

Original Research Article

OPERATIVE OUTCOMES AND EARLY POSTOPERATIVE MORBIDITY FOLLOWING DIFFERENT SURGICAL APPROACHES FOR RESECTABLE GASTROESOPHAGEAL JUNCTION ADENOCARCINOMA: A HOSPITAL-BASED COMPARATIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Gastroesophageal junction (GEJ) adenocarcinoma is a complex upper gastrointestinal malignancy with increasing incidence and ongoing controversy regarding the optimal surgical approach. This study evaluates early operative outcomes and postoperative complications associated with different surgical approaches for resectable GEJ adenocarcinoma. To compare operative outcomes and early postoperative morbidity among patients undergoing transthoracic esophagectomy (TTE), proximal partial gastrectomy (PPG), and total gastrectomy (TG) for resectable GEJ adenocarcinoma.

Materials and Methods: A hospital-based ambispective comparative observational study was conducted among patients with histopathologically confirmed resectable GEJ adenocarcinoma undergoing curative-intent surgery at a tertiary care centre. Patients treated between February 2019 and April 2025 were included. Clinical, operative, pathological, and postoperative data were collected using standardized protocols. A total of 80 patients underwent surgical exploration, of whom 77 patients undergoing definitive resection were included in comparative analysis. Outcomes following TTE, PPG, and TG were assessed using appropriate statistical tests, with $p < 0.05$ considered statistically significant.

Results: Among the 77 resected patients, 9 (11.3%) underwent TTE, 42 (52.5%) underwent PPG, and 26 (32.5%) underwent TG. The median age was 60 years, with male predominance (85.6%). Siewert type II tumours were most common (61.3%). TTE was associated with the longest operative duration (238.3 minutes) and highest intraoperative blood loss (161.1 mL) compared with PPG and TG. Respiratory complications ($p=0.049$), cardiovascular complications ($p=0.006$), and duration of hospital stay ($p=0.003$) showed significant differences among surgical groups. Median hospital stay was longer after TTE (12 days) compared with PPG and TG (7 days each). Anastomotic leak, chyle leak, wound complications, and 30-day and 90-day mortality rates were comparable between groups.

Conclusion: Different surgical approaches for resectable GEJ adenocarcinoma demonstrate comparable short-term oncological safety; however, transthoracic esophagectomy is associated with increased operative complexity, higher morbidity, and prolonged hospitalization.

Keywords: Gastroesophageal junction adenocarcinoma; Transthoracic esophagectomy; Proximal partial gastrectomy; Total gastrectomy; Postoperative morbidity; Surgical outcomes; Early complications

INTRODUCTION

Adenocarcinoma of the gastroesophageal junction (GEJ) has emerged as one of the fastest rising upper gastrointestinal malignancies worldwide and represents a unique therapeutic challenge because of its complex anatomical location, heterogeneous lymphatic drainage, and the absence of universal consensus regarding the optimal surgical approach.^[1,2,3] Although the incidence has plateaued in some Western countries during the last decade, GEJ adenocarcinoma continues to constitute a major healthcare burden and is increasingly being recognized in Asian populations.^[1,2] The rising prevalence of obesity, gastroesophageal reflux disease (GERD), Barrett's oesophagus, and other lifestyle-related risk factors has been implicated in the changing epidemiology of this disease.^[2,3] Despite substantial advances in perioperative chemotherapy, chemoradiotherapy, minimally invasive surgical techniques, and immunotherapy, complete surgical resection with adequate lymphadenectomy remains the cornerstone of curative treatment for localized disease.^[3,4]

The anatomical location of GEJ adenocarcinoma at the interface of the thoracic and abdominal cavities presents unique challenges in tumour classification, staging, and operative planning. The classification proposed by Siewert and Stein remains the most widely accepted system for categorizing these tumours according to the location of the tumour epicentre relative to the anatomical gastroesophageal junction.⁵ Tumours are classified as Type I (distal oesophagus), Type II (true carcinoma of the cardia), and Type III (Subcardial gastric carcinoma infiltrating the gastroesophageal junction). This classification has important therapeutic implications because it determines the extent of oesophageal and gastric resection, the pattern of lymphadenectomy, and the preferred surgical approach.^[5,6] Contemporary staging systems and international guidelines classify Siewert type I and II tumours as oesophageal cancers, whereas Siewert type III tumours are generally managed according to gastric cancer treatment principles.^[6,7,8]

