Omentopexy versus Falciformopexy for Management of Perforated Peptic Ulcer: A Prospective Non-Randomized Study

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Abstract:

Background: Peptic ulcer perforation (PUP) is a common surgical emergency with high mortality rate. The omentum, first used in 1937, remains a common treatment for PUP, though its use is limited in cases of severe peritonitis. The falciform ligament, introduced in 1978 as an alternative, has shown effectiveness in both open and laparoscopic surgeries, even for large perforations.

Objectives: To evaluate the use of falciform ligament as a feasible alternative technique when the omentum cannot be used for the management of PUP.

Patients and methods: This study was conducted at the Emergency Centre of Qena University Hospitals from January 1, 2023, to December 30, 2023, involved patients undergoing surgery for PPU. Complete preoperative evaluation was done. One group underwent omentopexy, and the other group underwent Falciformpexy. Patients were followed up for postoperative outcomes.

Results: The mean age was 44.23 years. 53.33% were male. 55% had duodenal ulcer (55%). The mean perforation diameter was 0.92±0.26 cm. The Omentopexy group had 66.67% presenting late perforation while Falciformpexy group showed 50%. There were insignificant differences regarding, operative duration, hospital stay, and oral intake. The incidence of the leak was 10% in both groups, (p=0.99). Ileus occurred in 13.33% of the Omentopexy group compared to 6.67% of the Falciformpexy group (p=0.398). Pulmonary complications occurred in 23.33% of the Omentopexy group and 10% of Falciformpexy group (p=0.1715). Similarly, evisceration and wound infection showed no significant difference.

Conclusion: Both surgical techniques proved to be effective and safe, offering viable options for the treatment of PUPs.

Keywords: Omentopexy; Falciformopexy; Peptic ulcer; Perforation.

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Introduction

Peptic ulcer is a chronic condition arising from an imbalance between the stomach's protective mechanisms (e.g., mucus and bicarbonate secretion, adequate blood flow, prostaglandin E2, nitric oxide, sulfhydryl compounds, and antioxidant enzymes) and harmful factors (acid and pepsin secretions) **(Danilo and Leanza, 2022).**

Exploratory laparotomy and omental patch repair are considered the gold standard. Laparoscopic surgery is preferable in early disease presentations to minimize complications. Definitive antiulcer surgery, while addressing the condition, is associated with increased fatal outcomes, longer operation times, prolonged anesthesia, and higher postoperative complication rates. **(Ali et al., 2022).**

Omentopexy described by Graham many years ago, stills widely used surgical technique. It involves closing the area of perforation with a piece of omentum, secured with sutures **(Demetriou and Chapman, 2022).** The falciformpexy method, discussed in the present study, uses the falciform ligament like the omentum in the modified method of Graham omentopexy **(Terzioğlu et al., 2023).**

While studies show favorable outcomes with the falciform flap method for covering peptic ulcer perforations, most research comprises small case series involving minor perforations with early onset (under 12 hours) **(Allart et al., 2018; Boshnaq et al., 2016; Ölmez et al., 2019).**

The main objective of the study was to evaluate the use of falciform ligament as a feasible alternative technique when the omentum cannot be used for the management of peptic ulcer perforation (PUP) in terms of perioperative outcomes.

Patients and methods

This prospective randomized study, conducted at the Emergency Centre of Qena University Hospitals between January 1, 2023, to December 30, 2023, included all patients undergoing surgery for perforated peptic ulcer (PPU). Following the Surviving Sepsis Campaign guidelines, we focused on the early detection of life-threatening injuries and the prevention of the lethal triad in PPU patients.

Patients aged 18 or older with a clinically and radiologically confirmed perforated peptic ulcer requiring surgery were included in the study, provided they consented to participate. Exclusion criteria included gastrointestinal malignancies, severe comorbid conditions, prior abdominal surgery complicating the approach, pregnancy, lactation, or inability to consent.

Ethical code: SVU-MED-SUR011-1-23-3-595.

In the operational design, all patients provided informed consent and underwent a thorough evaluation, including a detailed medical history and general examination of vital signs (blood pressure, temperature, heart rate, respiratory rate). A local abdominal examination was also performed.

Laboratory investigations involved obtaining 8 ml of venous blood under aseptic conditions. The tests included a complete blood picture (RBC count, hemoglobin, platelet count, and prothrombin concentration), a coagulation profile with Prothrombin Time (PT), and INR calculations (Normal PT: 12-15 seconds; ISI: 1.3-1.5), liver function tests (AST, ALT, ALP) and renal function tests (serum creatinine and BUN). Imaging consisted of abdominal plain X-rays (erect, antero-posterior, and lateral views) and abdominal ultrasonography.

