

Association Between the Anatomical Location of Single-Group Lymph Node Metastasis and Major Postoperative Complications in Siewert Type II/III Adenocarcinoma of the Esophagogastric Junction

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Research Article

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Abstract

Objective

To examine whether the anatomical location of single-group lymph node metastasis is associated with major postoperative complications in patients with Siewert type II/III adenocarcinoma of the esophagogastric junction (AEG).

Methods

We retrospectively reviewed 653 consecutive patients with AEG treated at Changzhi People's Hospital between January 2019 and December 2023. The final cohort comprised 60 patients with Siewert type II/III AEG and pathologically confirmed single-group lymph node metastasis, defined as metastatic lymph nodes confined to one numbered nodal group regardless of the number of positive nodes within that group. Patients were classified into a perigastric group (No. 1–6; $n = 46$) and a non-perigastric group (outside No. 1–6; $n = 14$). The primary outcome was a major postoperative complication within 30 days, defined as Clavien–Dindo grade III or higher. Associations were assessed using Firth penalized logistic regression.

Results

Major postoperative complications occurred in 2 of 46 patients (4.3%) in the perigastric group and 7 of 14 patients (50.0%) in the non-perigastric group ($P < 0.001$). In the univariable Firth penalized logistic regression analysis, non-perigastric single-group lymph node metastasis was associated with major postoperative complications (OR, 17.80; 95% CI, 3.89–111.43; $P < 0.001$). The association remained after adjustment for age, preoperative serum carcinoembryonic antigen status, and CT-visible lymph node count (OR, 10.69; 95% CI, 2.26–70.25; $P = 0.002$). Similar estimates were obtained in sensitivity analyses incorporating lower mediastinal lymphadenectomy or the number of examined lymph nodes.

Conclusion

Among patients with Siewert type II/III AEG and single-group lymph node metastasis, non-perigastric involvement was associated with a higher incidence of major postoperative complications within 30 days after surgery. The findings should be interpreted cautiously because of the small number of outcome events.

Introduction

Adenocarcinoma of the esophagogastric junction (AEG) arises at the anatomical transition between the esophagus and stomach. Its lymphatic drainage extends in both mediastinal and abdominal directions,

producing a complex pattern of nodal spread ^[1, 2]. The incidence of AEG has increased worldwide, with a particularly marked disease burden in East Asia ^[3, 4]. Siewert type II and III tumors are the most common subtypes and account for approximately 70%–80% of AEG cases ^[5–7]. Their nodal spread commonly involves the perigastric, celiac, and lower mediastinal regions ^[8]. This anatomical pattern is clinically relevant because it influences the extent of lymphadenectomy and perioperative management.

Lymph node metastasis is a major prognostic factor in AEG ^[9]. The UICC/AJCC TNM system classifies nodal disease primarily according to the number of metastatic lymph nodes ^[10]. Most prognostic studies have similarly focused on nodal count ^[11]. However, patients with a similar number of metastatic nodes may differ in the anatomical distribution of nodal disease and in their postoperative course ^[12]. Nodal location may therefore provide information that is not captured by nodal count alone.

Major postoperative complications can prolong recovery, increase the need for invasive treatment and readmission, and delay subsequent oncological therapy ^[13]. Previous studies of nodal location have focused mainly on the therapeutic value of lymphadenectomy, recurrence, and survival. Evidence regarding the relationship between the anatomical location of metastatic nodes and postoperative morbidity remains limited.

Studies of nodal location are often confounded by metastatic burden because non-perigastric involvement frequently coexists with multiple metastatic nodes and multigroup spread ^[14, 15]. To reduce this source of heterogeneity, we restricted the analysis to patients in whom metastatic lymph nodes were confined to a single numbered nodal group. We then compared postoperative outcomes between perigastric and non-perigastric involvement and assessed the association between nodal location and Clavien–Dindo grade III or higher complications.

Materials and Methods

Study Design and Patients

This single-center retrospective cohort study included 653 consecutive patients with pathologically confirmed AEG treated at Changzhi People's Hospital between January 2019 and December 2023. After application of the eligibility criteria, 60 patients with Siewert type II/III AEG and postoperative pathological confirmation of single-group lymph node metastasis were included. The patient selection process is shown in Fig. 1.

Lymph nodes were separated by the operating surgeon according to the Japanese Gastric Cancer Association classification and submitted to the pathology department in numbered-group-specific containers. Pathological findings were recorded by nodal group. Follow-up information was obtained from outpatient records and telephone interviews and was updated through December 2025.

The study was approved by the Ethics Committee of Changzhi People's Hospital (approval No. 2025K055). The requirement for informed consent was waived.

