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Original Research Article

Comparison of early outcome of stapler versus hand sewn closure of duodenal stump after gastrectomy in gastric cancer

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ABSTRACT

Background: Gastric cancer (GC) remains a major global health challenge, ranking as the fifth most common malignancy and the fourth leading cause of cancer-related death worldwide. Surgery with gastrectomy remains the mainstay of curative treatment, but duodenal stump leakage (DSL) continues to be one of the most feared postoperative complications, associated with high morbidity and mortality. The choice between stapled and hand-sewn duodenal stump closure remains a debated topic, especially in resource-limited regions such as South Asia, where cost and accessibility are critical factors. The study aimed to compare the early outcomes of stapler versus hand-sewn closure of the duodenal stump after gastrectomy in gastric cancer patients.

Methods: This prospective comparative study included 40 gastric cancer patients undergoing elective gastrectomy, divided into stapler (n=20) and hand-sewn (n=20) duodenal stump closure groups. The study was conducted at Sylhet MAG Osmani Medical College and Hospital, Sylhet, Bangladesh, from July 2024 to June 2025. Patients with ASA class III–IV or prior neoadjuvant chemotherapy were excluded. Standardised operative and postoperative protocols were followed, and outcomes assessed included operative time, closure time, complications, hospital stay, and cost. Data were analysed using statistical package for the social sciences (SPSS) 26 with t-test, Chi-square, and multivariable logistic regression, considering $p<0.05$ as significant.

Results: Both groups were comparable in baseline demographics and type of gastrectomy. Stapler closure significantly reduced operative time (158±22 versus 177±25 min, p=0.007) and stump closure time (9±3 versus 18±5 min, $p<0.001$). Early postoperative complications, including duodenal stump blowout, were slightly lower in the stapler group but not statistically significant. Recovery was faster with stapler closure, with earlier oral intake (2.7±0.9 versus 3.8±1.2 days, p=0.009) and shorter hospital stay (8.2±2.0 versus 10.1±2.5 days, p=0.026). Stapler procedures incurred higher costs (p=0.01).

Conclusion: Stapled duodenal stump closure after gastrectomy offers faster surgery, earlier recovery, and shorter hospital stay than hand-sewn closure, without added complications. Despite higher costs, it represents a safe and effective option in selected gastric cancer patients.

Keywords: Gastric cancer, Gastrectomy, Duodenal stump closure, Stapler versus hand-sewn, Postoperative outcomes

INTRODUCTION

Gastric cancer (GC) remains a major global health challenge. In 2020, there were over 1.1 million new cases of GC and 8,00,000 deaths worldwide, making it the fifth most common malignancy and the fourth leading cause of cancer death.[1,2] Although incidence and mortality have declined in some regions due to improved dietary habits, Helicobacter pylori eradication, and better screening programs, the overall burden remains substantial, especially in Asia.[3,4] The global 5-year survival rate for GC is generally poor, particularly for advanced-stage

