

# Aetiological And Pathological Determinants Of Postoperative Complications In Proximal Gastric Cancer Surgery

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## Abstract

**Introduction:** Proximal gastric cancer, especially at the esophagogastric junction, presents a significant therapeutic challenge due to its high morbidity, mortality, and generally poor prognosis. This study aimed to assess the aetiological and pathological determinants of postoperative complications in proximal gastric cancer surgery.

**Methods:** This prospective observational study was conducted at the National Institute of Cancer Research and Hospital Department of Surgical Oncology. Patient selection followed predefined inclusion and exclusion criteria, leading to a study cohort of 50 eligible individuals. Data collection utilized a structured case record form, and the postoperative outcome was evaluated by examining complications and measuring hemoglobin and serum albumin levels. Statistical analysis employed the Statistical Package for Social Science (SPSS-24), incorporating the Paired Student's t-test and Z proportion test where applicable.

**Result:** Complications predominantly occurred in individuals with hemoglobin levels <11 g/dl and serum albumin <3.5 g/dl. Most postoperative patients had hospital stays of  $\leq 10$  days. Throughout the study, we found that the complications found significant were wound infection, anastomotic leakage, esophagojejunostomy site, and jejunojunctionostomy site.

**Conclusion:** Hemoglobin and serum albumin levels are crucial determinants of postoperative outcomes in patients undergoing surgery for proximal gastric cancer. Optimizing both hemoglobin and serum albumin levels preoperatively through nutritional support and medical interventions is essential for reducing the risk of complications and improving overall surgical outcomes.

**Keywords:** Proximal Gastric Cancer, Etio-pathological determinants, Hemoglobin, Serum albumin

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Date of Submission: 02-02-2025

Date of Acceptance: 12-02-2025

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## I. Introduction

Stomach cancer accounted for 769,000 deaths worldwide in 2020 [1]. Although the overall incidence of gastric cancer has declined, there has been a significant increase in the occurrence of cancer in the gastric cardia [2]. In Western countries, the incidence of gastric cancer affecting the upper part of the stomach is notably high. While gastric cancer predominantly affects the lower part of the stomach in Asia, recent years have seen a rising incidence of proximal gastric cancer in this region as well [3]. According to the latest WHO data from 2020, stomach cancer was responsible for 6,799 deaths in Bangladesh, representing 0.95% of all deaths. The use of

esophagogastroduodenoscopy (EGD) [4] has improved the early detection rates of gastric cancer. Surgical resection remains the gold standard and offers the only potential cure. A common procedure is total gastrectomy with Roux-en-Y (RY) [5] esophagojejunostomy (EJS), which involves the removal of the entire stomach and omentum, followed by the reconnection of the esophagus to the small intestine. This approach is used globally to treat gastric cancer of the upper or entire stomach, particularly after the advent of suturing tools like linear or circular staplers, which have variable short-term postoperative outcomes. Postoperative complications can be categorized into "local" and "systemic." Local complications include wound infection, anastomotic leakage, duodenal stump leak, intra-abdominal abscess, and peritonitis. Systemic complications include aspiration pneumonia, cardiac arrest, urinary tract infection, pulmonary embolism, and thrombosis [6]. Several factors contribute to postoperative complications following surgery for esophagogastric cancer. These factors can be divided into three categories: patient-related, surgeon-related, and disease-related. Patient-related factors, which include general health, lifestyle habits (such as smoking), and nutritional status, play a significant role and are often more impactful than surgeon-related factors. Disease-related factors include tumor staging, disease progression, and the biological behavior of the tumor. On the other hand, surgeon-related factors, such as skill, expertise, and access to appropriate logistical support, are crucial in determining postoperative outcomes. Understanding these short-term outcomes is essential for clinicians to assess the immediate impact of total radical gastrectomy on patients with proximal gastric cancer. This knowledge is vital for informed decision-making in patient care and management during the early stages of recovery. This study aimed to assess the aetiological and pathological determinants of postoperative complications in proximal gastric cancer surgery.

