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Original Research Article

Comparative analysis of short-term outcomes between upper radical and total radical gastrectomy in patients with proximal gastric cancer

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ABSTRACT

Background: Gastric cancer remains a significant global health burden, ranking as the fifth most common cancer and the third leading cause of cancer-related deaths. Surgical interventions like Upper Radical Gastrectomy (URG) and Total Radical Gastrectomy (TRG) are pivotal in the management of proximal gastric cancer. This study aims to compare the short-term outcomes between URG and TRG in patients with proximal gastric cancer. To evaluate and compare the immediate postoperative outcomes, including complications, gastrointestinal (GIT) functionality, nutritional status, hospital stay duration and recovery between URG and TRG in patients with proximal gastric cancer.
Methods: This prospective observational study was conducted on 67 patients diagnosed with operable proximal gastric cancer at the National Institute of Cancer Research & Hospital and National Gastro-liver Institute & Hospital, Dhaka.
Results: The study found that URG patients generally had better short-term outcomes than those undergoing TRG. URG was associated with a lower rate of immediate postoperative complications (7.14% vs. 84.62% in TRG), shorter hospital stays, superior nutritional outcome and faster recovery of gastrointestinal functionality with significantly lower mean feeding time with higher incidence of post-operative bile reflux in URG group compared to TRG group. Additionally, TRG patients exhibited higher rates of lympho-vascular invasion and node involvement, necessitating a more radical surgical approach.
Conclusions: URG may offer superior short-term outcomes compared to TRG in patients with proximal gastric cancer, particularly in terms of postoperative recovery and reduced complications.

Keywords: Comparative Analysis, Proximal gastric cancer, Radical gastrectomy

INTRODUCTION

Gastric cancer remains a significant global health burden, ranking as the fifth most commonly diagnosed cancer and the third leading cause of cancer-related deaths worldwide.[1] According to GLOBOCAN 2020, approximately 1.09 million new cases and an estimated 769,000 deaths from gastric cancer were reported globally. Additionally, 604,100 new cases of esophageal cancer and 544,100 deaths further underscored the serious public health impact of upper gastrointestinal malignancies.[2] In Bangladesh, gastric cancer is recognized as one of the ten most prevalent malignancies, with an estimated incidence of 5.1% in males and 2.6% in females.[3] Gastric cancer encompasses various subtypes based on anatomical location, with proximal gastric cancer gaining clinical attention due to its increasing incidence. A study from South Korea found that 44.5% of gastric cancer cases were proximal, indicating a significant rise. However, limited research has focused on the specific surgical approaches for proximal gastric cancer and their outcomes, particularly in resource-limited settings.[4] Surgical intervention is the cornerstone of curative therapy for

localized gastric cancer, with gastrectomy being the standard approach.[5,6] The tumour's location largely dictated the choice of surgical resection. For proximal gastric cancer, the main approaches were total radical gastrectomy (TRG) and upper radical gastrectomy (URG). TRG involved complete stomach removal and complex reconstruction, often leading to greater disruption of normal gastrointestinal function.[7]

In contrast, upper radical gastrectomy (or proximal gastrectomy) involved removing the upper stomach and regional lymph nodes while preserving the distal stomach to maintain partial function.[6-9] Supporters of TRG claimed it allowed more thorough lymph node dissection; for instance, Yoo et al, reported significantly higher lymph node retrieval with TRG, indicating better oncological clearance.[10] However, the clinical need for extensive lymphadenectomy remained unclear, as earlier studies showed a very low rate of metastasis to lower stomach lymph nodes in proximal gastric cancer, with their removal having little effect on survival outcomes.[11,12] As such, provided clear margins are achieved, both TRG and URG may offer comparable oncologic effectiveness.[13] The growing focus on organ preservation in cancer surgery supported the use of less extensive resections when appropriate. In gastric surgery, preserving the organ aimed to enhance postoperative quality of life and reduce long-term issues like nutritional deficiencies, weight loss and anemia.[14]