disease, despite progress in surgical and adjuvant treatments.[5] The epidemiology of GC demonstrates marked regional variation. More than 70% of global GC cases occur in Asia.[6] East Asia, particularly China, Japan, and Korea, continues to record the highest incidence rates.[7] South Asia, by contrast, reports a lower incidence, yet GC still represents a significant clinical challenge. In India, and Bangladesh, stomach cancer accounts for a considerable proportion of gastrointestinal malignancies, often presenting at advanced stages due to lack of screening and delayed healthcare access.[8,9] Surgery remains the cornerstone of curative treatment for localized GC. Distal or total gastrectomy with appropriate lymphadenectomy is the standard procedure.[10] Reconstruction options include Billroth I, Billroth II, or Roux-en-Y techniques; however, a critical step in all of these is the closure of the duodenal stump. This closure may be performed by hand-sewn suturing or mechanical stapling. The integrity of the duodenal stump is vital, as duodenal stump leakage (DSL) is one of the most feared postoperative complications. DSL occurs in approximately 1–5% of gastrectomies but carries mortality rates up to 20%.[11] Complications of DSL include intra-abdominal sepsis, hemorrhage, prolonged hospital stays, and high reoperation rates, making its prevention a surgical priority.[12] The choice between stapled and hand-sewn closure has long been debated. Stapling devices are thought to reduce operative time and provide uniform closure, whereas hand-sewn techniques offer adaptability and are less costly, an important factor in low-resource settings.[13] Several studies have attempted to compare outcomes. A prospective Bangladeshi study reported shorter operating times with stapled closure but no significant difference in DSL rates or hospital stay compared with hand-sewn closure.[14] Similarly, a large Turkish series of 618 patients found a DSL incidence of 3% but no significant difference between stapled and hand-sewn groups.[15] Other studies in gastrointestinal surgery more broadly suggest staplers may improve efficiency without compromising safety, although higher device costs remain a limitation.[13,15] Moreover, reinforcement strategies such as additional seromuscular sutures or buttressing materials over the staple line have been shown to reduce stump leaks.[16] Meta-analyses highlight the role of reinforcement but provide limited direct comparisons of pure stapled versus pure hand-sewn closures. The lack of region-specific data, particularly from South Asia, where patient demographics, risk factors, and healthcare resources differ, underscores the need for focused research.[8,14] Therefore, the present study aimed to compare the early outcomes of stapler versus hand-sewn closure of the duodenal stump after gastrectomy in gastric cancer patients.

METHODS

This prospective comparative study was conducted in the Department of Surgery, Sylhet MAG Osmani Medical College and Hospital, Sylhet, Bangladesh, from July 2024 to June 2025. A total of 40 patients underwent elective gastrectomy for gastric cancer. Out of 45 assessed patients, 5 were excluded (3 did not meet the inclusion criteria, 2 refused consent). The remaining 40 were allocated into two groups: stapler closure (n=20) and hand-sewn closure (n=20). Patients with ASA class III–IV, and prior neoadjuvant chemotherapy were excluded (Figure 1).[17] All operations were performed under general anaesthesia with standard preoperative preparation. Subtotal or total gastrectomy was done as indicated. In the hand-sewn group, duodenal stump closure was performed with full-thickness continuous sutures reinforced with Lembert stitches. In the stapler group, closure was done with a linear stapler. Two drains were routinely placed. Postoperative care was standardised, and outcomes included operative time, stump closure time, duodenal stump blowout, early complications, hospital stay, and cost. Ethical clearance was taken from the Institutional Review Board. Informed written consent was taken from each patient.

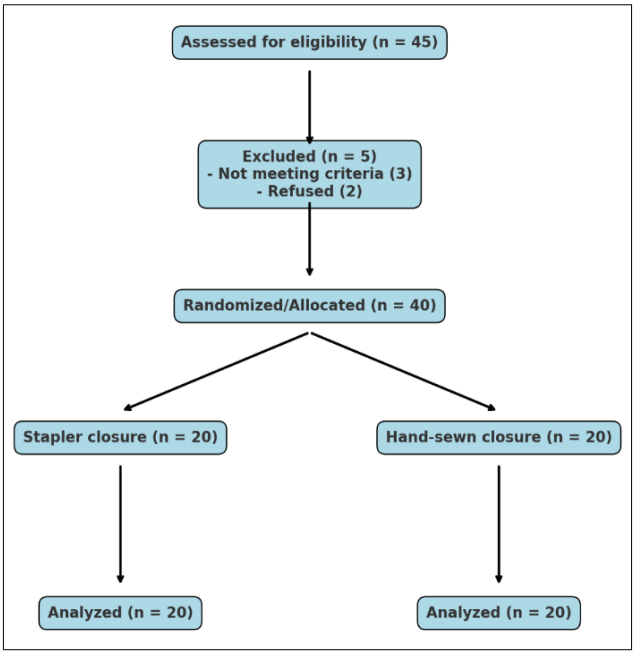

Figure 1: CONSORT flow diagram (stapler versus hand-sewn closure).