Patients were excluded if they had undergone non-curative surgery; had Siewert type I AEG; had no lymph node metastasis or metastatic lymph nodes involving more than one numbered nodal group; had concomitant malignant tumors at other sites; had previously undergone major gastric or esophageal surgery; had incomplete key clinical, imaging, or follow-up data; or had undergone D1 lymphadenectomy only.

Definition of Nodal Groups

Nodal groups were classified according to the Japanese Gastric Cancer Association system. Single-group lymph node metastasis was defined as metastatic lymph nodes confined to one numbered nodal group, regardless of the number of metastatic lymph nodes within that group.

Patients were divided according to the anatomical location of the metastatic nodal group. The perigastric group included metastasis confined to No. 1–6 lymph nodes: right paracardial, left paracardial, lesser-curvature, greater-curvature, suprapyloric, and infrapyloric nodes. The non-perigastric group included metastasis outside No. 1–6, mainly No. 7 and 8 nodes along the left gastric and common hepatic arteries, No. 9 nodes around the celiac axis, No. 10 and 11 nodes at the splenic hilum and along the splenic artery, No. 19 and 20 nodes in the infradiaphragmatic and esophageal hiatal regions, and No. 110 and 111 nodes in the lower mediastinum.

CT Acquisition and Image Analysis

Preoperative CT examinations were performed using a Revolution CT scanner (GE Healthcare, USA). Patients fasted for 12 h before examination and drank approximately 800 mL of warm water within 20 min before scanning to achieve gastric distension. CT scanning was performed from the lower margin of the aortic arch to the upper margin of the pubic symphysis. Iodixanol (320 mg iodine/mL) was administered intravenously at a dose of 1.0 mL/kg and an injection rate of 3.0–3.5 mL/s, followed by a 20-mL saline flush at the same rate. Arterial- and portal venous-phase images were acquired 25–30 s and 65–70 s after contrast administration, respectively. Scanning parameters were as follows: tube voltage, 120 kVp; automatic tube current modulation; collimation, 64×0.625 mm; rotation time, 0.5 s; pitch, 0.992; reconstructed slice thickness, 1.25 mm; and reconstruction interval, 1.25 mm.

All preoperative CT examinations were independently reviewed by two radiologists with 10 and 3 years of experience in abdominal CT interpretation, respectively. Both readers were blinded to the postoperative pathological findings. The CT-visible lymph node count was defined as the total number of lymph nodes visually identifiable on preoperative CT, irrespective of nodal size or morphological features suggestive of metastasis. Peritumoral enhancing small vessels within 5 mm were defined as visually identifiable small vessels showing contrast enhancement within 5 mm of the outer tumor margin and were recorded

as present or absent. Other evaluated CT features included serosal involvement, maximum nodal short-axis diameter, attenuation homogeneity of the solid tumor component, tumor margin definition, and clarity of the peritumoral fat plane.

Outcomes and Data Collection

The primary outcome was a major postoperative complication within 30 days after surgery. Complication severity was graded according to the Clavien–Dindo classification, with major complications defined as grade III or higher ^[16]. Secondary outcomes included any postoperative complication, length of postoperative hospital stay, complication-related readmission, and bowel obstruction within two years after surgery.

Postoperative complications were identified retrospectively from medical records, operative notes, and records of interventional or endoscopic treatment. Two investigators who had not participated in the original clinical decision-making independently reviewed and classified the events; disagreements were resolved by discussion.

Collected variables included demographic characteristics, preoperative clinical and tumor-related characteristics, CT findings, laboratory measurements, pathological and immunohistochemical findings, operative variables, postoperative outcomes, and follow-up data.

Baseline variables included age and sex. Preoperative clinical and tumor-related variables included neoadjuvant treatment, maximum tumor diameter, distance from the tumor center to the esophagogastric junction, length of esophageal involvement, maximum wall thickness, direction of tumor extension, and Lauren classification.

Preoperative laboratory variables included fibrinogen, absolute monocyte count, absolute lymphocyte count (ALC), absolute neutrophil count, platelet count, fibrinogen-to-lymphocyte ratio, neutrophil-to-lymphocyte ratio, lymphocyte-to-monocyte ratio, platelet-to-lymphocyte ratio, serum carcinoembryonic antigen (CEA), and carbohydrate antigen 19 – 9 (CA19-9). Serum CEA and CA19-9 results were classified as positive or negative according to the upper limit of normal established by the institutional laboratory.

Pathological and immunohistochemical variables included lymphovascular invasion, perineural invasion, mismatch repair protein status, human epidermal growth factor receptor 2 (HER2) status, and CD56 expression. Selected imaging and immunohistochemical variables are reported in Supplementary Table 1.