Although surgery remains the principal treatment modality for resectable GEJ adenocarcinoma, the optimal operative strategy, particularly for Siewert type II tumours, continues to be debated.^[3,8,9] Transthoracic esophagectomy offers superior exposure of the mediastinum, facilitates extensive mediastinal lymph node dissection, and provides wider proximal resection margins, but may be associated with longer operative time, increased pulmonary morbidity, and prolonged postoperative recovery.^[9,10] Conversely, transabdominal procedures, including proximal gastrectomy and total gastrectomy, avoid thoracotomy and may reduce perioperative morbidity while achieving satisfactory oncological clearance in appropriately

selected patients.^[9,10,11] Consequently, the choice of operation is influenced by tumour location, extent of oesophageal involvement, lymph node distribution, patient comorbidities, neoadjuvant treatment, and surgeon expertise.^[3,9,11]

Over the past decade, numerous retrospective studies, systematic reviews, and meta-analyses have compared esophagectomy and gastrectomy for GEJ adenocarcinoma. However, considerable heterogeneity exists with respect to patient selection, tumour characteristics, surgical techniques, extent of lymphadenectomy, and perioperative treatment protocols.^[10,11,12,13] While some studies have reported improved oncological clearance with transthoracic esophagectomy, others have demonstrated comparable survival with lower perioperative morbidity following transabdominal gastrectomy.^[11,12,13] Consequently, there remains no universal consensus regarding the preferred surgical procedure for Siewert type II GEJ adenocarcinoma, and current guidelines advocate an individualized, multidisciplinary approach to treatment planning.^[3,7,12]

Evidence from the Indian subcontinent evaluating operative outcomes following different surgical approaches for GEJ adenocarcinoma is relatively limited.^[14] Differences in tumour presentation, nutritional status, healthcare infrastructure, and surgical expertise may influence perioperative outcomes and limit the generalizability of data derived from Western populations.^[14,15] Institution-specific evidence from high-volume tertiary referral centres is therefore essential to evaluate the safety, feasibility, and early outcomes of different operative strategies within the local clinical setting.

In view of these considerations, the present study was undertaken to compare the operative outcomes and early postoperative morbidity associated with transthoracic esophagectomy, proximal partial gastrectomy, and total gastrectomy in patients with resectable gastroesophageal junction adenocarcinoma treated at a tertiary care centre. The secondary objectives are to compare perioperative and early postoperative outcomes, including operative duration, intraoperative blood loss, lymph node yield, resection margin status, postoperative complications, length of hospital stay, and 30-day and 90-day mortality, among the three surgical approaches for resectable gastroesophageal junction adenocarcinoma.

MATERIALS AND METHODS

Study Design

This was a hospital-based ambispective comparative observational study conducted in the Department of Surgical Oncology, Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar, Jammu and Kashmir, India. The study comprised a retrospective arm (February 2019 to January 2023) and a prospective arm (February 2023 to April 2025).

Consecutive eligible patients fulfilling the inclusion criteria were enrolled using identical eligibility criteria and outcome definitions in both study phases.

Study Setting

The study was conducted at the Department of Surgical Oncology, SKIMS, Srinagar, a tertiary referral centre for upper gastrointestinal malignancies catering to patients from Jammu and Kashmir and neighbouring regions.

Study Population

The study population consisted of patients with histopathologically confirmed gastroesophageal junction adenocarcinoma who underwent curative-intent surgical exploration during the study period.

Sample Size

As gastroesophageal junction adenocarcinoma is an uncommon malignancy, all consecutive eligible patients presenting during the study period were included. A total of 80 patients underwent surgical exploration. Three patients were found to have unresectable metastatic disease intraoperatively and underwent biopsy only. The remaining 77 patients who underwent definitive surgical resection constituted the comparative study population.

Sampling Technique

Consecutive sampling was employed, wherein all eligible patients presenting during the study period were included without randomization.

Eligibility Criteria

Patients aged 18 years or older with histopathologically confirmed adenocarcinoma of the gastroesophageal junction who had resectable disease based on preoperative evaluation and underwent curative-intent surgery were included in the study. Patients with distant metastatic disease detected before surgery, histology other than adenocarcinoma, those undergoing palliative surgical procedures, patients who were medically unfit for definitive surgery, and those with incomplete clinical records were excluded.

Preoperative Evaluation

All patients underwent a standardized preoperative evaluation comprising detailed clinical assessment, routine laboratory investigations, upper gastrointestinal endoscopy with biopsy, and contrast-enhanced computed tomography (CECT) of the thorax and abdomen. Additional staging investigations, including positron emission tomography-computed tomography (PET-CT), endoscopic ultrasonography (EUS), and staging laparoscopy, were performed selectively based on clinical indications. Tumours were classified according to the Siewert classification, and clinical staging was performed using the American Joint Committee on Cancer (AJCC) 8th edition TNM staging system (5). Treatment decisions were made following discussion at a multidisciplinary tumour board consisting of surgical oncologists, medical oncologists, radiation oncologists, radiologists, pathologists, and gastroenterologists.