## II. Methods

This prospective observational study was conducted in the Department of Surgical Oncology, National Institute of Cancer Research and Hospital, Mohakhali, Dhaka, from January 2018 to August 2019. Patients with proximal gastric cancer admitted to NICRH for operative treatment were considered as the study population. A total of 100 patients were selected as study subjects by purposive sampling technique. The eligibility criteria of the study subjects included histologically proven adenocarcinoma, no distant metastasis, and a potentially resectable mass (R0) with lymph node dissection. A total radical gastrectomy with Roux-en-Y esophagojejunostomy was performed. All the documents like pre-operative investigations, measures taken to optimize the patient's fitness for an anesthetic checkup, per-operative events, and postoperative outcomes were categorically taken in a pre-fixed, peer-reviewed, interviewed, and observation-based data collection sheet. Postoperative adjuvant chemotherapy with platinum and fluorouracil was principally administered. Overall survival (OS) was defined as the time from the start of surgery until death from any cause. Recurrence-free survival (RFS) is defined as the time from the start of surgery until either recurrence of the disease or death. All patients were followed up as outpatients every 3 to 6 months. Each visit included a physical examination, hematologic analysis, and evaluation of tumor markers such as carcinoembryonic antigen (CEA), carbohydrate antigen 72-4 (CA72-4), and carbohydrate antigen 19-9 (CA19-9). All the data were compiled and appropriately sorted, and the quantitative data were analyzed statistically using Statistical Package for Social Science (SPSS-24). The results were expressed as frequency, percentage, and mean  $\pm$  SD, and  $p < 0.05$  were considered the significance level—comparisons of continuous variables between the two groups with paired sample t-tests. In addition, comparisons of proportions between the two groups were made with Z proportion tests. A logistic regression model was used to predict the probability of a binary outcome based on one or more predictor variables. Ethical clearance was obtained from the Institutional Review Board (IRB) of the National Institute of Cancer Research and Hospital, Mohakhali, Dhaka.

### Inclusion Criteria:

- Diagnosis of gastric adenocarcinoma confirmed by tissue biopsy.
- Age between 20 and 80 years.
- Willingness to participate, confirmed by signing a written informed consent.
- Eligibility for proximal gastrectomy based on preoperative tests, including:
  - Tumor located in the proximal third of the stomach.
  - Tumor size  $\leq 5$  cm.
  - Clinically staged as T1 (tumor).
  - All lymph nodes (LNs)  $\leq 8$  mm on preoperative imaging, with specific attention to LNs 4d, 5, 6, and 10.
- Eligibility for radical resection or curative intent surgical resection.

**Exclusion Criteria:**

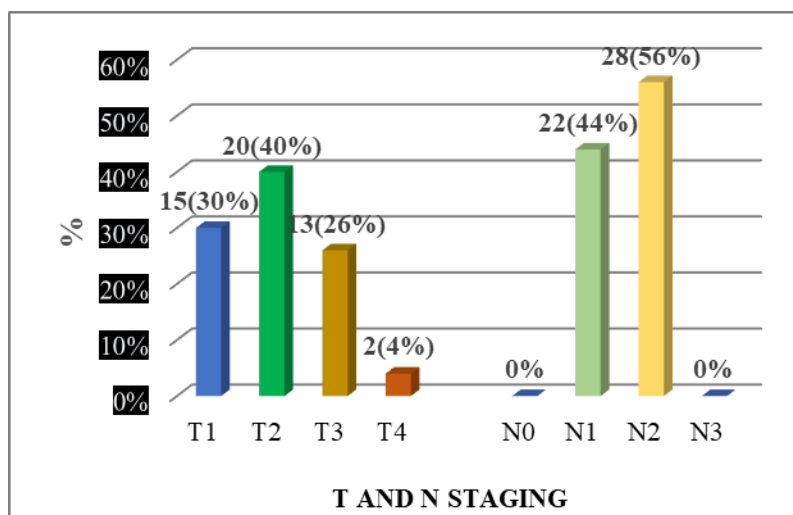
- Prior chemotherapy or radiotherapy for gastric cancer.
- Need for combined resection due to other conditions (except for cholecystectomy).
- Presence of concurrent malignancies that could impact gastric function preservation, including a history of or current malignancy in other organs.
- History of or ongoing treatment for systemic inflammatory disease.
- History of previous gastrectomy.
- Vulnerable populations, including pregnant women, women planning pregnancy, or individuals lacking decision-making capacity.

