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Robotic versus Laparoscopic Surgery in Upper Gastrointestinal Procedures: A Narrative Review of Recent Literature

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Rezumat

Chirurgie robotică versus laparoscopică în procedurile tractului gastrointestinal superior: review de literatură

Introducere: Chirurgia asistată robotic oferă avantaje teoretice față de laparoscopie în procedurile tractului gastrointestinal superior, precum vizualizare tridimensională, dexteritate îmbunătățită şi ergonomie superioară. Cu toate acestea, impactul său clinic rămâne dezbătut, având în vedere durata operatorie mai lungă şi costurile mai ridicate.
Metode: Am realizat un review narativ de literatură prin interogarea bazelor de date PubMed/MEDLINE, Embase, Cochrane Library şi Web of Science pentru studii publicate între ianuarie 2020 şi august 2025 care compară chirurgia robotică cu chirurgia laparoscopică sau deschisă pentru patologia gastroesofagiană. Studiile au fost incluse dacă raportau rezultate perioperatorii, oncologice sau pe termen lung la pacienți cu cancer gastric, cancer esofagian, boală de reflux gastroesofagian sau hernie hiatală. Au fost incluse şaisprezece studii, cuprinzând 3 studii randomizate controlate, 6 meta-analize şi 7 studii observaționale.
Rezultate: Pentru cancerul gastric, gastrectomia robotică a asociat pierderi sanguine reduse, rate mai scăzute de conversie, o prelevare ganglionară îmbunătățită şi o scădere a complicațiilor în meta-analize ce au inclus peste 68.755 de pacienți, cu rezultate oncologice comparabile. Prin utilizarea laparoscopiei tridimensionale s-au obținut rezultate similare în mai multe domenii. În cazul esofagectomiei, abordurile robotice au evidențiat reduceri semnificative ale complicațiilor pulmonare, ale morbidității globale şi o îmbunătățire a calității vieții comparativ cu chirurgia minim invazivă convențională şi cea deschisă, cu rate mai ridicate de rezecție R0. Pentru chirurgia funcțională a esofagului, miotomia Heller robotică a demonstrat mai puține perforații şi reintervenții, în timp ce fundoplicatura şi cura herniei hiatale au prezentat rezultate echivalente. Toate procedurile robotice au avut durate operatorii mai lungi.
Concluzii: Chirurgia robotică oferă beneficii perioperatorii cuantificabile în procedurile tractului gastrointestinal superior, cele mai evidente pentru esofagectomie. În cancerul gastric, avantajele chirurgiei robotice susțin o utilizare selectivă, deşi laparoscopia tridimensională reduce diferența.

Beneficiile în chirurgia gastroesofagiană sunt dependente de tipul procedurii. Laparoscopia rămâne standardul datorită eficacității, accesibilității şi costului. Sunt necesare studii randomizate suplimentare, cu urmărire pe termen lung şi analize de cost-eficiență.

Cuvinte cheie: proceduri chirurgicale robotice, laparoscopie, gastrectomie, esofagectomie, proceduri chirurgicale minim invazive, tract gastrointestinal superior

Abstract

Introduction: Robotic-assisted surgery overs theoretical advantages over laparoscopy for upper gastrointestinal (UGI) procedures including three-dimensional visualization, enhanced dexterity, and improved ergonomics. However, its clinical impact remains debated given longer operative times and higher costs.
Methods: We conducted a narrative review searching PubMed/MEDLINE, Embase, Cochrane Library, and Web of Science for studies published between January 2020 and August 2025 comparing robotic versus laparoscopic or open surgery for gastroesophageal pathologies. Studies were included if they reported perioperative, oncological, or long-term outcomes in patients with gastric cancer, esophageal cancer, gastroesophageal reflux disease, or hiatal hernia. Sixteen studies were included comprising 3 randomized controlled trials, 6 meta-analyses, and 7 observational studies.
Results: For gastric cancer, robotic gastrectomy demonstrated reduced blood loss, lower conversion rates, enhanced lymph node retrieval, and decreased complications across meta-analyses of 68,755+ patients, with comparable oncological outcomes. Three-dimensional laparoscopy achieved similar results in several domains. For esophagectomy, robotic approaches showed substantial reductions in pulmonary complications, overall morbidity, and improved quality of life versus conventional minimally invasive and open surgery, with higher R0 resection rates. For functional foregut surgery, robotic Heller myotomy demonstrated fewer perforations and reinterventions, while fundoplication and hiatal hernia repair showed equivalent outcomes. All robotic procedures had longer operative times.
Conclusions: Robotic surgery o ers measurable perioperative benefits in UGI procedures, strongest for esophagectomy. For gastric cancer, advantages support selective use though three-dimensional laparoscopy narrows the gap. Benefits in foregut surgery are procedure-specific. Laparoscopy remains standard due to efficacy, accessibility, and cost. Further randomized trials with long-term follow-up and cost-effectiveness analyses are needed.