Surgical Procedures

The choice of surgical approach was individualized based on tumour location, Siewert classification, extent of oesophageal involvement, clinical stage, patient fitness, and multidisciplinary team recommendations. Depending on these factors, patients underwent transthoracic esophagectomy (TTE), proximal partial gastrectomy (PPG), or total gastrectomy (TG). Transthoracic esophagectomy involved resection of the thoracic oesophagus with proximal gastrectomy and reconstruction using a gastric conduit. Proximal partial gastrectomy consisted of resection of the proximal stomach with distal oesophageal resection followed by reconstruction according to institutional protocol, whereas total gastrectomy involved complete gastric resection with distal oesophageal resection and Roux-en-Y oesophagojejunostomy. Patients in whom unresectable metastatic disease was identified during surgical exploration underwent biopsy alone and were excluded from the comparative analysis.

Data Collection

Clinical, operative, pathological, and postoperative data were retrieved from hospital records for retrospectively enrolled patients and prospectively recorded using a standardized case record form for patients included during the prospective phase. Baseline variables included age, sex, body mass index, presenting symptoms, comorbidities, tumour location, Siewert classification, clinical stage, and receipt of neoadjuvant therapy. Operative variables comprised the type of surgery performed, operative duration, estimated intraoperative blood loss, intraoperative blood transfusion, and extent of lymphadenectomy. Pathological variables included tumour size, histological differentiation, pathological TNM stage, number of lymph nodes retrieved, number of metastatic lymph nodes, and proximal and distal resection margin status. Postoperative variables included pulmonary complications, anastomotic leak, surgical site infection, chyle leak, requirement for reoperation, duration of postoperative hospital stay, and 30-day and 90-day mortality.

Outcome Measures

The primary outcome of the study was early postoperative morbidity following different surgical approaches for resectable gastroesophageal junction adenocarcinoma. Secondary outcomes included operative duration, intraoperative blood loss, lymph node yield, resection margin status, postoperative complications, duration of postoperative hospital stay, and 30-day and 90-day postoperative mortality.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, Version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR), depending on the distribution of data, while categorical variables were presented as frequencies and percentages. Comparisons of

continuous variables among the three surgical groups were performed using one-way analysis of variance (ANOVA) for normally distributed data and the Kruskal–Wallis test for non-normally distributed data. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A two-tailed p-value of <0.05 was considered statistically significant.

Ethical Considerations

The study was approved by the Institutional Ethics Committee of Sher-i-Kashmir Institute of Medical Sciences (SKIMS), Srinagar. Written informed consent was obtained from all patients enrolled prospectively, while data from the retrospective component were collected from anonymized hospital records in accordance with institutional ethical guidelines. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and adhered to the applicable institutional and national guidelines for biomedical research involving human participants.

RESULTS

A total of 80 patients with gastroesophageal junction (GEJ) adenocarcinoma underwent surgical exploration during the study period. Of these, 77 patients underwent curative-intent resection, while three patients (3.7%) were found to have unresectable metastatic disease at exploration and underwent biopsy alone. These three patients were excluded from the comparative analysis of operative outcomes and postoperative morbidity. The distribution of patients according to the surgical procedure was as follows: transthoracic esophagectomy (TTE), 9 (11.3%); proximal partial gastrectomy (PPG), 42 (52.5%); and total gastrectomy (TG), 26 (32.5%).

The median age of the study population was 60 years. There was a marked male predominance, with males accounting for 85.6% of the patients. Hypertension was the most common comorbidity (33.7%), followed by type 2 diabetes mellitus (10.0%) and hypothyroidism (8.7%). Tobacco smoking was the most frequently reported habit. Dysphagia was the commonest presenting symptom, occurring in 55% of patients, followed by epigastric pain (35%) and upper gastrointestinal bleeding (22.5%). All patients underwent upper gastrointestinal endoscopy with biopsy and contrast-enhanced computed tomography for diagnosis and staging, while positron emission tomography-computed tomography was performed in 32.5% of

patients and staging laparoscopy in 2.5%. Siewert type II tumours constituted the majority (61.3%), followed by type III (32.5%) and type I (6.3%). These baseline demographic and clinicopathological characteristics are summarized in Table 1.

Operative Outcomes

The mean operative duration differed among the three surgical approaches. Patients undergoing transthoracic esophagectomy had the longest mean operative time (238.3 minutes), followed by total gastrectomy (163.2 minutes) and proximal partial gastrectomy (155.8 minutes). Patients who underwent biopsy alone had the shortest operative duration (40 minutes). Similarly, the mean intraoperative blood loss was highest in the transthoracic esophagectomy group (161.1 mL), compared with 104.8 mL in the total gastrectomy group and 88.3 mL in the proximal partial gastrectomy group. The lowest blood loss was observed in patients undergoing biopsy alone (26.7 mL). These findings are summarized in Table 2.