URG was designed to reduce postoperative weight loss by preserving gastric capacity, whereas TRG was associated with higher rates of complications such as anemia and nutritional difficulties. Short-term outcomes feeding tolerance, GI function, early complications and hospital stay were crucial for recovery. Given TRG's complexity, strategies that shortened hospital stay without compromising oncologic outcomes were preferred.[15] Furthermore, URG may lead to better recovery, lower bile reflux risk, improved stump condition and enhanced quality of life, yet few studies have addressed its short-term outcomes within Bangladesh's healthcare context. This study aimed to fill this gap by providing a comparative analysis of the short-term outcomes of upper radical versus total radical gastrectomy in patients with proximal gastric cancer, contributing valuable evidence to inform surgical decision-making and improve patient care.

METHODS

This prospective observational study was conducted over a 12-month period from January 2024 to December 2024 at two prominent national institutions in Bangladesh: The National Institute of Cancer Research and Hospital (NICRH) and the National Gastro-liver Institute and Hospital (NGIH), both located in Mohakhali, Dhaka. Ethical approval for the study was obtained from the Institutional Review Board of NICRH. Informed written consent was obtained from all participants after explaining the purpose, procedures, potential risks and benefits of the study.

Study population

The study population consisted of individuals diagnosed with proximal gastric cancer who underwent either upper radical gastrectomy (URG) or total radical gastrectomy (TRG) at NICRH or NGIH during the study period. A purposive convenient sampling technique was employed to recruit eligible participants. A total of 67 patients were enrolled, with 28 patients undergoing URG (25 from NICRH and 3 from NGIH) and 39 patients undergoing TRG (33 from NICRH and 6 from NGIH).

Inclusion criteria

Age≥18 years, regardless of gender. Diagnosis of proximal gastric cancer confirmed by endoscopic, radiological and histopathological evaluation. Provision of written informed consent for study participation. Willingness to attend scheduled follow-up visits for up to six months postoperatively.

Exclusion criteria

Evidence of distant metastasis or metastatic gastric cancer. Presence of other concurrent malignancies. History of previous gastric surgery for cancer.

Surgical procedures

The URG and TRG procedures were performed by experienced surgical oncologists at both institutions. Upper Radical Gastrectomy involved resection of the upper two-thirds of the stomach with D2 lymphadenectomy, while Total Radical Gastrectomy included complete gastric resection along with D2 lymph node dissection. Reconstruction following URG was achieved through esophagogastrostomy and for TRG, Roux-en-Y oesophagojejunostomy was performed.

Data collection

Data collection was carried out using a pre-designed, semi-structured questionnaire administered by trained clinicians. Relevant information was obtained through comprehensive clinical evaluation, operative and anaesthetic records, laboratory test results and radiological imaging reports. Baseline demographic and clinical characteristics were recorded preoperatively. Intraoperative data included surgical approach, duration and perioperative findings.

Postoperative follow-up assessments were conducted at the 2nd, 4th and 6th months following surgery to monitor patient recovery and identify complications. During these visits, clinical status, laboratory parameters and imaging findings were reviewed to evaluate both primary and secondary outcome measures. Standardized protocols

were followed to ensure consistency and minimize inter-observer variability in data recording. All collected data were de-identified and entered into a secured database for subsequent analysis.

Follow-up and complication assessment

Postoperative complications were systematically monitored using standardized diagnostic criteria. Anastomotic leakage was diagnosed based on radiologic confirmation and clinical symptoms such as fever, abdominal pain or sepsis. Wound infections were evaluated according to the centers for disease control and prevention (CDC) surgical site infection (SSI) criteria. Reflux esophagitis was diagnosed via endoscopic findings and symptom reporting. Gastrointestinal motility complications, including ileus and bowel obstruction, were confirmed through clinical examination and imaging modalities. Respiratory and cardiovascular complications were documented using appropriate clinical and diagnostic tools.