Keywords: robotic surgical procedures, laparoscopy, gastrectomy, esophagectomy, minimally invasive surgical procedures, upper gastrointestinal tract

Introduction

Minimally invasive surgery has revolutionized the management of upper gastrointestinal (UGI) diseases over the past thirty years. Laparoscopy, first introduced in the early 1990s, led to significant reductions in blood loss, postoperative pain, length of hospital stay, and recovery time, becoming the gold standard for many procedures (1-3). However, the two-dimensional views of laparoscopy, limited instrument articulation, and technical challenge in confined anatomical spaces have limited its adoption in complex UGI operations and prolonged the learning curve (4).

Robotic-assisted surgery, introduced in the early 21st century, was developed to enhance surgical dexterity, providing surgeons with three-dimensional vision, tremor elimination, articulated instruments (endowrists), and ergonomic advantages (5,6,7). These features are particularly beneficial for technically demanding esophageal and gastric procedures requiring precise dissection and reconstruction within limited anatomical spaces (7-9).

Despite the theoretical advantages and increasing utilization of robotic surgery, its impact on clinical outcomes compared with laparoscopy remains debated, especially considering longer operative times and costs (1-5,7-11). This review critically examines recently published evidence on robotic versus laparoscopic surgery in UGI procedures, emphasizing gastric cancer surgery, esophagectomy, and esophagogastric junction surgery.

Methods

Literature Search and Selection

A narrative literature review was conducted to compare robotic-assisted versus laparoscopic and open surgery for gastroesophageal conditions. PubMed/MEDLINE, Embase, Cochrane Library, and Web of Science were searched for studies published between January 2020 and August 2025 using the following terms: "robotic surgery", "laparoscopic surgery", "gastric cancer", "gastrectomy", "esophageal cancer", "esophagectomy", "GERD", "fundoplication", "hiatal hernia", and "Heller myotomy".

Studies were included if they: (1) compared robotic versus laparoscopic or open surgery; (2) included patients with gastric cancer, esophageal cancer, GERD, hiatal hernia, or achalasia; (3) were RCTs, meta-analyses, or comparative observational studies; and (4) reported perioperative, oncological, or long-term outcomes. Studies published before 2020, case series with fewer than 10 patients, and those without direct surgical comparisons were excluded.

The literature selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Initial database searches identified 692 records. After removing 179 duplicates, 513 records were screened based on title and abstract, resulting in the exclusion of 464 records. Full-text assessment was performed on 49 articles, of which 33 were excluded: 11 did not include robotic versus laparoscopic /open comparison, 8 were published before 2020, 6 had insufficient data, 4 had duplicate populations, and 4 were unavailable as full text. Finally, 16 studies were included in the qualitative synthesis, comprising 3 RCTs, 6 meta-analyses, and 7 observational studies. Studies were categorized by procedure type: 8 on gastric cancer gastrectomy, 4 on esophageal cancer esophagectomy, and 4 on anti-reflux surgery/hiatal hernia repair.

Data Synthesis

Data extracted included study design, sample size, surgical procedure, operative outcomes (operative time, blood loss, conversions), postoperative outcomes (complications, hospital stay, mortality), and oncological outcomes (lymph nodes retrieved, margins, recurrence). Given the heterogeneity of included studies, a qualitative synthesis was performed, grouping studies by procedure type (gastrectomy, esophagectomy, antireflux surgery).

Results

The primary findings of the included studies are summarized in *Table 1*, which presents the main characteristics, design, and comparative outcomes of robotic versus laparoscopic upper gastrointestinal procedures across the analyzed literature.

Gastric Oncologic Surgery

Recent high-quality evidence consistently shows robotic gastrectomy is associated with longer operative times and higher costs than laparoscopy but offers significant perioperative advantages (1-6,10). Meta-analyses demonstrate reduced intra-operative blood loss, decreased conversion rates to open surgery, and faster postoperative recovery with earlier return of bowel function and oral intake in robotic gastrectomy (2-4).