Operative variables included type of gastrectomy, number of examined lymph nodes (ELNs), number of metastatic lymph nodes (mLNs), lymph node ratio (LNR), Additional hiatal and peridiaphragmatic lymphadenectomy and lower mediastinal lymphadenectomy. Dissection of No. 19 and 20 nodes was classified as Additional hiatal and peridiaphragmatic lymphadenectomy, whereas dissection of No. 110 and 111 nodes was classified as lower mediastinal lymphadenectomy. Follow-up outcomes included

bowel obstruction, complication-related readmission, disease-free survival, and recurrence or metastasis.

Statistical Analysis

Statistical analyses were performed using R version 4.4.1 (R Foundation for Statistical Computing, Vienna, Austria). Continuous variables were assessed for normality. Normally distributed variables are presented as mean $\pm$ standard deviation and were compared using the independent-samples t test. Non-normally distributed variables are presented as median and interquartile range and were compared using the Wilcoxon rank-sum test. Categorical variables are presented as number and percentage and were compared using Fisher's exact test. All tests were two-sided, and $P < 0.05$ was considered statistically significant.

Firth penalized logistic regression was used to assess the association between nodal location and major postoperative complications. Because only nine major postoperative complications occurred, the adjusted model was kept parsimonious. Age, preoperative serum CEA status, and CT-visible lymph node count were included as clinically distinct host-, tumor-, and imaging-related covariates.

An univariable model was fitted first, followed by a multivariable model adjusted for age, preoperative serum CEA status, and CT-visible lymph node count. Sensitivity analyses separately added lower mediastinal lymphadenectomy and ELNs to the adjusted model.

Results

Patient Characteristics

Among the 653 patients screened, 60 met the eligibility criteria. Forty-six patients had perigastric single-group lymph node metastasis and 14 had non-perigastric single-group lymph node metastasis (Table 1 and Supplementary Table 1).

The two groups did not differ significantly in sex, neoadjuvant treatment, maximum tumor diameter, Lauren classification, type of gastrectomy, ELNs, mLN, LNR, or the evaluated extent of lymphadenectomy (all $P > 0.05$).

Patients in the non-perigastric group were younger than those in the perigastric group (median, 60.50 vs 67.00 years; $P = 0.029$), had lower preoperative ALCs (median, $1.23 \times 10^9/L$ vs $1.54 \times 10^9/L$; $P = 0.025$), and had fewer CT-visible lymph nodes (median, 1.00 vs 2.00; $P = 0.031$). Preoperative serum CEA positivity was observed in 1 of 14 patients (7.1%) in the non-perigastric group and 16 of 46 patients (34.8%) in the perigastric group ($P = 0.050$).

Peritumoral enhancing small vessels within 5 mm were observed in 3 of 14 patients (21.4%) in the non-perigastric group and 7 of 46 patients (15.2%) in the perigastric group ($P = 0.589$). A clear peritumoral fat

plane was recorded in 7 of 14 patients (50.0%) and 10 of 46 patients (21.7%), respectively ($P = 0.087$). Neither difference was statistically significant.

Table 1
Baseline characteristics, operative variables, and postoperative outcomes in the perigastric and non-perigastric groups

Variable	Perigastric Group N = 46	Non-perigastric Group N = 14	P value
Baseline characteristics			
Age, years, median [IQR]	67.00 [60.00, 70.75]	60.50 [54.25, 62.75]	0.029*
Sex			0.725
Female	11 (23.9%)	4 (28.6%)	
Male	35 (76.1%)	10 (71.4%)	
Preoperative clinicopathological features			
History of neoadjuvant therapy			0.264
No	39(84.8%)	10(71.4%)	
Yes	7(15.2%)	4(28.6%)	
Maximum tumor diameter, cm, median [IQR]	3.73 [3.00, 4.99]	3.31 [2.95, 4.88]	0.545
Lauren classification			0.794
Intestinal type	21 (45.7%)	6 (42.9%)	
Diffuse type	12 (26.1%)	5 (35.7%)	
Mixed type	13 (28.3%)	3 (21.4%)	
Preoperative CT characteristics			
CT-visible lymph node count, median [IQR]	2.00 [1.00, 2.75]	1.00 [1.00, 1.00]	0.031*
Peritumoral enhancing small vessels within 5 mm, n (%)			0.589
Yes	7 (15.2%)	3 (21.4%)	
No	39 (84.8%)	11 (78.6%)	
Clear peritumoral fat plane, n (%)			0.087
Yes	10 (21.7%)	7 (50.0%)	
No	36 (78.3%)	7 (50.0%)	
Preoperative laboratory indicators			