Gastrointestinal and nutritional functional outcomes were monitored throughout the follow-up period, with specific attention to food intake progression, need for dietary modifications and supplementation.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables (e.g., complication rates) were compared using Chi-square tests, while continuous variables (e.g., length of hospital stay, serum albumin levels) were compared using independent-sample t-tests. A two-tailed p value of <0.05 was considered statistically significant.

RESULTS

Age distribution was most common in the 41–50 and 61–70 years ranges for the upper radical group and in the 51–60 years range for the total radical group. The mean age was 54.71±10.91 years in the upper radical group and 52.19±12.48 years in the total radical group. Males predominated in both groups, with a higher male representation in the upper radical group. Comorbidities like hypertension and diabetes were equally distributed, but heart disease, lung disease, kidney disease and DVT were present only in the total radical group (Table 1).

Table 2 showed similar preoperative serum albumin levels in both groups. Postoperatively, levels declined in both, with a greater reduction in the total radical group (2.85±0.52 g/dl) than in the upper radical group (3.41±0.64 g/dl), showing a significant difference.

Histopathological examination revealed a higher prevalence of adenocarcinoma in TRG patients (74.36%) compared to those undergoing URG (50.00%, p=0.007). Poorly differentiated tumors were more common in TRG patients (64.10%) than in the URG group (21.43%, p<0.001), while moderately differentiated tumors were more frequent in URG patients (60.71%). Analysis also showed a higher incidence of mixed adenocarcinoma in TRG patients (41.03%, p<0.001). Additionally, lympho-vascular invasion was significantly higher in TRG patients (48.72%) versus URG patients (21.43%, p=0.018). Node staging indicated a higher incidence of N3 stage in TRG patients (23.08%, p<0.001), as shown in Table 3.

Postoperative complications were notably less frequent in patients who underwent URG, with 92.86% of these patients experiencing no complications, in contrast to only 15.38% of those who underwent TRG (p<0.001). In the URG group, 7.14% encountered complications, whereas a substantial 84.62% of the TRG group exhibited immediate postoperative complications (Table 4).

Among the participants, some immediate post operative complications were observed. Among the URG group, incidence of complications was minimal, with 1 case of anastomotic leakage and 1 case of wound infection. On the other hand, 10 cases of wound infection, 12 cases of gastrointestinal problems and 11 cases with other complications (bleeding, pain, seroma) were present in the TRG group.

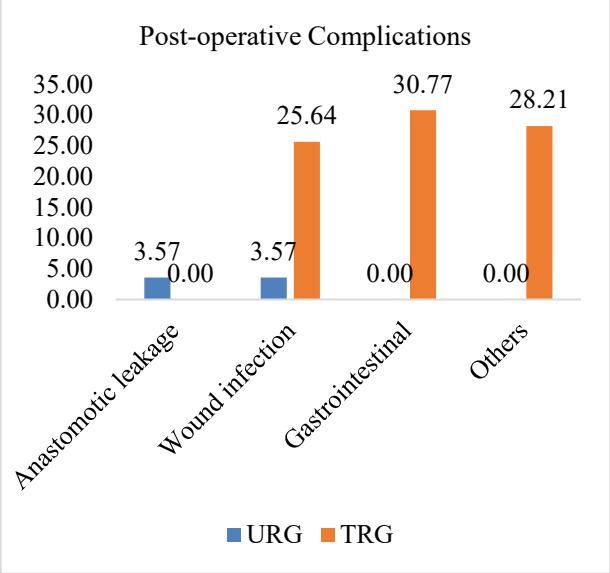

Figure 1: Distribution of post-operative complication in both groups (n=67).