Randomized trials and meta-analyses confirm decreased severe complications, including lower rates of pancreatic complications (OR 0.60, $p=0.004$), and shorter hospitalization after robotic gastrectomy (1,2). Large meta-analyses reinforce these patterns across tens of thousands of patients, with Du et al. analyzing outcomes from 68,755 patients and demonstrating significantly lower overall postoperative complications (OR 0.82, $p<0.001$), severe complications (OR 0.65, $p<0.001$), reduced reoperation rates (OR 0.68, $p=0.010$), decreased conversion to open surgery (OR 0.62, $p=0.004$), and more extensive lymph node harvests (all $p<0.001$) (3). Guerrini et al., in a meta-analysis of 17,712 patients, reported similar perioperative advantages including reduced severe complications (Clavien-Dindo ≥3: OR 0.66, $p = 0.005$), less intra-operative blood loss, and increased lymph node retrieval (mean difference 1.84 nodes, $p=0.0003$), though at the cost of significantly longer operative times (mean difference 44.73 minutes, $p<0.00001$) (4). Studies focusing on patients receiving neo-adjuvant therapy show that robotic gastrectomy maintains these advantages even in more complex clinical scenarios (10). Importantly, long-term oncologic outcomes, including resection margin adequacy, anastomotic leak rates, mortality, recurrence rates, overall survival, and disease-free survival, appear comparable between robotic and laparoscopic approaches in both randomized trials and propensity-matched analyses (1,3,4,6).

Table 1. Comparative characteristics and outcomes of robotic versus laparoscopic upper gastrointestinal procedures in recent literature (January 2020 - August 2025)

Article (Year)	Study Design	Procedure	Cases (Robotic/ Lap)	Key Outcomes	Main Findings	Reference
Ojima T et al., 2021	RCT	Gastrectomy	113/117	Complications, LOS, LNs	Robotic: ↓ intra-abdominal infectious complications	1
Deng Y et al., 2024	Meta-analysis	Gastrectomy	547/508	Blood loss, hospital stay	Robotic: ↓ intraoperative blood loss, ↑ LNs, ↓ postoperative hospital stay, ↓ postoperative complications, ↓ time to first flatus, ↓ liquid intake	2
Du R et al., 2025	Meta-analysis	Gastrectomy	68,755	Morbidity, survival	Robotic: ↓ blood loss, ↓ hospital stays, ↑ LNs, ↓ time to first flatus, ↓ liquid intake, ↓ conversion to open	3
Guerrini GP et al., 2020	Meta-analysis	Gastrectomy	17,985	Conversion, complications, oncological outcomes	Robotic: ↓ blood loss, ↓ conversions, ↓ complications, ↑ operative time	4
Wang QW et al., 2025	Meta-analysis	Gastrectomy	533/698	Lymph node yield	Robotic: ↓ blood loss, ↓ LNs, ↓ time to first flatus	5
Tian Y et al., 2022	Cohort	Gastrectomy	456/456	Overall survival, relapse-free survival	Robotic: ↑ LNs, ↑ operative time, ↓ blood loss	6
Angeramo CA et al., 2021	Systematic review and meta-analysis	Esophagectomy	974/5275	Surgical and oncologic outcomes	Robotic: ↓ pulm. comp, ↓ blood loss, ↑ operative time, ↓ overall morbidity, ↑ R0 resection	7
Patton A et al., 2024	Network meta-analysis	Esophagectomy	1063	Mortality, complications	Robotic: ↓ pulmonary complications	8
van der Sluis PC et al., 2019	RCT	Esophagectomy	112	Survival, LNs	Robotic: ↓ pulmonary complications, ↓ blood loss, comparable oncologic results	9
Tuohuti T et al., 2025	Meta-analysis	Gastrectomy	283/286	Short-term outcomes	Robotic: ↑ LNs, ↑ operative time, ↓ time to flatus, ↓ liquid intake	10
Awshah S et al., 2024	Meta-analysis	Hiatal hernia / myotomy	196,339	Perforation, reoperation	Robotic: ↓ mucosal perf., ↓ reoperation, ↑ operative time	11
Tagkalos E et al., 2020	Cohort	Esophagectomy	50/50	LNs, complications	Robotic: ↓ ICU stay, comparable LOS	12
Wang Z et al., 2021	Meta-analysis	Fundoplication	110/111	Symptom control	Robotic: ↑ operative time, comparable clinical outcomes	13
Lang F et al., 2022	RCT	Fundoplication	20/20	Symptom control, QoL, treatment failure	Comparable clinical outcomes	14
Powell C et al., 2024	Cohort	Hiatal hernia repair	1567/2778	Complications, mortality, readmission	Robotic: ↑ pulmonary embolism, comparable complications	15
Ma L et al., 2023	Meta-analysis	Hiatal hernia repair	1088/7111	Complications	Robotic: ↓ complications, ↓ LOS	16