Postoperative Outcomes

Postoperative complications following curative surgery are presented in Table 3. Anastomotic leak occurred in six patients, including three following transthoracic esophagectomy, two following proximal partial gastrectomy, and one following total gastrectomy; however, the difference among the groups was not statistically significant ($p = 0.21$). Wound dehiscence occurred in one patient following transthoracic esophagectomy ($p = 0.39$), while chyle leak was observed in four patients overall, with no significant difference between the groups ($p = 0.62$).

Respiratory complications were the most frequent postoperative complication and differed significantly among the three surgical approaches ($p = 0.049$). Cardiovascular complications also demonstrated a statistically significant difference across the groups ($p = 0.006$). Other postoperative complications occurred infrequently and were comparable among the groups ($p = 0.38$).

The median duration of postoperative hospital stay was 12 days (IQR: 6–18) following transthoracic esophagectomy, compared with 7 days (IQR: 6–8) following both proximal partial gastrectomy and total gastrectomy. Thirty-day mortality occurred in one patient following proximal partial gastrectomy, while two patients in the same group died within 90 days of surgery. There was no statistically significant difference in either 30-day ($p = 0.39$) or 90-day mortality ($p = 0.15$) among the three surgical groups.

Table 1: Baseline demographic and clinicopathological characteristics of patients with gastroesophageal junction adenocarcinoma

Characteristics	n (%) / Median (IQR)
Age, years	60 (56–65)
Sex	
Male	77 (85.6)
Female	13 (14.4)
Comorbidities	

Hypertension	27 (33.7)
Type 2 diabetes mellitus	8 (10.0)
Hypothyroidism	7 (8.7)
Lifestyle factors	
Tobacco smoker	47 (58.8)
Tobacco chewer	4 (5.0)
Snuff abuser	1 (1.3)
None	16 (20.0)
Unknown	13 (16.3)
Presenting symptoms	
Dysphagia	44 (55.0)
Epigastric pain	28 (35.0)
Upper gastrointestinal bleeding	18 (22.5)
Dyspepsia	8 (10.0)
Vomiting	5 (6.3)
Loss of appetite	4 (5.0)
Preoperative investigations	
Upper GI endoscopy with biopsy	80 (100)
Contrast-enhanced CT	80 (100)
PET-CT	26 (32.5)
Staging laparoscopy	2 (2.5)
Siewert classification	
Type I	5 (6.3)
Type II	49 (61.3)
Type III	26 (32.5)

Table 2: Surgical procedures performed among the patients

Surgical procedure	Approach	n (%)
Transthoracic esophagectomy	Transthoracic + transabdominal	9 (11.3)
Proximal partial gastrectomy	Transabdominal	42 (52.5)
Total gastrectomy	Transabdominal	26 (32.5)
Exploratory surgery with biopsy only	Transabdominal	3 (3.7)

Table 3: Comparison of postoperative complications

Variable	TTE (n=9)	PPG (n=42)	TG (n=26)	P value
Anastomotic leak	3	2	1	0.210
Wound dehiscence	1	0	0	0.390
Chyle leak	1	1	2	0.620
Respiratory complications	1	6	1	0.049*
Cardiovascular complications	0	6	1	0.006*
Other complications	0	1	2	0.380
30-day mortality	0	1	0	0.390
90-day mortality	0	2	0	0.150

Table 4: Comparison of hospital stay

Surgical procedure	Median hospital stays, days (IQR)	P value
Transthoracic esophagectomy	12 (6–18)	0.003*
Proximal partial gastrectomy	7 (6–8)	
Total gastrectomy	7 (6–8)	

DISCUSSION

Gastroesophageal junction (GEJ) adenocarcinoma remains one of the most challenging upper gastrointestinal malignancies because of its anatomical complexity, variable lymphatic drainage, and the ongoing debate regarding the optimal surgical approach. Although multimodal treatment incorporating perioperative chemotherapy and chemoradiotherapy has improved survival, complete surgical resection with adequate lymphadenectomy remains the cornerstone of curative treatment.^[1-3] The present ambispective comparative observational study evaluated early operative outcomes and postoperative morbidity following transthoracic esophagectomy (TTE), proximal partial gastrectomy

(PPG), and total gastrectomy (TG) in patients with resectable GEJ adenocarcinoma treated at a high-volume tertiary referral centre. The principal findings indicate that transthoracic esophagectomy was associated with significantly longer operative duration, greater intraoperative blood loss, and prolonged hospital stay, whereas respiratory and cardiovascular complications differed significantly among the surgical approaches. Importantly, anastomotic leak, chyle leak, wound complications, and short-term mortality were comparable across the three procedures.