The mean hospital stay was similar between groups, at 29.93±10.92 days for URG and 30.62±6.16 days for TRG (p=0.744). Post-surgery, bile reflux was reported in 35.71% of URG patients, while no TRG patients experienced this complication (p<0.001). The mean time to start feeding was 5.64±1.61 days for URG and 6.76±0.99 days for TRG (p=0.001). Post-surgery, all URG patients (100%) were able to consume semi-solid food, whereas only 53.85% of TRG patients could (p<0.001). Additionally, 46.15% of TRG patients were restricted to a

liquid diet, indicating superior digestive recovery in the URG group. Furthermore, 100% of URG patients achieved food transit within 48 hours, compared to 69.23% of TRG patients, with the remaining TRG patients exceeding 48 hours. This difference in food transit time was statistically significant (Table 8). Following surgery, 85.71% of patients undergoing URG were able to tolerate a regular diet, compared to just 15.38% of those undergoing TRG ($p<0.001$). Gastric dumping syndrome was reported in 28.21% of TRG patients, with none in the URG group ($p=0.002$). Furthermore, 64.10% of TRG patients required nutritional supplements postoperatively, significantly higher than the 14.29% of URG patients ($p<0.001$), as shown in Table 9.

Table 1: Baseline characteristics of the study population (n=67).

Variables	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)	
	N	%	N	%
Age (in years)				
≤30	0	0	4	10.26
31-40	3	10.71	7	17.95
41-50	10	35.71	8	20.51
51-60	5	17.86	10	25.64
61-70	10	35.71	7	17.95
>70	0	0	3	7.69
Mean±SD	54.71±10.91		52.19±12.48	
Gender				
Male	25	89.29	25	64.1
Female	3	10.71	14	35.9
Comorbidities				
Hypertension	3	10.71	4	10.26
Diabetes	3	10.71	4	10.26
Heart disease	0	0	1	2.56
Lung disease	0	0	2	5.13
Others (kidney dis. DVT)	0	0	2	5.13

Table 2: Distribution of Serum Albumin levels before and after surgery by type of surgery among the participants (n=67).

Serum albumin	Upper radical gastrectomy (n=28)	Total radical gastrectomy (n=39)	P value
	Mean±SD	Mean±SD	
Pre-operative (g/dl)	4.03±0.47	4.05±.052	0.816
Post-operative (g/dl)	3.41±0.64	2.85±0.52	<0.001

Table 3: Distribution of preoperative and postoperative-histopathological findings among the participants (n=67).

Variables	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		P value
	N	%	N	%	
Types (Preoperative)					
Adenocarcinoma	14	50.00	29	74.36	0.007
Signet ring cell carcinoma	0	0.00	1	2.56	
Others (tubular, mucinous, papillary)	14	50.00	5	12.82	
Mixed Adenocarcinoma	0	0.00	3	7.69	
Differentiation (Preoperative)					
Well-differentiated	5	17.86	1	2.56	<0.001
Moderately-differentiated	17	60.71	13	33.33	
Poorly-differentiated	6	21.43	25	64.10	
Types (Postoperative)					
Adenocarcinoma	14	50.00	19	48.72	0.001
Others (tubular, papillary)	13	46.43	2	5.13	
Mixed adenocarcinoma	1	3.57	16	41.03	
Mucinous adenocarcinoma	0	0.00	2	5.13	
Perineural invasion (postoperative)					
Yes	0	0.00	2	5.13	0.387
No	28	100.00	37	94.87	

Continued.

Variables	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		P value
	N	%	N	%	
Lympho-vascular invasion (postoperative)					
Yes	6	21.43	19	48.72	0.018
No	22	78.57	20	51.28	
Tumor stage (postoperative)					
Early	8	28.57	7	17.95	0.171
Advance	20	71.43	32	82.05	
Node stage (postoperative)					
N0	22	78.57	11	28.21	0.001
N1	3	10.71	13	33.33	
N2	3	10.71	6	15.38	
N3	0	0.00	9	23.08	

Table 4: Distribution of overall postoperative complications among the participants (n=67).

Complications	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		Total (n=67)		P value
	N	%	N	%	N	%	
Present	2	7.14	33	84.62	35	52.24	<0.001
Absent	26	92.86	6	15.38	32	47.76	

Table 5: Length of hospital stay distribution among the participants (n=67).

Variables	Upper radical gastrectomy (n=28)	Total radical gastrectomy (n=39)	P value
Days, Mean±SD	29.93±10.92	30.62±6.16	0.744
Range (min-max)	(17-74)	(18-48)	

Table 6: Incidence of bile reflux post-surgery among the participants (n=67).