Operative technique

In all patients, a midline laparotomy was performed with an incision through the linea alba. The peritoneum was carefully incised and extended to avoid underlying structure injury. Abdominal fluid was collected for bacterial cultures and

sensitivity testing. Pyoperitoneum was aspirated, and the cavity was lavage with 3-5 liters of warm 0.9% saline. The abdominal cavity, including the diaphragm, liver, gallbladder, stomach, duodenum, small intestine, colon, and Douglas pouch, was thoroughly assessed **(Fig.1).**

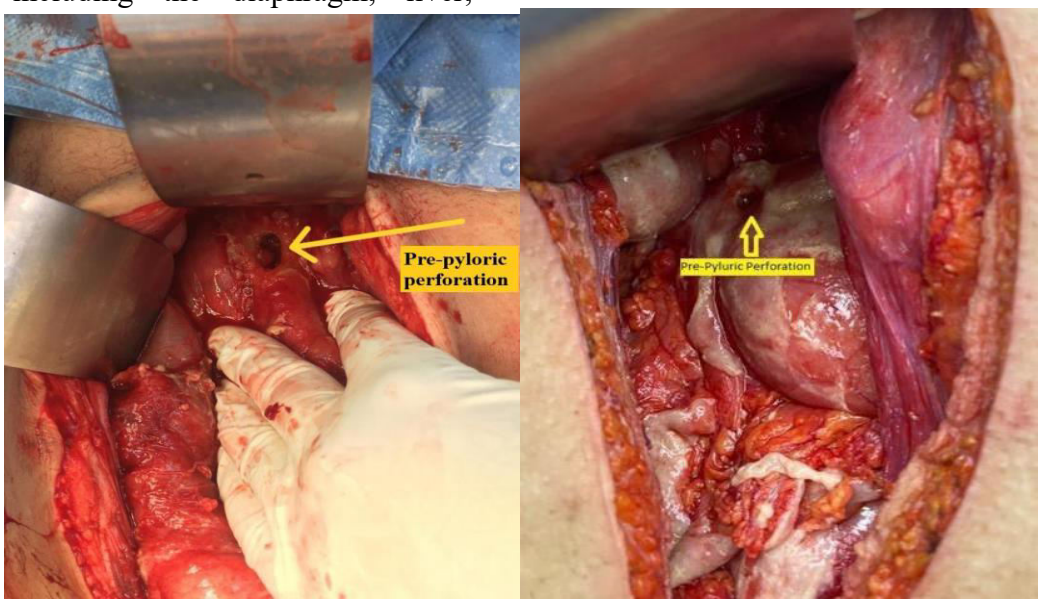

Fig.1. Pre-pyloric perforation detected after abdominal cavity examination.

Omentopexy: In the supine position, the patient's bowel perforation was identified, and sponges were used to contain gastroduodenal contents. A patch of the greater omentum, transected from the greater curvature of the stomach, was sized to match the ulcer and placed over the perforation without tension **(Fig.2).**

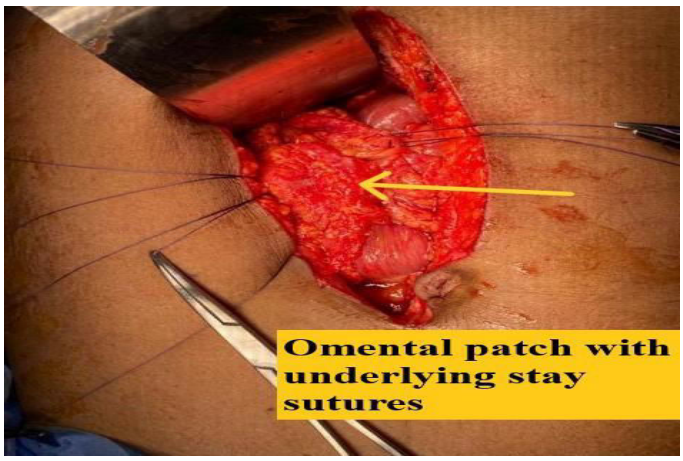

Fig.2. The omental patch was transected and fixed over the perforation with stay sutures.