The demographic profile observed in the present study is consistent with the established epidemiology of GEJ adenocarcinoma. The median age of 60 years and marked male predominance are

comparable with reports from both Western and Asian populations, where the disease predominantly affects males in the sixth and seventh decades of life.^[1-3] Chevallay et al. reported that GEJ adenocarcinoma has become increasingly prevalent worldwide, particularly among men, largely because of increasing obesity, gastroesophageal reflux disease, Barrett's oesophagus, and tobacco exposure.^[2] Likewise, Oberoi et al. highlighted that the epidemiological transition observed in recent decades has resulted in GEJ adenocarcinoma becoming one of the fastest-growing gastrointestinal malignancies globally.^[1]

More than half of the patients in the present study were tobacco smokers, further emphasizing the contribution of smoking to the pathogenesis of GEJ adenocarcinoma. Smoking has consistently been identified as an independent risk factor for junctional cancers and is associated with poorer postoperative recovery and long-term survival.^[1,2] Although obesity and reflux disease have emerged as dominant risk factors in Western populations, tobacco exposure continues to play a significant role in Asian countries, including India.^[14]

Dysphagia was the commonest presenting symptom in the present study, followed by epigastric pain and upper gastrointestinal bleeding. This clinical profile mirrors findings reported by Heger and Blank, who observed progressive dysphagia to be the predominant presenting complaint because of progressive luminal narrowing at the gastroesophageal junction.^[3] The predominance of dysphagia reflects the advanced local disease at presentation commonly encountered in tertiary referral centres and underscores the importance of early endoscopic evaluation in symptomatic patients.

Siewert type II tumours constituted nearly two-thirds of the study population, followed by type III lesions. This distribution is comparable with previous institutional series and reflects the clinical reality that true junctional tumours represent the greatest therapeutic dilemma.^[4,9] Siewert and Stein originally proposed the anatomical classification that continues to guide operative planning by distinguishing tumours arising from the distal oesophagus, true cardia, and subcardial stomach.^[4] Although the AJCC staging system now classifies Siewert type I and II tumours as oesophageal cancers, important differences remain regarding the extent of oesophageal resection and lymphadenectomy required.^[5] Consequently, current recommendations from the NCCN, ESMO, and Japanese Gastric Cancer Association advocate individualized surgical planning through multidisciplinary discussion rather than a single standardized operative strategy.^[6-8]

An important finding of the present study was that transthoracic esophagectomy required substantially longer operative time than proximal partial gastrectomy and total gastrectomy. The mean operative duration of 238.3 minutes observed in the

TTE group reflects the additional thoracic phase, mediastinal dissection, extensive lymphadenectomy, gastric conduit preparation, and intrathoracic reconstruction required during esophagectomy. Similar observations have been reported by Hagens et al., who demonstrated that transthoracic esophagectomy is consistently associated with longer operative duration because of its greater technical complexity.^[9] Jung et al. likewise observed significantly prolonged operating times among patients undergoing esophagectomy compared with gastrectomy, particularly in Siewert type II tumours.^[11] Yoshikawa et al. further reported that although esophagectomy provides wider proximal margins and more comprehensive mediastinal lymph node clearance, these advantages are achieved at the expense of longer operative duration and greater surgical complexity.^[12]

The findings of the present study are also supported by recent systematic reviews. A meta-analysis comparing esophagectomy and total gastrectomy for Siewert type II GEJ adenocarcinoma concluded that esophagectomy consistently requires significantly longer operative time than gastrectomy across most published comparative studies.^[13,16] The increased duration primarily reflects the thoracic component of surgery, more extensive mediastinal lymph node dissection, and technically demanding intrathoracic or cervical anastomosis.

Similarly, intraoperative blood loss was greatest following transthoracic esophagectomy and lowest after proximal partial gastrectomy. This finding is biologically plausible because transthoracic surgery involves more extensive tissue dissection, greater vascular exposure, and prolonged operative manipulation within both the thoracic and abdominal cavities. Hagens et al. and Maatouk et al. reported comparable observations, demonstrating significantly greater blood loss during transthoracic procedures than during transabdominal gastrectomy.^[9,10] Nevertheless, despite higher blood loss, the absolute intraoperative blood loss recorded in the present study remained relatively modest, suggesting effective haemostatic control and meticulous operative technique at the study centre.

