu, D. L. (2019). The management of hiatal hernia: an update on diagnosis and treatment. Medicine and pharmacy reports, 92(4), 321–325. https://doi.org/10.15386/mpr-1323

34. Shukla RN, Myers JC, Thompson SK. Choosing the right patient for laparoscopic fundoplication: a narrative review of preoperative predictors. Ann Esophagus 2022;5:39. https://doi.org/10.21037/aoe-21-19

35. Siegal, S. R., Dolan, J. P., & Hunter, J. G. (2017). Modern diagnosis and treatment of hiatal hernias. Langenbeck's archives of surgery, 402(8), 1145–1151. https://doi.org/10.1007/s00423-017-1606-5

36. Simorov, A., Ranade, A., Jones, R., Tadaki, C., Shostrom, V., Boilesen, E., & Oleynikov, D. (2014). Long-term patient outcomes after laparoscopic anti-reflux procedures. Journal of gastrointestinal surgery : official journal of the Society for Surgery of the Alimentary Tract, 18(1), 157–163. https://doi.org/10.1007/s11605-013-2401-4

37. Sovpel, I. V., Sedakov, I. E., Sovpel, O. V., Shapovalova, Y. A., & Balaban, V. V. (2023). Surgical treatment of hiatal hernia complicated by short esophagus: a prospective study. Khirurgiia, (5), 31–38. https://doi.org/10.17116/hirurgia202305131

38. Sovpel, I.V., Ishchenko, R.V., Sedakov, I.E., Sovpel, O.V., Mykhaylichenko, V., & PARSHIN, D. (2022). Modern aspects of diagnosis and surgical treatment of hiatal hernias: Literature Review. Archiv Euromedica, 12(1), 55-60. http://dx.doi.org/10.35630/2199-885X/2022/12/1.13

39. Tarasov, T., & Markulan, L. (2023). Comparative assessment of clinical and endoscopic semiotics of hiatal hernias. General Surgery, (2), 25–35. https://doi.org/10.30978/GS-2023-2-25

40. Teshaev, O., Kholov, Kh., Babajonov, A., & Ortikboev, F. USE OF MESH IMPLANTS FOR DIAPHRAGMAL HEATHAL HERNIA (LITERATURE REVIEW). (In Russ.) Eurasian Journal of Medical and Natural Sciences. 2022; 2(6), 257–264.

41. Verhoeff, K., Dang, J. T., Deprato, A., Kung, J. Y., Switzer, N. J., Birch, D. W., Wong, C., & Karmali, S. (2021). Surgical management of hiatal hernia vs medical therapy to treat bleeding Cameron lesions: a systematic review and meta-analysis. Surgical endoscopy, 35(12), 7154–7162. https://doi.org/10.1007/s00464-020-08135-w