Variable	Perigastric Group N = 46	Non-perigastric Group N = 14	P value
Absolute lymphocyte count, ×10 ⁹ /L, median [IQR]	1.54 [1.26, 2.14]	1.23 [0.93, 1.64]	0.025*
Preoperative serum and pathological markers			
Preoperative serum CEA positivity, n (%)	16 (34.8%)	1 (7.1%)	0.050
Lymphovascular invasion			0.520
No	31 (67.4%)	11 (78.6%)	
Yes	15 (32.6%)	3 (21.4%)	
Perineural invasion			1.000
No	29 (63.0%)	10 (71.4%)	
Yes	17 (37.0%)	4 (28.6%)	
Surgical variables			
Type of gastrectomy			0.444
Proximal gastrectomy	11 (23.9%)	2 (14.3%)	
Total gastrectomy	35 (76.1%)	12 (85.7%)	
ELNs	44.00 [30.00, 53.00]	36.00 [29.50, 40.00]	0.128
mLNs	1.00 [1.00, 1.00]	1.00 [1.00, 1.00]	0.767
Additional hiatal and peridiaphragmatic lymphadenectomy			1.000
No	17 (37.0%)	5 (35.7%)	
Yes	29 (63.0%)	9 (64.3%)	
Lower mediastinal lymphadenectomy			1.000
No	34 (73.9%)	11 (78.6%)	
Yes	12 (26.1%)	3 (21.4%)	
Short-term postoperative outcomes			
Number of postoperative complications per patient, mean ± SD	0.97 ± 1.47	1.91 ± 1.38	0.003*
Any postoperative complication, n (%)	17 (37.0%)	11 (78.6%)	0.013*

Variable	Perigastric Group N = 46	Non-perigastric Group N = 14	P value
Major postoperative complications (Clavien–Dindo grade $\geq$ III)			$< 0.001^*$
CD grade $<$ III	44 (95.7%)	7 (50.0%)	
CD grade $\geq$ III	2 (4.3%)	7 (50.0%)	
Postoperative hospital stay (days, median [IQR])	13.00 [9.00, 16.00]	17.50 [12.75, 25.00]	0.024*
2-year postoperative follow-up endpoints			
Bowel obstruction within 2 years after surgery			0.023*
No	44 (95.7%)	10 (71.4%)	
Yes	2 (4.3%)	4 (28.6%)	
Complication-related readmission			0.002*
No	45 (97.8%)	9 (64.3%)	
Yes	1 (2.2%)	5 (35.7%)	

Data are presented as n (%), mean $\pm$ standard deviation, or median [interquartile range], as appropriate. P values were calculated using the independent-samples t test for normally distributed continuous variables, the Wilcoxon rank-sum test for non-normally distributed continuous variables, and Fisher's exact test for categorical variables. ALC, absolute lymphocyte count; CEA, carcinoembryonic antigen; CT, computed tomography; CD, Clavien–Dindo; ELNs, examined lymph nodes; mLNs, metastatic lymph nodes; LNR, lymph node ratio; IQR, interquartile range; SD, standard deviation. * $P < 0.05$.

Postoperative Outcomes

Any postoperative complication occurred in 11 of 14 patients (78.6%) in the non-perigastric group and 17 of 46 patients (37.0%) in the perigastric group ($P = 0.013$). Major postoperative complications occurred in 7 patients (50.0%) and 2 patients (4.3%), respectively ($P < 0.001$).

Complication-related readmission occurred in 5 of 14 patients (35.7%) in the non-perigastric group and 1 of 46 patients (2.2%) in the perigastric group ($P = 0.002$). Bowel obstruction within two years after surgery occurred in 4 patients (28.6%) and 2 patients (4.3%), respectively ($P = 0.023$).

The mean number of postoperative complications per patient was higher in the non-perigastric group than in the perigastric group (1.91 ± 1.38 vs 0.97 ± 1.47 ; $P = 0.003$). Median postoperative hospital stay

was also longer in the non-perigastric group (17.50 [12.75–25.00] vs 13.00 [9.00–16.00] days; P = 0.024) (Table 1 and Fig. 2). Disease-free survival and recurrence/metastasis outcomes are reported in Supplementary Table 1.

Nine of the 60 patients developed a major postoperative complication: 2 of 46 patients in the perigastric group and 7 of 14 patients in the non-perigastric group.

In the univariable Firth penalized logistic regression model, non-perigastric single-group lymph node metastasis was associated with major postoperative complications (OR, 17.80; 95% CI, 3.89–111.43; P < 0.001).

After adjustment for age, preoperative serum CEA status, and CT-visible lymph node count, the association remained (OR, 10.69; 95% CI, 2.26–70.25; P = 0.002). The estimate remained similar when lower mediastinal lymphadenectomy was added to the adjusted model (OR, 9.63; 95% CI, 2.08–60.03; P = 0.003) and when ELNs were added (OR, 9.84; 95% CI, 2.06–67.98; P = 0.004) (Table 2 and Fig. 3).