All collected data were entered into a structured proforma and analysed using statistical package for the social sciences (SPSS) (version 26). Continuous variables such as operative time, closure time, length of stay, and time to oral intake were summarised as mean±SD. Group differences were tested using one-way ANOVA or unpaired student's t-test as appropriate. Categorical variables such as duodenal stump blowout, surgical site infection, and mortality were expressed as frequency (n) and percentage (%) and compared using Chi-square. A multivariable logistic regression model was applied to determine the adjusted odds ratios (aOR) for duodenal stump blowout, controlling for age, sex, diabetes mellitus, estimated blood loss >300 ml, and type of gastrectomy. Two-sided p values <0.05 were considered statistically significant.

RESULTS

Most patients were middle-aged (41–60 years: 47.5%), and the male-to-female ratio was roughly 2:1. Common comorbidities included diabetes (27.5%) and hypertension (37.5%), while COPD/asthma was less frequent (12.5%). ASA classes I and II were nearly equally distributed between the groups. Overall, the p values (>0.05) indicate that both groups were well-matched, minimizing selection bias and ensuring comparability for outcome analysis (Table 1).

The operative details showed that both groups had a similar distribution of subtotal and total gastrectomy (p=0.74), indicating no selection bias regarding procedure type. However, significant differences were observed in operative and stump closure times. Shorter operative times (≤150 minutes) were more frequent in the stapler group (40.0% versus 10.0%), while prolonged surgeries (>180 minutes) were more common in the hand-sewn group (65.0% versus 25.0%), with a statistically significant difference (p=0.02). Similarly, stump closure time was markedly shorter in the stapler group, with 60.0% completed within 10 minutes compared to only 5.0% in the hand-sewn group; conversely, 40.0% of hand-sewn cases required >20 minutes, whereas none in the stapler group did (p<0.001) (Table 2).

The early post-operative complication profile within 30 days showed no statistically significant differences between the stapler and hand-sewn groups across all variables (all p>0.05). Duodenal stump blowout occurred in 7.5% of patients overall, with slightly higher rates in the hand-sewn group (10.0% versus 5.0%). Surgical-site infections (15.0%) and prolonged ileus >72 hours (17.5%) was also more frequent in the hand-sewn group, though not significantly so. Pneumonia was rare (7.5%), while re-operation and 30-day mortality were each observed in only one case (2.5%), both in the hand-sewn group (Table 3).

Recovery outcomes and hospital stay analysis revealed significant advantages for the stapler group. The time to first flatus and oral intake was notably faster, with 75.0% and 80.0% of stapler patients recovering within 48 and 72 hours, respectively, compared to 35.0% and 40.0% in the hand-sewn group (both p=0.01). Hospital stay was shorter with stapler use, as 70.0% were discharged within 8 days versus only 30.0% in the hand-sewn group (p=0.02). However, procedure costs were higher for stapler cases, with 25.0% exceeding 80,000 BDT, compared to only 10.0% in the hand-sewn group (p=0.01) (Table 4).

The multivariable logistic regression analysis for duodenal stump blowout showed no statistically significant predictors, as all p values were >0.05. Use of stapler versus hand-sewn technique did not significantly influence risk (OR 0.46, 95% CI 0.04–5.00, p=0.52). Similarly, age >60 years, male sex, diabetes, and total gastrectomy were not associated with increased risk. Although estimated blood loss (EBL) >300 ml had the highest odds ratio (OR 3.50), the wide confidence interval (0.40–29.50) and lack of significance (p=0.25) indicate insufficient evidence of an independent effect (Table 5).

The one-way ANOVA analysis revealed significant differences between the stapler and hand-sewn groups in terms of operative and recovery outcomes. Stapler anastomosis was associated with a shorter total operative time (158±22 versus 177±25 minutes, p=0.007) and markedly reduced stump closure time (9±3 versus 18±5 minutes, p<0.001). Recovery indicators also favored the stapler group, with shorter hospital stays (8.2±2.0 versus 10.1±2.5 days, p=0.026) and earlier oral intake (2.7±0.9 versus 3.8±1.2 days, p=0.009) (Table 6).