**III. Results**

**Table 1:** General characteristics of study population (N=100)

Parameter	Categories	Percentage (%)
Age	40-50	24.0
	50-60	44.0
	60-70	22.0
	70-80	10.0
sex	Male	64.0
	Female	36.0
BMI (kg/m <sup>2</sup> )	18.5-24.9	48.0
	25-30	44.0
	>30	8.0
Smoker	Yes	70.0
	No	30.0
Betel nut taker	Yes	6.0
	No	94.0
Alcoholic	Yes	24.0
	No	76.0
Socioeconomic conditions	Upper class	4.0
	Middle class	60.0
	Lower class	36.0
Tumor size (cm)	2.5-4	48.0
	4.1-6	32.0
	6.1-9.2	20.0
Time of index surgery	2-3 hours	60.0
	3-4 hours	40.0
Treatment plan (Neo-adjuvant)	Yes	52.0
	No	48.0
Adjuvant	Yes	92.0
	No	8.0

Most of the participants fall within the 50-60 age range (44%), followed by the 40-50 age group (24%). In terms of gender, the population is predominantly male (64%). Body Mass Index (BMI) analysis indicates that nearly half of the participants have a BMI between 18.5-24.9 (48%), while 70% of the population are smokers. The socioeconomic breakdown shows a majority in the middle class (60%). Tumor size distribution indicates that 48% of cases fall within the 2.5-4 cm range. Notably, 87% of the population does not exhibit metastasis. Most index surgeries are completed in 2-3 hours (60%). Regarding treatment plans, 52% undergo neo-adjuvant therapy, and 92% receive adjuvant treatment. This table serves as a comprehensive overview, offering valuable insights into the demographic and health-related characteristics of the study cohort. [Table 1]



**Figure 1:** Distribution of study subjects according to T and N staging (n=50)

In this study, the majority (40%) of study subjects were in the T2 stage according to the T stage. According to the N stage, the majority (56%) of the subjects were in the N2 stage.

**Table 2:** Determinants of postoperative complications (N=100)

Characteristics	Odds Ratio				
	Wound infection	Wound disruption	Anastomotic leakage	Esophagojejunostomy site	Jejunojunctionostomy site
Age					
50-60	1.499	1.233	1.788	1.413	1.713
60-70	0.766	0.712	1.122	1.674	1.824
70-80	1.577	0.799	0.407	0.236	0.837
Sex					
Female	1.775	0.675	1.384	1.467	1.089
BMI (kg/m <sup>2</sup> )					
25-30	0.467	0.431	0.564	0.437	1.002
>30	0.564	0.145	0.984	0.268	0.031
Smoker					
Yes	1.734	1.099	0.367	0.583	0.746
Alcoholic					
Yes	0.373	0.865	0.845	0.253	0.923
Tumor size (cm)					
4.1-6	1.756	1.053	1.085	1.249	1.093
6.1-9.2	1.457	1.045	1.023	1.765	1.048
Low Albumin					
Yes	2.095	1.942	2.456	1.845	1.234
Low Hemoglobin					
yes	0.468	0.867	0.409	0.763	0.284