Table 2
Association of Non-Perigastric Single-Group Lymph Node Metastasis With Major Postoperative Complications

Model	Variables adjusted	OR (95% CI)	P value
Model 1 (Univariable)	—	17.80 (3.89–111.43)	< 0.001
Model 2 (Multivariable)	Age, CEA status, CT-visible lymph node count	10.69 (2.26–70.25)	0.002
Sensitivity analysis A	Model 2 + lower mediastinal lymphadenectomy	9.63 (2.08–60.03)	0.003
Sensitivity analysis B	Model 2 + ELNs	9.84 (2.06–67.98)	0.004

Firth penalized logistic regression was used, with the perigastric group as the reference. CEA, carcinoembryonic antigen; CT, computed tomography; ELNs, examined lymph nodes; OR, odds ratio; CI, confidence interval.

Discussion

The principal finding of this study was that the anatomical location of single-group lymph node metastasis was associated with postoperative morbidity in patients with Siewert type II/III AEG. Major postoperative complications occurred in 50.0% of patients with non-perigastric involvement compared with 4.3% of those with perigastric involvement. After adjustment for age, preoperative serum CEA status, and CT-visible lymph node count, non-perigastric involvement remained associated with major postoperative complications. The effect estimates were also similar after lower mediastinal lymphadenectomy or the number of examined lymph nodes was incorporated into the model. By

restricting the cohort to patients whose metastatic lymph nodes were confined to a single numbered nodal group, the present study reduced the influence of extensive multigroup nodal spread and allowed the association between nodal location and postoperative outcomes to be examined in a more homogeneous setting.

The anatomical distribution of nodal metastasis may represent a dimension of disease that is not fully described by nodal count alone. The current UICC/AJCC TNM system classifies regional nodal disease primarily according to the number of metastatic lymph nodes ^[16–18], whereas Siewert type II/III AEG has lymphatic drainage extending from the perigastric region toward the celiac and lower mediastinal pathways ^[5, 19, 20]. Previous studies have therefore examined the prognostic and therapeutic relevance of specific nodal regions, and a multi-institutional gastric cancer study has further shown that nodal location can provide prognostic information in addition to nodal number ^[12, 21]. Our findings add a perioperative perspective to this issue. Even when nodal spread was confined to a single group, patients with metastasis outside the perigastric No. 1–6 groups experienced substantially more major postoperative complications. This suggests that the spatial distribution of metastatic nodes may convey clinical information beyond the number of involved nodes.

One possible explanation for the higher complication rate in the non-perigastric group is that nodal involvement outside the perigastric region may be accompanied by a broader operative field. In the present cohort, however, the proportions undergoing lower mediastinal lymphadenectomy and additional hiatal or peridiaphragmatic lymphadenectomy did not differ significantly between the two groups. Moreover, the association between non-perigastric involvement and major postoperative complications remained of similar magnitude when lower mediastinal lymphadenectomy or examined lymph node count was added separately to the adjusted model. These analyses do not exclude the influence of operative complexity, particularly because operative time, blood loss, and other intraoperative factors were not included in the current model. Nevertheless, the consistency of the estimates indicates that the observed association was not substantially altered by the measured differences in lymphadenectomy extent.

Several clinical differences between the two groups may further characterize this nodal pattern. Patients with non-perigastric involvement were younger but nevertheless had a higher incidence of major postoperative complications, and the association with nodal location persisted after adjustment for age. Preoperative ALC was also lower in the non-perigastric group. Previous gastric cancer studies have shown that peripheral lymphocyte profiles are associated with immune status, postoperative recovery, and surgical outcomes ^[15, 22, 23]. The lower ALC observed in the non-perigastric group may therefore reflect differences in host condition that are not captured by age alone. In contrast, Lauren classification, lymphovascular invasion, and perineural invasion were similar between the groups. Preoperative serum CEA positivity was less frequent in the non-perigastric group, although the difference was borderline (7.1% vs 34.8%; $P = 0.050$). Taken together, these findings suggest that non-perigastric single-group metastasis cannot be characterized by a single conventional clinicopathological marker and may represent a distinct pattern of nodal spread requiring further investigation.

The CT findings provide another perspective on this distinction. Patients with non-perigastric metastasis had fewer lymph nodes visible on preoperative CT despite having pathologically confirmed metastatic involvement outside the perigastric region. In this study, CT-visible lymph node count included all visually identifiable lymph nodes irrespective of size or morphological suspicion for metastasis. Therefore, the lower CT-visible lymph node count in the non-perigastric group should not be interpreted as a lower pathological nodal burden. Rather, it highlights the difference between the number of nodes visible on CT and the eventual anatomical distribution of pathological nodal metastasis. Recent studies have demonstrated the feasibility of using CT-based texture, radiomics, and fusion models for preoperative prediction of lymph node metastasis in AEG [24–25]. Peritumoral enhancing small vessels within 5 mm and the clarity of the peritumoral fat plane also showed numerical differences between the two groups, but neither reached statistical significance. These findings suggest that conventional nodal size or count alone may be insufficient to characterize the spatial pattern of nodal spread and support further investigation of preoperative CT features associated with non-perigastric involvement.