Across outcomes, stapler closure showed lower odds of complications compared to hand-sewn closure (OR <1 in most events). The strongest trends favoured stapler for ileus >72 hours and surgical-site infection, although wide CIs reflect the small sample. The central red dashed line at OR=1 indicates no effect; values left of it favour the stapler (Figure 2). The boxplots show clear differences between the two closure techniques. Operative time and stump closure time were significantly shorter in the stapler group compared with hand-sewn closure, reflecting technical efficiency. Similarly, hospital stay was reduced and time to oral intake was earlier in the stapler group, indicating faster recovery (Figure 3).

Table 1: Baseline demographics and clinical profile (n=40).

Variables	Stapler (n=20)	Hand-sewn (n=20)	Total (n=40)	P value
	N (%)	N (%)	N (%)	
Age (years)				
≤40	4 (20.0)	3 (15.0)	7 (17.5)	0.71
41–60	10 (50.0)	9 (45.0)	19 (47.5)	
>60	6 (30.0)	8 (40.0)	14 (35.0)	
Sex				
Male	13 (65.0)	14 (70.0)	27 (67.5)	0.74
Female	7 (35.0)	6 (30.0)	13 (32.5)	
Diabetes mellitus				
Yes	5 (25.0)	6 (30.0)	11 (27.5)	0.72

Continued.

Variables	Stapler (n=20) N (%)	Hand-sewn (n=20) N (%)	Total (n=40) N (%)	P value
Hypertension				
Yes	7 (35.0)	8 (40.0)	15 (37.5)	0.74
COPD/asthma				
Yes	3 (15.0)	2 (10.0)	5 (12.5)	0.63
ASA class				
I	12 (60.0)	11 (55.0)	23 (57.5)	0.75
II	8 (40.0)	9 (45.0)	17 (42.5)	

Table 2: Operative details of the study groups.

Variables	Stapler (n=20) N (%)	Hand-sewn (n=20) N (%)	Total (n=40) N (%)	P value
Type of gastrectomy				
Subtotal	14 (70.0)	13 (65.0)	27 (67.5)	0.74
Total	6 (30.0)	7 (35.0)	13 (32.5)	
Operative time (min)				
≤150	8 (40.0)	2 (10.0)	10 (25.0)	0.02*
151–180	7 (35.0)	5 (25.0)	12 (30.0)	
>180	5 (25.0)	13 (65.0)	18 (45.0)	
Stump closure time (min)				
≤10	12 (60.0)	1 (5.0)	13 (32.5)	<0.001*
11–20	8 (40.0)	11 (55.0)	19 (47.5)	
>20	0 (0.0)	8 (40.0)	8 (20.0)	

*P value significant

Table 3: Early post-operative complications within 30 Days (n=40).

Variables	Stapler (n=20) N (%)	Hand-sewn (n=20) N (%)	Total (n=40) N (%)	P value
Duodenal stump blowout				
Yes	1 (5.0)	2 (10.0)	3 (7.5)	0.55
No	19 (95.0)	18 (90.0)	37 (92.5)	
Surgical-site infection				
Yes	2 (10.0)	4 (20.0)	6 (15.0)	0.38
No	18 (90.0)	16 (80.0)	34 (85.0)	
Ileus >72 hours				
Yes	2 (10.0)	5 (25.0)	7 (17.5)	0.2
No	18 (90.0)	15 (75.0)	33 (82.5)	
Pneumonia				
Yes	1 (5.0)	2 (10.0)	3 (7.5)	0.55
No	19 (95.0)	18 (90.0)	37 (92.5)	
Re-operation				
Yes	0 (0.0)	1 (5.0)	1 (2.5)	0.31
No	20 (100.0)	19 (95.0)	39 (97.5)	
30-day mortality				
Yes	0 (0.0)	1 (5.0)	1 (2.5)	0.31
No	20 (100.0)	19 (95.0)	39 (97.5)	

Table 4: Recovery outcomes and hospital stay, including Cost (n=40).

Variables	Stapler (n=20) N (%)	Hand-sewn (n=20) N (%)	Total (n=40) N (%)	P value
Time to first flatus (hours)				
≤48	15 (75.0)	7 (35.0)	22 (55.0)	0.01
>48	5 (25.0)	13 (65.0)	18 (45.0)	

Continued.