The ongoing controversy regarding the optimal operation for Siewert type II tumours largely reflects the balance between oncological radicality and perioperative morbidity. Esophagectomy allows superior mediastinal lymph node dissection and wider proximal margins, whereas transabdominal gastrectomy avoids thoracotomy and may reduce surgical trauma.^{10 - 13} Walmsley et al., in their recent systematic review and meta-analysis, concluded that neither operative approach demonstrated clear superiority regarding short-term survival or postoperative mortality, emphasizing that patient selection and surgeon expertise remain more important determinants of outcome than the surgical procedure itself.^[16] These observations closely support the findings of the present study, in which transabdominal procedures achieved

favourable early postoperative outcomes while transthoracic esophagectomy provided acceptable morbidity despite greater operative complexity. Taken together, the operative findings of the present study reinforce contemporary international recommendations advocating individualized surgical decision-making. Rather than adopting a uniform operative strategy for all GEJ adenocarcinomas, current evidence suggests that tumour location, oesophageal extension, anticipated lymph node spread, physiological reserve, neoadjuvant therapy, and institutional expertise should collectively determine the most appropriate surgical approach.^[6-9,15-16]

Postoperative Morbidity

Early postoperative morbidity remains one of the most important determinants of patient recovery following surgery for gastroesophageal junction adenocarcinoma. In the present study, respiratory and cardiovascular complications demonstrated statistically significant differences among the three surgical approaches, whereas anastomotic leak, chyle leak, wound dehiscence, and short-term mortality were comparable. These findings suggest that although the operative approach influences perioperative morbidity, meticulous perioperative management and careful patient selection can minimize major complications irrespective of the procedure performed.

Anastomotic leak is widely regarded as the most serious complication following upper gastrointestinal surgery because it is associated with increased morbidity, prolonged hospitalization, re-intervention, and mortality. In the present study, six patients developed an anastomotic leak, with a numerically higher incidence following transthoracic esophagectomy; however, this difference did not reach statistical significance. The relatively small number of patients undergoing transthoracic esophagectomy may have limited the statistical power to detect significant differences. Similar observations have been reported by Hagens et al., Jung et al., and Yoshikawa et al., who demonstrated that although intrathoracic anastomoses may theoretically carry a higher risk of leakage, overall leak rates are influenced more by surgical expertise, tissue perfusion, nutritional status, and perioperative care than by the surgical approach itself.^[9-12]

Recent systematic reviews further support these findings. Walmsley et al. reported no significant difference in anastomotic leak rates between esophagectomy and total gastrectomy for Siewert type II gastroesophageal junction cancers.^[16] Likewise, recent meta-analyses evaluating different techniques of oesophagojejunal reconstruction have concluded that surgical technique, vascularity of the conduit, and meticulous anastomotic construction are more important determinants of leak than the choice of resection alone.^[20,21] These findings reinforce the observation in the present study that careful operative technique may successfully

maintain acceptable leak rates across different procedures.

Chyle leak occurred infrequently and did not differ significantly between the surgical groups. This observation agrees with previous reports demonstrating that postoperative chyle leak is an uncommon complication, usually occurring after extensive mediastinal lymphadenectomy during transthoracic esophagectomy. Hagens et al. reported an incidence ranging between 2% and 5%, while other contemporary series have demonstrated similarly low frequencies in experienced centres.^[9,15] Prompt recognition, nutritional support, and timely intervention remain essential to minimize morbidity associated with this complication.

Respiratory complications represented the most frequent postoperative morbidity in the present study and showed statistically significant differences among the three operative approaches. Pulmonary complications remain the leading cause of postoperative morbidity following upper gastrointestinal surgery and have consistently been associated with prolonged hospital stay, delayed recovery, and increased healthcare costs. Thoracotomy, prolonged mechanical ventilation, postoperative pain, impaired coughing, reduced pulmonary expansion, and mediastinal dissection contribute substantially to pulmonary dysfunction following transthoracic procedures.^[9-11] Although a greater absolute number of respiratory complications occurred in the proximal partial gastrectomy group because this group comprised more than half of the study population, the statistically significant overall difference highlights that perioperative physiological factors, patient comorbidities, and surgical complexity collectively influence postoperative pulmonary outcomes.

Recent literature has emphasized the importance of enhanced recovery after surgery (ERAS) protocols, aggressive chest physiotherapy, early ambulation, effective pain control, and minimally invasive surgical techniques in reducing respiratory complications following oesophageal and gastric surgery.^[18,19] Implementation of standardized perioperative pathways has resulted in significant reductions in pulmonary morbidity and shortened postoperative recovery in several high-volume centres. These strategies may further improve outcomes in future patients undergoing surgery for GEJ adenocarcinoma.