Three to four interrupted full-thickness 3-0 Vicryl sutures were placed 1 cm from the perforation edges to secure a vascularized omental patch. The sutures were tied from superior to inferior to anchor the graft. The peritoneal cavity was irrigated with 3-5 liters of warm saline, covering the supra-hepatic and infra-hepatic recesses, lesser sac, paracolic gutters, and pelvis. **(Fig.3).**

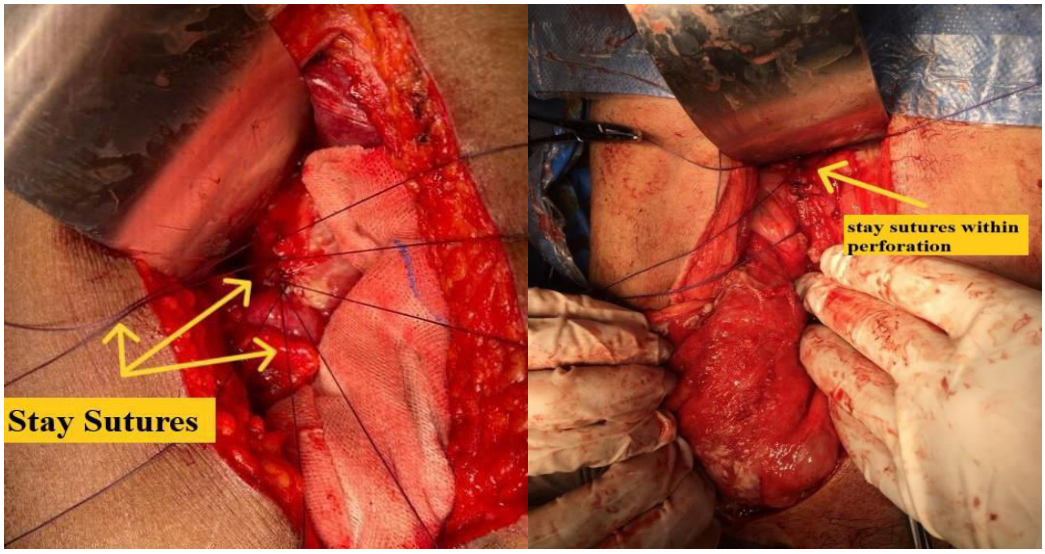

Fig.3. 3-0 vicry sutures were used to anchor the omental graft in places.

Falciformpexy: The falciform ligament was dissected from the umbilicus to the umbilical fissure, yielding a 20–30 cm pedicle with intact blood supply. Division of the left triangular ligament allowed the liver to drop away from the abdominal wall. Full thickness Interrupted 3-0 Vicryl sutures were sited through all layers of the peptic ulcer, and an archway of stay sutures was placed without primary closure **(Fig.4).**

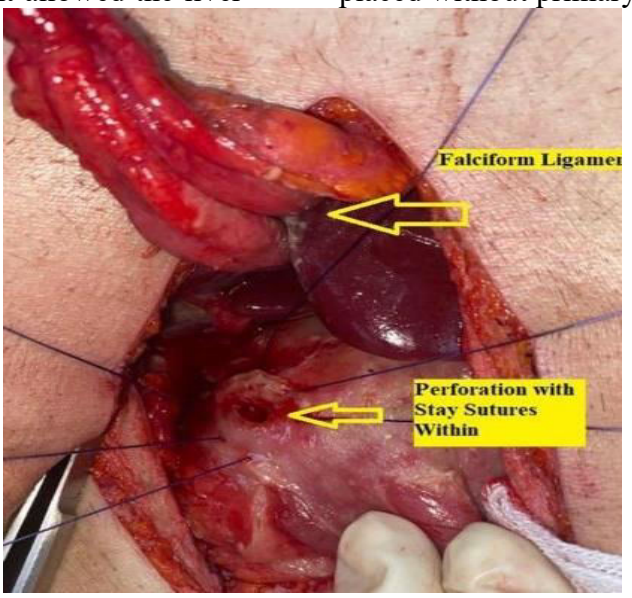

Fig.4. Falciform ligament was dissected and mobilized, and full thickness Interrupted sutures were sited.

The falciform ligament was positioned over the archway and sutured with careful tension to maintain blood supply and prevent slippage. The peritoneal cavity was irrigated with 3-5 liters of warm saline to remove contamination **(Fig.5).**