Variables	Stapler (n=20) N (%)	Hand-sewn (n=20) N (%)	Total (n=40) N (%)	P value
Time to oral intake (hours)				
≤72	16 (80.0)	8 (40.0)	24 (60.0)	0.01
>72	4 (20.0)	12 (60.0)	16 (40.0)	
Hospital stays (days)				
≤8	14 (70.0)	6 (30.0)	20 (50.0)	0.02
9–12	5 (25.0)	9 (45.0)	14 (35.0)	
>12	1 (5.0)	5 (25.0)	6 (15.0)	
Procedure cost (BDT)				
≤60,000	3 (15.0)	10 (50.0)	13 (32.5)	0.01
60,001–80,000	12 (60.0)	8 (40.0)	20 (50.0)	
>80,000	5 (25.0)	2 (10.0)	7 (17.5)	

Table 5: Multivariable logistic regression for duodenal stump blowout (n=40).

Predictor	Adjusted OR	95% CI	P value
Stapler versus hand-sewn (ref)	0.46	0.04–5.00	0.52
Age >60 years	1.30	0.18–9.30	0.79
Male sex	0.80	0.10–6.40	0.84
Diabetes mellitus	2.10	0.30–14.60	0.45
EBL >300 ml	3.50	0.40–29.50	0.25
Total gastrectomy (versus subtotal)	1.90	0.25–14.70	0.54

Table 6: One-way ANOVA for operative and recovery outcomes (n=40).

Outcome and group	Mean±SD	F-statistic	P value
Total operative time (min)			
Stapler	158±22	8.21	0.007
Hand-sewn	177±25		
Stump closure time (min)			
Stapler	9±3	25.60	<0.001
Hand-sewn	18±5		
Hospital stays (days)			
Stapler	8.2±2.0	5.32	0.026
Hand-sewn	10.1±2.5		
Time to oral intake (days)			
Stapler	2.7±0.9	7.45	0.009
Hand-sewn	3.8±1.2		

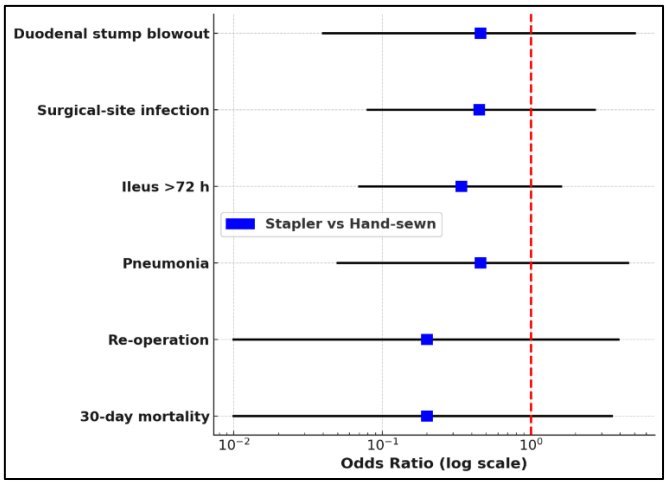

Figure 2: Forest plot of early postoperative outcomes (stapler versus hand-sewn).