#### IV. Discussion

Postoperative complications in proximal gastric cancer surgery are influenced by multiple factors, including age, sex, body mass index (BMI), smoking, tumor size, and nutritional status. Age plays a significant role, with patients aged 50-60 having higher odds of wound infection (OR 1.499) and anastomotic leakage (OR 1.788). However, older patients (70-80) demonstrated lower odds of some complications, likely due to more conservative management, aligning with evidence showing that proper perioperative care can mitigate risks in older adults [7]. Sex also influences outcomes, with females having higher odds of wound infections (OR 1.775) and complications at the esophagojejunostomy site (OR 1.467). Hormonal and immune system differences may

contribute to these risks, as noted in studies examining sex-related disparities in surgical outcomes [8]. BMI is another critical factor, with patients in the 25-30 kg/m<sup>2</sup> range showing lower odds of wound infection (OR 0.467) and anastomotic leakage (OR 0.564). Obesity increases technical difficulties during surgery, which can complicate recovery (Songun et al., 2010). Smoking also correlates with higher odds of wound infection (OR 1.734) and wound disruption (OR 1.099), as smoking impairs tissue oxygenation and healing [9]. Tumor size impacts postoperative outcomes, with larger tumors (6.1-9.2 cm) increasing the likelihood of complications at the esophagojejunostomy site (OR 1.765). Larger tumors are often more advanced and technically challenging to resect, increasing postoperative risks [7]. Additionally, poor nutritional status, particularly low albumin and hemoglobin, significantly raises the odds of wound infection (OR 2.095) and anastomotic leakage (OR 2.456). Optimizing preoperative nutrition is crucial for minimizing these risks. In the present study, we observed various complications in those with hemoglobin levels <11 g/dl and serum albumin <3.5 g/dl. However, most of the previous studies do not focus on the association of anemia with postoperative complications, but from our social perspective, we observed this association. For example, sun et al. (2017) observed hemoglobin before and after chemotherapy. But Ryu and Kim [10] and Sakurai et al. [11] observed the association of serum albumin with postoperative outcomes. In the present study, most patients needed to stay post-operatively in the hospital for ≤10 days. Hong et al. [12], Song et al. [13], Huang et al. [14], and Nusrat et al. [15] agreed with our findings. They suggested that open radical total gastrectomy needs a longer hospital stay than laparoscopy-assisted radical total gastrectomy. However, laparoscopy-assisted radical total gastrectomy needs an experienced surgeon and prolonged operation times. In the present study, 41(82%) patients came for follow-up, and 4 (8%) patients died six months after total radical gastrectomy with Roux-en-Y esophagojejunostomy. Only 4 (8%) were found with anastomotic stenosis in their endoscopic report. Yoo et al. [16] agreed with our studies. They reported a relatively high incidence of local recurrence. The causes of local recurrence may be an inadequate resection margin, either proximally or distally, along with the possibility of remnant cancer or a missed multiple gastric cancer [17].

### **Limitations of The Study**

The study was carried out in a single hospital with a small sample size. So, the results may not represent the whole community.

### **V. Conclusion**

Factors such as age, sex, BMI, smoking status, tumor size, and nutritional markers (hemoglobin and serum albumin) all influence postoperative complications. Low hemoglobin levels, indicative of anemia, are associated with poorer wound healing and increased susceptibility to complications such as wound infection and anastomotic leakage. Similarly, low serum albumin levels reflect poor nutritional status, which significantly increases the risk of postoperative infections and delayed recovery due to impaired tissue repair and immune function. Optimizing both hemoglobin and serum albumin levels preoperatively through nutritional support and medical interventions is essential for reducing the risk of complications and improving overall surgical outcomes.

### **VI. Recommendation**

To improve outcomes in proximal gastric cancer surgery, focus on preoperative optimization by addressing risk factors such as age, sex, BMI, smoking, and nutritional status. Enhance preoperative nutrition to boost serum albumin and hemoglobin levels, encourage smoking cessation, and manage BMI effectively. Tailor surgical strategies for larger tumors to minimize complications. Implement thorough postoperative monitoring to address any issues promptly. These measures can significantly reduce complications and improve recovery.

**Funding:** No funding sources

**Conflict of interest:** None declared

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