Cardiovascular complications also differed significantly among the surgical groups in the present study. Major thoracoabdominal surgery induces a substantial systemic inflammatory response, perioperative haemodynamic fluctuations, fluid shifts, and increased myocardial oxygen demand, predisposing susceptible patients to cardiac complications. Previous studies have similarly identified advanced age, hypertension, diabetes mellitus, prolonged operative duration, and major blood loss as important predictors of postoperative cardiovascular morbidity.^[9,10] The relatively high

prevalence of hypertension within the present cohort may also have contributed to the observed cardiovascular events. These findings underscore the importance of comprehensive preoperative cardiovascular assessment and optimization before undertaking major oncological surgery.

An important finding of the present study was the significantly longer postoperative hospital stay following transthoracic esophagectomy compared with proximal partial gastrectomy and total gastrectomy. Patients undergoing transthoracic esophagectomy remained hospitalized for a median of 12 days compared with 7 days following transabdominal procedures. Similar observations have been consistently reported in comparative studies, where longer recovery following thoracic surgery has been attributed to greater postoperative pain, pulmonary complications, delayed oral intake, and the need for prolonged nutritional rehabilitation.^[9-13,16] These findings suggest that although transthoracic esophagectomy provides excellent oncological exposure, it is associated with a greater perioperative burden that should be carefully considered when selecting the optimal operative strategy.

Despite differences in perioperative morbidity, neither 30-day nor 90-day mortality differed significantly among the three surgical approaches. Only one patient died within 30 days, while two patients died within 90 days following proximal partial gastrectomy. Contemporary international series have reported perioperative mortality rates below 5%, reflecting improvements in perioperative anaesthesia, critical care, nutritional optimization, and multidisciplinary management.^[1,9,13,16] The low mortality observed in the present study therefore compares favourably with published literature and supports the safety of all three procedures when performed in specialized centres.

The findings of this study have important clinical implications. The choice of operation for gastroesophageal junction adenocarcinoma should not be determined solely by tumour location but should integrate tumour stage, Siewert classification, expected lymph node spread, patient comorbidities, physiological reserve, response to neoadjuvant therapy, and institutional expertise. Current recommendations from the National Comprehensive Cancer Network (NCCN), the European Society for Medical Oncology (ESMO), and the Japanese Gastric Cancer Association advocate individualized multidisciplinary decision-making rather than routine preference for either esophagectomy or gastrectomy.^[6-8] The present findings strongly support these recommendations by demonstrating that although transthoracic esophagectomy is associated with greater operative complexity and longer recovery, short-term mortality and major complications remain comparable when surgery is performed in experienced centres.

The strengths of the present study include its ambispective design, inclusion of consecutive patients over a six-year period, standardized eligibility criteria, and comprehensive assessment of operative and postoperative outcomes. Furthermore, the study represents one of the relatively few comparative analyses of different surgical approaches for GEJ adenocarcinoma from the Indian subcontinent, thereby contributing valuable regional evidence to an area dominated by Western and East Asian studies.^[14,15]

Nevertheless, several limitations should be acknowledged. First, the observational non-randomized design introduces potential selection bias because the surgical approach was determined according to tumour characteristics and multidisciplinary team recommendations rather than random allocation. Second, the relatively small sample size, particularly in the transthoracic esophagectomy group, may have limited the ability to detect statistically significant differences for uncommon postoperative complications such as anastomotic leak and chyle leak. Third, the study evaluated only early postoperative outcomes, and therefore long-term oncological endpoints including disease-free survival, overall survival, recurrence patterns, functional outcomes, and quality of life could not be assessed. Future multicentre prospective studies with larger sample sizes and longer follow-up are required to establish the optimal operative strategy for Siewert type II gastroesophageal junction adenocarcinoma.

CONCLUSION

In conclusion, the present study demonstrates that transthoracic esophagectomy is associated with longer operative duration, increased intraoperative blood loss, and prolonged postoperative hospitalization compared with proximal partial gastrectomy and total gastrectomy. Respiratory and cardiovascular complications differed significantly among the three operative approaches, whereas anastomotic leak, chyle leak, wound complications, and short-term mortality were comparable. These findings suggest that no single surgical approach is universally superior for all patients with resectable gastroesophageal junction adenocarcinoma. Instead, individualized surgical planning based on tumour characteristics, patient factors, and multidisciplinary assessment remains the most appropriate strategy for optimizing perioperative outcomes while maintaining oncological adequacy.