Complications	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		Total (n=67)		P value
	N	%	N	%	N	%	
Present	10	35.71	0	0.00	10	14.92	<0.001
Absent	18	64.29	39	100.00	57	85.08	

Table 7: Commencement of post-surgery feeding among the participants (n=67).

Post-surgery feeding commencement	Upper radical gastrectomy (n=28)	Total radical gastrectomy (n=39)	P value
Days, Mean±SD	5.64±1.61	6.76±0.99	0.001
Range (min-max)	(5-13)	(5-10)	

Table 8: Distribution of food consumption type and food transit time post-surgery among the participants (n=67).

Variables	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		Total (n=67)		P value
	N	%	N	%	N	%	
Food consumption type							
Liquid	0	0.00	18	46.15	18	26.86	<0.001
Semi-solid	28	100	21	53.85	49	73.14	
Food transit time							
≤48 hours	28	100	27	69.23	55	82.09	<0.001
>48 hours	0	0.00	12	30.77	12	17.91	

Table 9: Distribution of stomach reservoir functionality post-surgery among the participants (n=67).

Stomach reservoir functionality	Upper radical gastrectomy (n=28)		Total radical gastrectomy (n=39)		P value
	N	%	N	%	
Able to tolerate regular diet	24	85.71	6	15.38	<0.001
Dumping syndrome	0	0	11	28.21	0.002
Need for nutritional supplements	4	14.29	25	64.1	<0.001

DISCUSSION

Gastric cancer (GC) remains a major global health concern with high mortality, particularly for proximal GC, which shows a higher rate of cancer-related deaths. URG was introduced to improve patient outcomes by preserving half of the stomach, thereby minimizing postoperative weight loss and offering effective radicality and safety in upper-third gastric cancers. Most participants were aged 41–50 years (26.87%), with a mean age of 51.98 years, consistent with global GC trends that show middle-aged populations are most affected.[16]

A male predominance was observed (74.63%), aligning with previous findings, possibly due to higher smoking and alcohol use among men.[17-19] Common comorbidities included hypertension and diabetes (each in 10.45% of participants), reflecting similar trends reported by.[20] These conditions are known to complicate recovery and increase surgical risks.[21] Pathological data support TRG for more advanced cases, with higher lympho-vascular invasion (48.72% in TRG vs. 21.43% in URG), highlighting more extensive tumor spread. Lympho-vascular invasion is a critical prognostic factor linked to recurrence and survival.[22]

Additionally, TRG patients had more node involvement, with 23.08% showing N3 status compared to 0% in URG, in line with studies emphasizing nodal metastasis in guiding surgical strategies.[23] Both groups experienced a significant decline in serum albumin levels post-surgery, but the decrease was significantly greater in the TRG group. The mean serum albumin level dropped from 4.05±0.52 g/d preoperatively to 2.85±0.52 g/dl postoperatively in TRG patients ($p<0.001$), whereas URG patients showed a reduction from 4.03±0.47 g/dl to 3.41±0.64 g/dl ($p<0.001$). This significant decline in serum albumin levels is consistent with previous research, which associates TRG with increased postoperative hypoalbuminemia due to increased physiological disruption and impaired gastrointestinal function.[21]

However, An et al, found no significant difference in serum albumin level in URG and TRG group.[24] Lower postoperative serum albumin levels have been identified as risk factors for delayed recovery, higher rates of postoperative complications and extended hospital stays, as discussed by Hübner et al.[25] The significant nutritional decline in TRG patients is also likely related to the more extensive tissue resection and the accompanying reduction in gastric reservoir capacity, which can impair food intake and nutrient absorption postoperatively. The significantly higher proportion of TRG patients (84.62%) experiencing immediate postoperative complications compared to URG patients (7.14%) underscores the greater physiological stress and surgical complexity associated with TRG. Previous studies have linked this higher complication rate in TRG to more advanced disease stages and complex procedures.[26,27] However, An et al reported higher overall complications in the URG group, possibly due to their inclusion of bile reflux, which this study treats as a separate variable.[24] Hospital stay duration, an indicator of recovery, was longer in 53.85% of TRG patients compared to 32.14% in the URG group, though this was not statistically significant ($p=0.242$). The mean hospital stay was comparable: 29.93±10.92 days for URG and 30.62±6.16 days for TRG ($p=0.744$), suggesting prolonged recovery in TRG may be due to more extensive surgical intervention.