Abbreviations: LNs = lymph nodes; LOS = length of stay; pulm. comp = pulmonary complications; QoL = quality of life; ICU = intensive care unit

The introduction of 3D laparoscopic technology has narrowed the performance gap between robotic and laparoscopic approaches. Wang et al., comparing robotic gastrectomy to advanced 3D laparoscopy in 1,231 patients (533 robotic, 698 3D laparoscopy), reported that robotic surgery was associated with reduced intraoperative blood loss and faster return of bowel function (5). However, 3D laparoscopy achieved significantly higher lymph node yields, while operative times, hospital stays, and complication rates were comparable between techniques (5). These findings suggest that improvements in laparoscopic visualization technology may replicate some perioperative advantages traditionally attributed to robotic systems, though the clinical significance of differences in lymph node harvest warrants further investigation, particularly given the comparable oncological outcomes observed in other comparative studies (3,4).

Esophageal Surgery

Esophagectomy remains among the most complex UGI procedures, with significant risk for pulmonary and systemic complications. Recent meta-analyses and RCTs demonstrate that robotic-assisted minimally invasive esophagectomy (RAMIE) offers perioperative advantages compared to conventional minimally invasive esophagectomy and open approaches (7-9,12),

The largest multicenter study by Angeramo et al., comparing robotic Ivor Lewis esophagectomy to conventional minimally invasive technique in 6,249 patients, demonstrated that RAMIE is associated with significantly reduced postoperative pneumonia (OR 0.46, $p < 0.0001$), lower overall morbidity (OR 0.67, $p < 0.0001$), decreased intraoperative blood loss, and higher rates of R0 resection (OR 2.84, p < 0.001) (7). Operative times were longer with RAMIE, while anastomotic leak rates, lymph node yields, mortality rates, and length of hospital stay were comparable between techniques (7).

Additional studies support these findings. Patton et al. conducted a network meta-analysis demonstrating that minimally invasive approaches are associated with reduced complications compared to open esophagectomy, with comparable mortality rates across techniques (8). Van der Sluis et al. performed a landmark RCT (ROBOT trial) with 112 patients comparing RAMIE to open transthoracic esophagectomy, confirming that RAMIE resulted in fewer overall surgery-related complications (59% vs 80%, p = 0.02), lower pulmonary complications (RR 0.54, p = 0.005), reduced cardiac complications (RR 0.47, p = 0.006), less blood loss, lower postoperative pain, better functional recovery at 14 days, and improved quality of life at discharge and 6 weeks postoperatively (9). Short- and long-term oncological outcomes were comparable at a median follow-up of 40 months (9). Tagkalos et al., in a propensity-matched analysis of 80 patients, demonstrated that RAMIE compared to conventional minimally invasive esophagectomy was associated with significantly shorter intensive care unit (ICU) stay (1 vs 2 days, p = 0.029) and a trend toward improved lymph node harvest (median 27 vs 23 nodes, p = 0.053), with similar postoperative complication rates (12).

Overall, current evidence demonstrates that RAMIE offers substantial perioperative advantages over both open and conventional minimally invasive approaches, with significant reductions in pulmonary and cardiac complications, improved postoperative recovery, and enhanced quality of life (7-9,12). Importantly, these benefits are achieved without compromising oncological adequacy, as evidenced by comparable lymph node yields, higher R0 resection rates, and equivalent long-term survival outcomes (7,9). While operative times remain longer with robotic approaches, the consistent reduction in major morbidity and improved functional recovery support RAMIE as a safe and effective technique for esophageal cancer surgery in experienced centers.

Functional Esophagogastric Junction Surgery

Procedures including fundoplication, Heller myotomy, and hiatal hernia repair require technical precision to minimize mucosal injury and ensure durable outcomes. Meta-analyses demonstrate that robotic surgery is associated with improved perioperative outcomes (11,13-16).