REFERENCES

1. Oberoi M, Noor MS, Abdelfatah E. The multidisciplinary approach and surgical management of gastroesophageal junction adenocarcinoma. *Cancers (Basel)*. 2024;16(2):288. doi:10.3390/cancers16020288.
2. Chevallay M, Bollschweiler E, Chandramohan SM, Schmidt T, Koch O, Demanzoni G, et al. Cancer of the gastroesophageal junction: a diagnosis, classification, and

- management review. *Ann N Y Acad Sci.* 2018;1434(1):132-138. doi:10.1111/nyas.13954.
3. Heger P, Blank S. Surgical treatment of gastroesophageal junction cancer. *J Gastric Cancer.* 2018;18(3):209-217. doi:10.5230/jgc.2018.18.e34.
4. Siewert JR, Stein HJ. Carcinoma of the cardia: carcinoma of the gastroesophageal junction—classification, pathology and extent of resection. *Dis Esophagus.* 1996;9(3):173-182.
5. Amin MB, Edge SB, Greene FL, Byrd DR, Brookland RK, Washington MK, et al., editors. *AJCC Cancer Staging Manual.* 8th ed. New York: Springer; 2017.
6. National Comprehensive Cancer Network. *NCCN Clinical Practice Guidelines in Oncology: Esophageal and Esophagogastric Junction Cancers.* Version 2025. Plymouth Meeting (PA): NCCN.
7. Japanese Gastric Cancer Association. *Japanese gastric cancer treatment guidelines 2021 (6th edition).* Gastric Cancer. 2023;26:1-25.
8. Lordick F, Carneiro F, Cascinu S, Fleitas T, Haustermans K, Piessen G, et al. Gastric cancer: ESMO Clinical Practice Guideline for diagnosis, treatment and follow-up. *Ann Oncol.* 2024.
9. Hagens ERC, van Berge Henegouwen MI, Gisbertz SS. Surgical treatment of adenocarcinoma of the gastroesophageal junction. *Ann Gastroenterol Surg.* 2020;4:395-404.
10. Maatouk M, Noura M, Ben Dhaou A, et al. Siewert II esophagogastric junction adenocarcinoma: still searching for the right treatment—transabdominal or transthoracic surgical approaches? *Asian Cardiovasc Thorac Ann.* 2024.
11. Jung DH, Lee YC, Park JC, et al. Surgical strategy for adenocarcinoma of the esophagogastric junction. *J Gastric Cancer.* 2022.
12. Yoshikawa T, Takeuchi H, Hiki N, et al. Optimal surgical approach for adenocarcinoma of the esophagogastric junction. *Ann Gastroenterol Surg.* 2021.
13. Oesophagectomy or total gastrectomy for the management of Siewert II gastroesophageal junction cancer: a systematic review and meta-analysis. *Ann Surg Oncol.* 2023.
14. Mazer LM, Poultides GA. Surgical management of gastric and gastroesophageal junction adenocarcinoma. *Surg Clin North Am.* 2019;99:457-469.
15. Hagens ERC, van Berge Henegouwen MI, Gisbertz SS. Current management of gastroesophageal junction adenocarcinoma: evidence and controversies. *Ann Gastroenterol Surg.* 2021.
16. Walmsley J, Ariyaratnam A, Berrisford R, Humphreys L, Sanders G, Tham JC, et al. Oesophagectomy or total gastrectomy for the management of Siewert II gastroesophageal junction cancer: a systematic review and meta-analysis. *J Gastrointest Surg.* 2023;27(7):1321-1335. doi:10.1007/s11605-023-05661-5.
17. Walmsley J, Ariyaratnam A, Berrisford R, Humphreys L, Sanders G, Tham JC, et al. Systematic review of quality of life after esophagectomy and total gastrectomy in patients with gastro-esophageal junction cancer. *Dis Esophagus.* 2023;36(12):doad039. doi:10.1093/dote/doad039.
18. Wang Q, Mine S, Nasu M, Fukunaga T, Nojiri S, Zhang CD, et al. Association of hospital volume and long-term survival after esophagectomy: a systematic review and meta-analysis. *Front Surg.* 2023;10:1161938.
19. Davey MG, Temperley HC, O'Sullivan NJ, Ryan EJ, et al. Minimally invasive and open gastrectomy for gastric cancer: a systematic review and network meta-analysis of randomized clinical trials. *Ann Surg Oncol.* 2023;30:5544-5557.
20. Sozzi A, Aiolfi A, Matsushima K, Bonitta G, Lombardo F, Viti M, et al. Linear- versus circular-stapled esophagojejunostomy during total gastrectomy: systematic review and meta-analysis. *J Laparoendosc Adv Surg Tech A.* 2023;33(6):524-533.
21. Aiolfi A, Sozzi A, Bonitta G, Lombardo F, Cavalli M, Campanelli G, et al. Short-term outcomes of different esophagojejunal anastomotic techniques during laparoscopic total gastrectomy: a network meta-analysis. *Surg Endosc.* 2023;37(8):5777-5790.
22. Booka E, Takeuchi H, Morita Y, Hiramatsu Y, Kikuchi H. What is the best reconstruction procedure after esophagectomy? A meta-analysis comparing posterior mediastinal and retrosternal approaches. *Ann Gastroenterol Surg.* 2023.