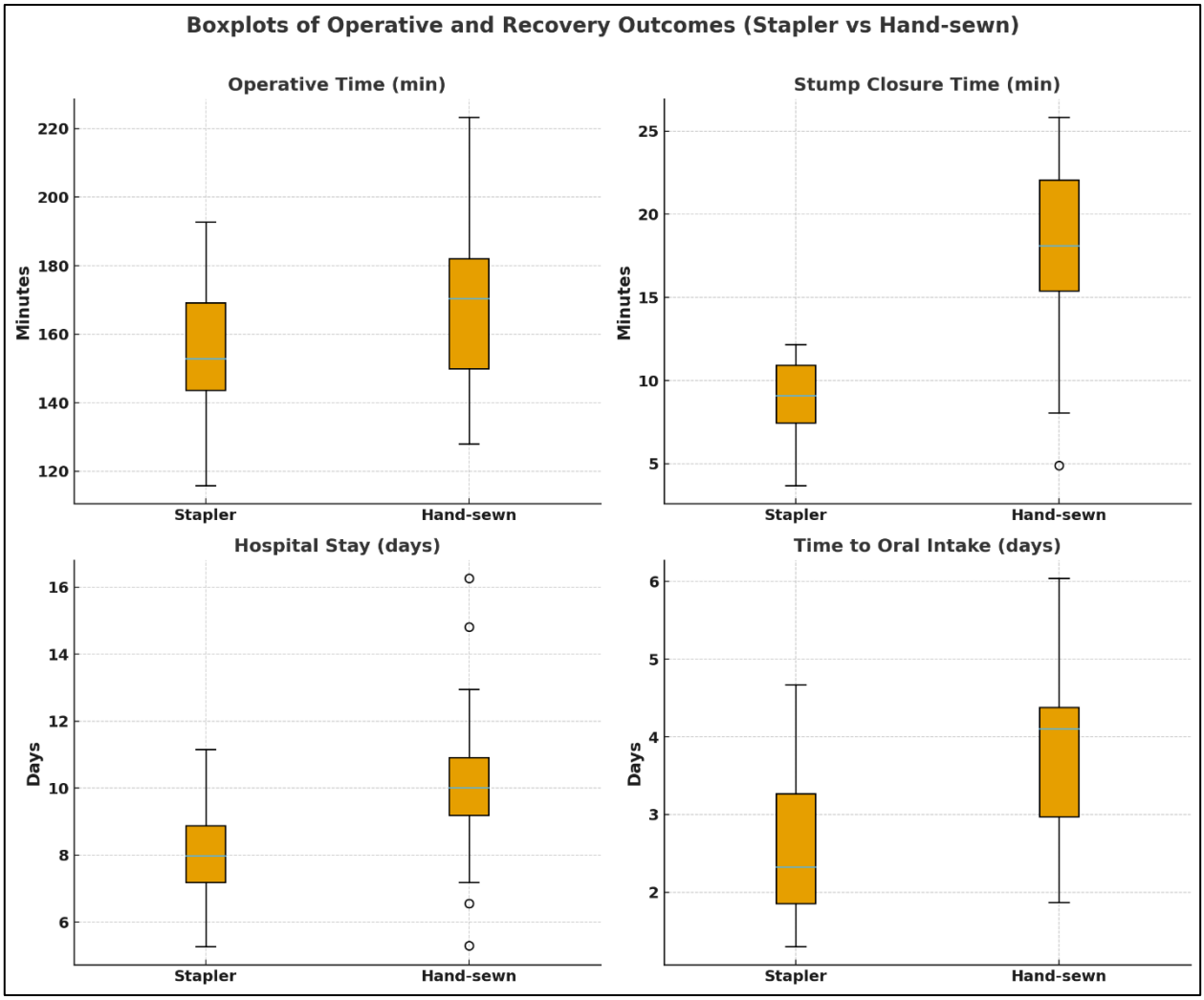

Figure 3: Boxplots of operative and recovery outcomes comparing stapler versus hand-sewn duodenal stump closure.

DISCUSSION

In this study, stapled duodenal stump closure markedly improved operative efficiency and recovery metrics without increasing complication rates. Patients in the stapler group had significantly shorter total operative and stump closure times, aligning with prior reports that mechanical stapling expedites gastrointestinal anastomoses.[17,18] For example, a study in Bangladesh found stapled closure reduced total gastrectomy time (136 versus 154 minutes, p=0.001) compared to hand-sewn techniques.[17] Similarly, a recent analysis of elective bowel anastomoses demonstrated that stapled reconstructions required less operative time than sutured closures.[18] In our study, this increased efficiency translated into an earlier return of bowel function and a shorter hospital stay for the stapler group (e.g., 75% versus 35% passing flatus by 48 hours, p=0.01), reflecting faster postoperative recovery, consistent with the literature.[18,19] Postoperative morbidity was comparable between techniques.