Awshah et al. conducted a comprehensive systematic review including 22 comparative studies with 196,339 patients. For Heller myotomy (2,384 robotic and 12,225 laparoscopic patients), robotic surgery resulted in significantly fewer esophageal perforations (OR 0.36, 95% CI 0.15-0.83) and reinterventions (OR 0.18, 95% CI 0.07-0.47), with a trend toward shorter hospital stay (11). For hiatal hernia repair (13,426 robotic and 168,335 laparoscopic patients), robotic approaches showed trends toward shorter length of stay, fewer conversions to open surgery, and lower morbidity rates, though these differences did not reach statistical significance (11). Both robotic Heller myotomy and hiatal hernia repair were associated with significantly longer operative times (11).

Ma et al. conducted a meta-analysis of hiatal hernia repairs confirming reduced conversion rates and shorter hospitalization with robotic approaches (16). Lang et al. provided 12-year follow-up data from a randomized controlled trial showing comparable symptom control, reflux outcomes, and reoperation rates between robotic and laparoscopic Nissen fundoplication, with demonstrated perioperative advantages including reduced complications and shorter hospital stays in the robotic group (14). Wang et al. meta-analyzed six RCTs with 221 patients undergoing Nissen fundoplication, demonstrating that robotic-assisted fundoplication prolonged operative time by approximately 3 minutes but achieved equivalent outcomes in terms of complications, patient satisfaction, need for antisecretory medication, and total costs compared to conventional laparoscopy (13).

Large cohort analyses by Powell et al., examining 4,345 paraesophageal hernia repairs from the NSQIP database, demonstrated comparable major and minor complication rates between robotic and laparoscopic approaches after adjustment for baseline characteristics, with significantly lower unadjusted 30-day mortality in the robotic cohort (0.0% vs 0.4%, p < 0.01) (15). However, the robotic approach was associated with increased risks of myocardial infarction and pulmonary embolism, though these events did not result in perioperative mortality (15).

Overall, current evidence suggests that robotic surgery in functional UGI procedures offers perioperative advantages including reduced perforation rates, shorter hospital stays, and comparable functional outcomes to laparoscopy (11,13-16).

While long-term symptomatic control appears equivalent between approaches, robotic surgery may provide technical benefits in procedures requiring precise dissection within confined anatomical spaces, particularly for hiatal hernia repair and Heller myotomy (11,14,16). However, the clinical significance of increased thromboembolic events and higher costs warrant careful patient selection and further investigation (15).

Discussion

This narrative review synthesizes recent evidence comparing robotic-assisted and laparoscopic surgery across major upper gastrointestinal procedures, revealing a nuanced landscape where robotic technology offers measurable advantages in specific clinical contexts while facing persistent challenges in cost-effectiveness and widespread adoption.

For gastric cancer surgery, robotic gastrectomy demonstrates consistent perioperative benefits including reduced blood loss, lower conversion rates, enhanced lymph node retrieval, and decreased severe complications across multiple large-scale meta-analyses encompassing tens of thousands of patients (1-4). These advantages are maintained even in technically demanding scenarios following neoadjuvant therapy (6,10). Crucially, these short-term benefits do not compromise oncological adequacy, with comparable long-term survival outcomes between robotic and laparoscopic approaches (1,3,6). However, the emergence of 3D laparoscopic technology narrows this performance gap, achieving comparable outcomes in several domains while maintaining cost advantages,5 suggesting that enhanced visualization alone may replicate some robotic benefits.

In esophageal surgery, RAMIE demonstrates the most compelling evidence for clinical superiority, with substantial reductions in pulmonary complications, overall morbidity, and improved quality of life across multiple high-quality studies including randomized controlled trials (7-9,12). The technical demands of esophagectomy - requiring precise dissection in confined mediastinal spaces, complex reconstruction, and extensive lymphadenectomy - appear particularly suited to robotic capabilities. Notably, the ROBOT trial by van der Sluis et al. demonstrated a 21% absolute reduction in surgery-related complications compared to open surgery, with sustained quality of life benefits extending to 6 weeks postoperatively (9). The higher R0 resection rates observed by Angeramo et al. (7) suggest potential oncological advantages that warrant longer-term survival analysis in ongoing studies.

For functional esophagogastric junction surgery, the evidence is more heterogeneous. While robotic Heller myotomy shows significant reductions in esophageal perforations and reinterventions (11), benefits for fundoplication and hiatal hernia repair are less pronounced, with most studies demonstrating equivalence in functional outcomes and symptom control (13,14). The finding by Powell et al. of increased thromboembolic events in robotic paraesophageal hernia repair (15) introduces an important safety consideration requiring further mechanistic investigation, potentially related to longer operative times, pneumoperitoneum duration, or patient positioning.