A significant difference ($p<0.001$) was found in the incidence of postoperative bile reflux, with 35.71% of URG patients affected and none in the TRG group. Similar findings have been reported in procedures preserving the pyloric sphincter.[28,29] In contrast, Lee et al observed no difference in bile reflux after URG, likely due to the routine use of anti-reflux procedures in their study, which were not applied in ours.[30] In this study, 75.00% of URG patients were able to begin feeding within 5 days post-surgery and 87.18% of TRG patients required 6-8 days to initiate feeding ($p<0.001$). This delay in TRG patients can be attributed to the greater physiological disruption associated with the more extensive surgery, as noted by Shinohara et al.[31]

Additionally, the mean time to start feeding was significantly shorter for URG patients (5.64±1.61 days) compared to TRG patients (6.76±0.99 days, $p=0.001$), which indicates a faster return to gastrointestinal function in the URG group. Food transit within 24 hours was observed in 78.57% of URG patients, compared to only 5.13% of TRG patients. This is mostly due to the preservation of a portion of the stomach in procedures like URG, which allows for more rapid recovery of gastric emptying and intestinal motility, whereas the complete removal of the stomach in TRG often leads to delayed food emptying and prolonged transit times. This faster recovery is also reflected in the time taken to return to normal activities post-surgery.

The majority of URG patients (67.86%) returned to normal activities within 8-14 days, whereas 56.41% of TRG patients required 15-21 days. According to this study, 85.71% of URG patients were able to tolerate a regular diet post-surgery, compared to only 15.38% of TRG patients. This outcome is consistent with findings by Badgwell et al, who demonstrated that patients who undergo more conservative gastric surgeries tend to have better postoperative gastrointestinal function and are more likely to resume normal dietary habits sooner.[32]

The complete removal of the stomach in TRG leads to significant alterations in the digestive process, often resulting in complications like dumping syndrome, which affected 28.21% of TRG patients in this study. The greater need for nutritional supplements among TRG patients (64.10%) compared to URG patients (14.29%) highlights the ongoing challenges faced by TRG patients in maintaining adequate nutrition post-surgery. Forstner-Barthell et al, emphasized that nutritional deficits are a

common complication of total gastrectomy, often requiring long-term dietary adjustments and supplementation.[33] In contrast, the preservation of some stomach function in URG allows patients to maintain better nutritional intake and reduces the need for supplemental nutrition. None of the patient in current study developed recurrence within 6 months of study period.

This study has several limitations. The small sample size reduces statistical power and the non-randomized design may introduce selection bias. Additionally, the focus on short-term outcomes limits the ability to evaluate important long-term effects such as survival, recurrence and quality of life. Furthermore, resource constraints, including limited access to advanced diagnostic and imaging tools, may have impacted the thoroughness of clinical assessments. These factors underscore the need for larger, randomized studies with long-term follow-up to better understand the outcomes.

CONCLUSION

The findings of this study highlight that URG is associated with significantly fewer postoperative complications, quicker recovery times, shorter hospital stays, superior nutritional outcomes and better preservation of overall gastrointestinal function when compared to TRG. However, URG also demonstrated a higher incidence of postoperative bile reflux. TRG, on the other hand, was more commonly performed in patients with more aggressive or advanced tumors, as indicated by higher rates of lympho-vascular invasion and lymph node involvement. Overall, URG appears to be a more preferable option than TRG in cases of proximal gastric carcinoma, particularly when stomach preservation is feasible.

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