The clinical value of these findings lies primarily in perioperative risk recognition rather than in determining the extent of surgery. Single-group nodal location in the present study was established by postoperative pathological examination and therefore cannot by itself guide preoperative selection of gastrectomy or lymphadenectomy. However, the marked difference in postoperative morbidity suggests that patients with non-perigastric involvement constitute a clinically relevant subgroup. Identification of this pattern may help explain heterogeneity in postoperative recovery among patients with apparently limited nodal disease and may support closer postoperative surveillance and earlier recognition of complications. More importantly, the observed differences in preoperative CT and clinical characteristics provide a basis for future studies aimed at identifying this nodal pattern before surgery. The recent development of CT-based models for preoperative assessment of AEG invasion and lymph node metastasis supports the feasibility of this direction [26]. If reproducible preoperative markers of non-perigastric involvement can be established, the present pathological observation could ultimately contribute to preoperative perioperative-risk assessment.

Several limitations should be considered. First, this was a single-center retrospective study with only 60 patients, including 14 with non-perigastric involvement, and only nine major postoperative complication events. Although Firth penalized logistic regression was used to reduce small-sample bias, the confidence intervals were wide and the magnitude of the association should be interpreted cautiously. Second, residual confounding remains possible because several established determinants of postoperative complications, including comorbidity burden, nutritional status, operative duration, and intraoperative blood loss, were not fully incorporated into the adjusted models. Third, the non-perigastric group included anatomically different nodal regions, such as celiac, splenic hilar, hiatal, and lower mediastinal groups, and the sample size did not permit reliable analysis of individual nodal groups. Finally, this study focused mainly on postoperative morbidity, and the current sample and follow-up were insufficient to determine the independent prognostic effect of nodal location on recurrence or survival.

Despite these limitations, the present study shows that, among patients with Siewert type II/III AEG and lymph node metastasis confined to a single numbered group, non-perigastric involvement was associated with a markedly higher incidence of major postoperative complications. The association persisted after adjustment for selected clinical and imaging characteristics and remained stable in sensitivity analyses incorporating lymphadenectomy-related variables. These findings support the view that the anatomical distribution of nodal metastasis may provide clinically relevant information beyond nodal count alone and warrant validation in larger, multicenter cohorts.

Declarations

Ethics approval and consent to participate

The study was approved by the Ethics Committee of Changzhi People's Hospital (approval No. 2025K055). The requirement for informed consent was waived due to the retrospective nature of the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author Contributions

YWW contributed to study design, manuscript drafting, statistical analysis, and figure preparation. Jb W contributed to data management and follow-up. LM, QF, JZ, and YQL contributed to the collection of clinical and imaging data. YAL reviewed the manuscript and obtained funding.