A consistent finding across all procedures is prolonged operative time with robotic approaches, typically ranging from 20 to 60 minutes longer than laparoscopy (1-11). This likely reflects a combination of factors including docking time, instrument exchanges, and the learning curve associated with robotic technology. However, operative time differences tend to diminish with increasing surgeon experience, and emerging evidence suggests that in high-volume centers, these temporal disadvantages may be partially offset by reduced complications requiring reintervention.

The learning curve for robotic surgery represents both an adoption barrier and a methodological challenge in comparative studies. Most included studies originate from high-volume tertiary centers with established robotic programs, potentially introducing selection bias and limiting generalizability to community practice settings. The standardization of training protocols and development of objective proficiency metrics remain critical needs for safe widespread implementation.

The higher costs of robotic surgery, driven by capital investment, maintenance, and disposable instruments, represent a persistent limitation despite clinical advantages. While none of the included studies performed comprehensive cost-effectiveness analyses incorporating long-term outcomes, the combination of longer operative times, higher equipment costs, and only modest clinical benefits in certain procedures raises questions about value in resource-constrained healthcare systems. Future economic evaluations should incorporate downstream costs related to complications, readmissions, and quality-adjusted life years to provide a more complete assessment of cost-effectiveness.

Several important research priorities emerge from this review. First, adequately powered randomized controlled trials with long-term oncological follow-up are needed, particularly for gastric cancer where most evidence derives from observational studies and short-term meta-analyses. Second, comparative effectiveness research should evaluate robotic surgery across the spectrum of hospital volumes and surgeon experience levels to determine real-world effectiveness beyond expert centers. Third, the emergence of new technologies - including single-port robotic systems, haptic feedback, and fluorescence-guided surgery - warrants systematic evaluation of their incremental benefits. Finally, patient-reported outcomes, including long-term quality of life and functional status, deserve greater emphasis in future comparative studies beyond traditional perioperative metrics.

Limitations

This review is subject to several limitations. First, the narrative synthesis approach, chosen due to heterogeneity in study design, precludes formal statistical pooling and may introduce selection bias. Second, included studies vary considerably in terms of population characteristics, surgical expertise, and perioperative protocols, potentially limiting the generalizability of our findings. Third, despite extensive efforts to capture recent and high-quality publications, the risk of publication bias remains, particularly for negative or inconclusive results. Fourth, follow-up duration and long-term oncological outcomes are inconsistently reported, hampering robust comparison of survival and recurrence. Lastly, as several multicenter registries and meta-analyses partially overlap in patient cohorts, the risk of double-counting events cannot be excluded. Further high-quality, prospective studies with stratified analyses and standardized endpoints are needed to strengthen the evidence base.

Conclusions

Robotic surgery represents a refined evolution in minimally invasive upper gastrointestinal surgery, conferring distinct perioperative benefits and enhanced technical capabilities that improve surgical quality and patient outcomes in selected clinical settings. The evidence is strongest for esophagectomy, where robotic approaches demonstrate substantial reductions in major morbidity with preserved oncological outcomes. For gastric cancer surgery, consistent perioperative advantages support robotic use, though the advent of 3D laparoscopy may narrow this gap. In functional esophagogastric junction surgery, benefits are more selective, with the most compelling evidence for Heller myotomy.

Laparoscopic surgery remains the mainstay for most upper gastrointestinal procedures due to established efficacy, wider accessibility, and lower costs. The optimal role for robotic surgery likely lies in complex procedures, challenging anatomy, or high-risk patients where its technical advantages translate into meaningful clinical benefits. Ongoing randomized trials, long-term outcomes assessment, comprehensive cost-effectiveness analyses, and evaluation of emerging technologies are essential to refine indications and guide evidence-based implementation of robotic surgery in upper gastrointestinal practice.

Author's Contributions

Serena Guarriello: conceptualization, literature search, data extraction and analysis, manuscript drafting, table preparation, revision and editing. Jacopo Andreuccetti: data extraction and analysis, study supervision, critical revision of the manuscript, final approval. Giusto Pignata: study supervision, critical revision of the manuscript, final approval. All authors read and approved the final version of the manuscript.

Conflicts of Interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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