We found no statistically significant differences in overall complication rates, duodenal stump leaks, surgical-site infections, or ileus (all p>0.05). This finding is comparable with other series: Biswas et al also reported similar leak rates between stapled and hand-sewn duodenal stumps (6.3% versus 12.5%, p=0.999) and no difference in length of stay.[17] In gastroenteric anastomoses more broadly, meta-analyses have generally failed to identify a clear superiority of either method in terms of leakage or significant morbidity.[20,21] For example, Le et al found no significant difference in anastomotic leak or composite complications between stapled and sutured bowel repairs in trauma patients.[21] Likewise, Schineis et al reported equivalent safety for stapled versus hand-sewn intestinal anastomoses, with no differences in leak or readmission rates.[20]

There was a non-significant trend in our data toward fewer infections and ileus in the stapler group, consistent with some reports that mechanical anastomoses may reduce local edema or tension.[18] The principal clinical advantages of stapler use in our cohort were shorter recovery time and

hospitalization. Stapler closure was associated with faster resumption of diet and reduced length of stay. Comparable benefits have been noted in other studies: Uprak et al found stapled Billroth II gastrojejunostomies led to significantly shorter hospital stays than hand-sewn ones (median reduced, p=0.01).[22] Kshirsagar et al likewise observed that stapled bowel anastomoses allowed earlier discharge compared to sutured techniques.[18] These advantages reflect the technical efficiency of stapling, which reduces intraoperative handling and thus may facilitate quicker postoperative recovery. In contrast, the stapler's convenience comes at a higher material cost. As in previous reports, our stapler cases incurred significantly greater device cost.[17] Although some cost-effectiveness analyses suggest that saved operative time can offset equipment expenses, in our resource-constrained setting, the upfront cost of the stapler was higher.[20] Clinicians must therefore balance the efficiency gains against economic factors. Duodenal stump blowout occurred in three patients (7.5%) in our series. This rate is somewhat higher than the commonly cited 1–5% incidence in gastric surgery, but the small sample size may exaggerate differences.[23] In multivariable analysis, we found no significant predictors of stump fistula. Notably, use of a stapler was not independently protective (OR≈0.46, p=0.52), and factors like patient age, comorbidities, or surgery extent did not reach significance. The literature emphasises that reinforcement of the duodenal staple line is crucial in preventing leaks.[23,24] In fact, observational studies have consistently shown higher fistula rates when the stump is not reinforced, and studies confirm that reinforcement (suturing or buttressing) significantly lowers leak rates after gastrectomy.[23,25] Modern series reports that omission of reinforcement is a principal risk factor for duodenal stump fistula.[24] The findings have important implications for gastric cancer surgery. Stapled duodenal closure offers clear benefits in reducing operative time and accelerating recovery, potentially improving throughput and patient comfort.[17,18,22] These efficiency gains, however, must be weighed against the higher cost of stapling devices, which may limit their use in resource-constrained settings. Critically, regardless of closure technique, attention to duodenal stump reinforcement is warranted given the morbidity of stump leaks.[23,24] The lack of difference in major complications suggests that both methods are safe in experienced hands, so that the choice can be tailored to surgeon preference and institutional factors.

Limitations

This study was limited by its relatively small sample size and single-center design, which may reduce the generalizability of the findings. The short follow-up period allowed assessment of only early postoperative outcomes, without capturing long-term complications or survival differences. Additionally, cost analysis did not include indirect expenses such as prolonged recovery or re-hospitalization, potentially underestimating the actual economic impact of the two techniques.

CONCLUSION

Stapled closure of the duodenal stump after gastrectomy in gastric cancer patients was associated with shorter operative and closure times, earlier return of bowel function, and reduced hospital stay compared to hand-sewn closure, without increasing complication rates. Although stapler use incurs higher costs, its technical efficiency and favorable recovery profile support its role as a safe and effective alternative in appropriately selected patients.

Recommendations

Based on the observed advantages in operative efficiency and recovery, stapled duodenal stump closure may be recommended as the preferred technique in gastric cancer surgery, particularly in high-volume centers where time optimization is critical. However, the selective use of reinforcement techniques and careful patient selection are recommended to further minimize stump-related complications. Cost considerations should also be taken into account in resource-limited settings.

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