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Figures

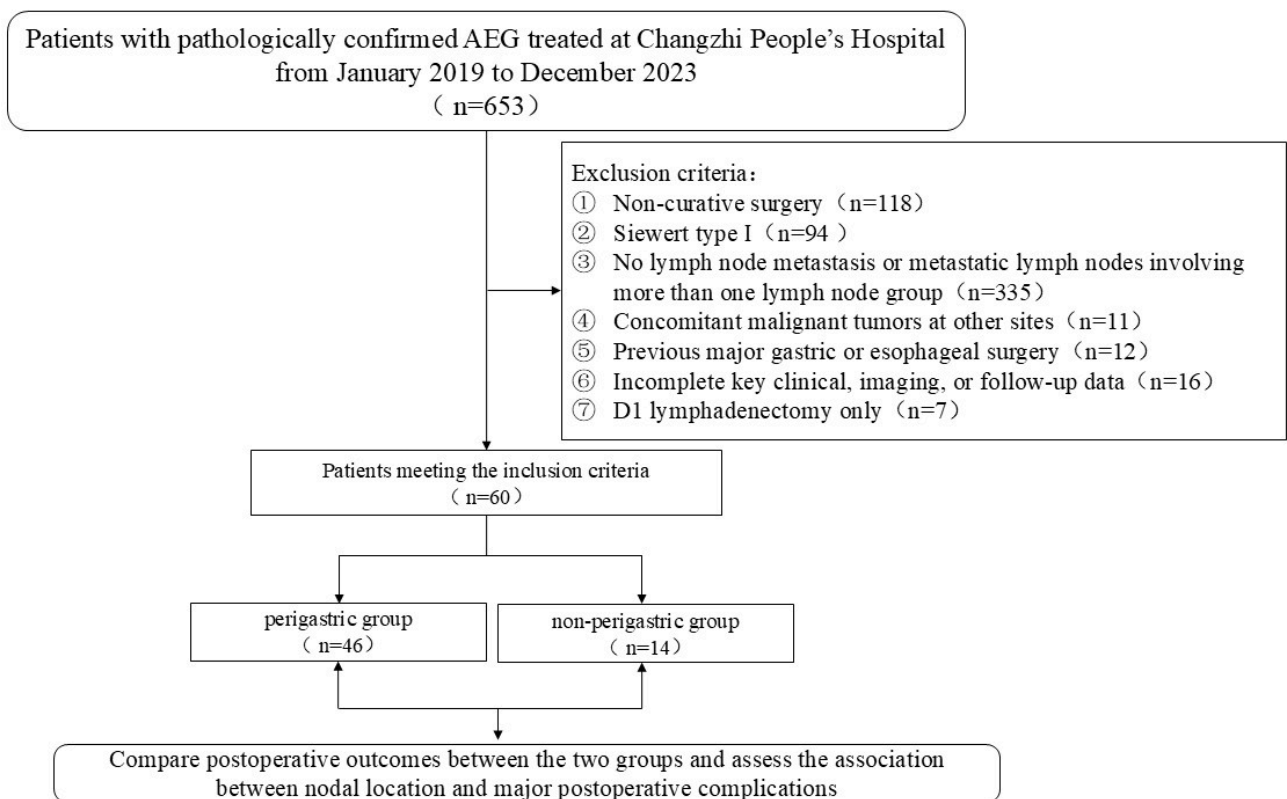


Figure 1

Patient selection flowchart

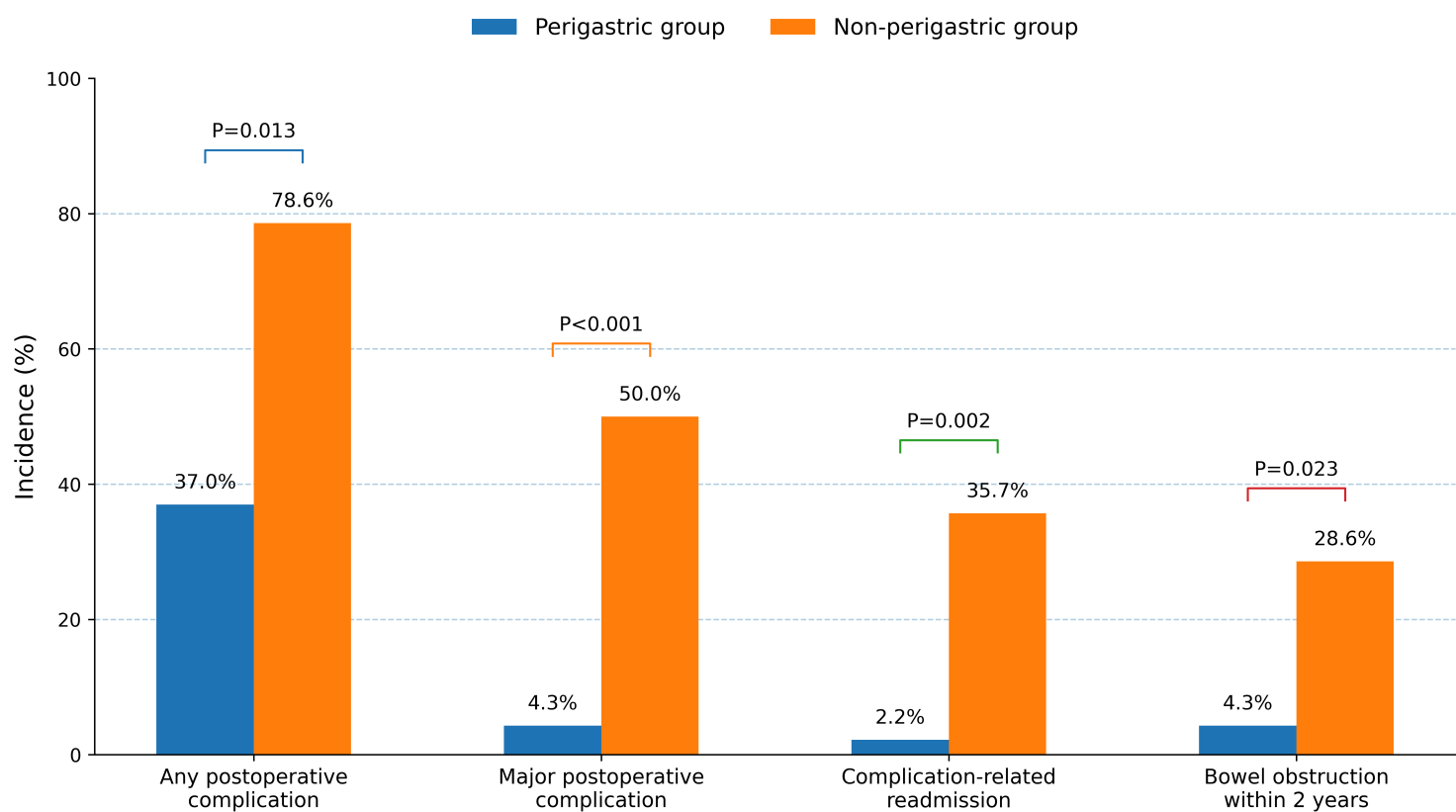


Figure 2

Postoperative outcomes in the perigastric and non-perigastric groups

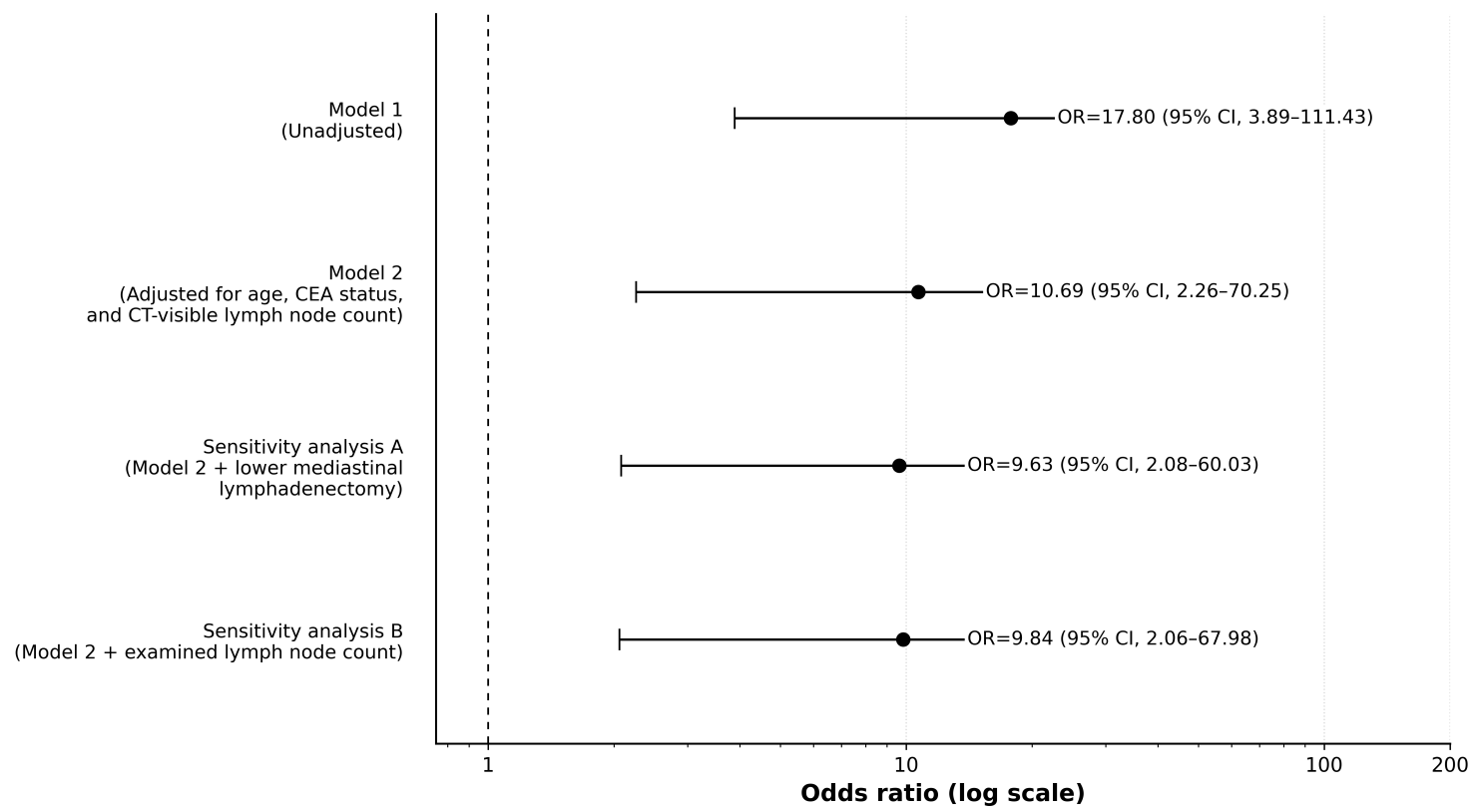


Figure 3

Association between non-perigastric single-group lymph node metastasis and major postoperative complications