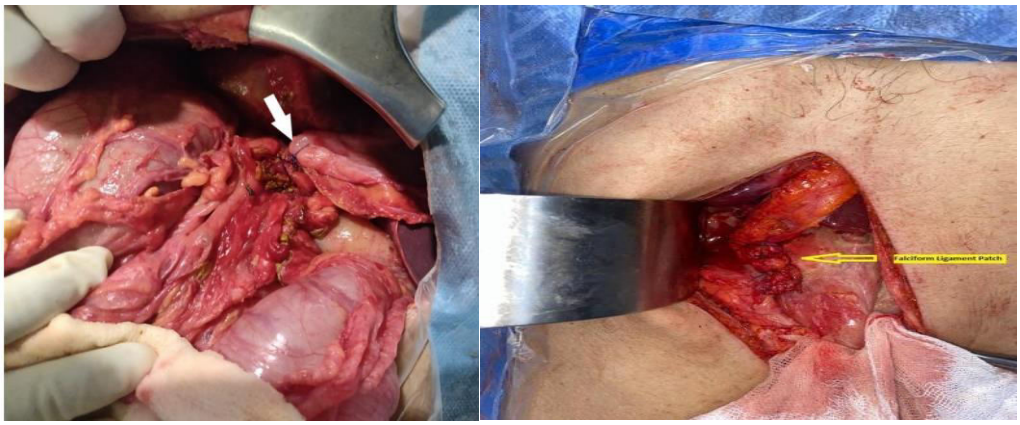

Fig.5. Falciform ligament was placed over the sutures.

Post-operative: Thromboprophylaxis was administered to patients at risk for thromboembolism. Nasogastric tubes were removed after 2 days, and patients began oral fluids on postoperative day 3. Antibiotic was continued for 7–10 days, and patients were discharged on proton pump inhibitors treatment for at least 1.5 months. Follow-up included monitoring with complete blood counts, prothrombin concentration, INR, liver and kidney functions, ultrasound, and ICU admission if needed. The primary outcome was leakage incidence within 10 days.

Statistical analysis

Data were analyzed using SPSS version 26, with results expressed as numbers and percentages for qualitative variables and means ± standard deviations for quantitative variables. The arithmetic means and standard deviation described central tendency and dispersion. Comparisons included the student's t-test for two independent groups, the Mann-Whitney test for non-normally distributed data, the Chi-square test for associations, the Z-test for percentages, and the Odds ratio for risk comparisons. Significance was set at a 5% level ($p < 0.05$).

Results

Our current study included a total of 60 patients, with a mean age of 44.23 years (SD ± 14.55). Of these, 53.33% were male (32 patients) and 46.67% were female (28 patients). divided into the Omentopexy group (30 patients) and the Falciformpexy group (30 patients presented with unhealthy or gangrenous omentum, previous upper abdominal surgery, and omentectomy). The difference in age and sex distribution was not statistically significant between 2 groups ($p = 0.1246$). Regarding co-morbidities, there were also no significant differences. In terms of the American Society of Anesthesiologists (ASA) grade, 60% of patients in the Omentopexy group were classified as ASA grade II (18 patients). In comparison, 50% were ASA grade II (15 patients). The difference in ASA grade distribution was not statistically significant ($p = 0.4448$). (**Table.1**).

Table 1. Comparison between Omentopexy and Falciformpexy Groups regarding demographic data and co-morbidities

Variables	Omentopexy group (N = 30)	Falciformpexy Group (N = 30)	P. Value
Age (Years)	44.67 ± 13.79	43.8 ± 15.25	0.4066[t]
Sex:			
Male	19 (63.33%)	13 (43.33%)	0.1246[X]
Female	11 (36.67%)	17 (56.67%)	0.1246[X]

ASA:			
I	12 (40%)	15 (50%)	0.4448[X]
II	18 (60%)	15 (50%)	0.4448[X]
Co-morbidity:			
DM	8 (26.67%)	9 (30%)	0.779[X]
HTN	5 (16.67%)	5 (16.67%)	0.99[X]
COPD	4 (13.33%)	4 (13.33%)	0.99[X]
Chronic renal disease	2 (6.67%)	2 (6.67%)	0.99[X]
Cardiovascular disease	3 (10%)	1 (3.33%)	0.3087[X]

The distribution of perforation types was 33 patients presented with duodenal ulcer (55%). The mean perforation diameter was 0.92 cm with a standard deviation of ± 0.26 cm., with no statistically significant difference observed between the two groups (Mann-Whitney U test, p = 0.3048). The Omentopexy group had 66.67% presenting late perforation (20 patients). In contrast, the Falciformpexy group showed 50% presenting late perforation (15 patients). However, these differences were not statistically significant (p =0.1967). **(Table.2).**

Table 2. Comparison between Omentopexy and Falciformpexy Groups regarding characteristics of perforation and time of presentation

Variables	**Omentopexy group (N = 30)**	**Falciformpexy Group (N = 30)**	**P. Value**
Type of perforation			
Duodenal ulcer	17 (56.67%)	16 (53.33%)	0.7994[X]
Gastric ulcer	13 (43.33%)	14 (46.67%)	0.7994[X]
Perforation diameter, Cm	0.9 ± 0.29	0.93 ± 0.22	0.3048[MWU]
Presentation			
Early	10 (33.33%)	15 (50%)	0.1967[X]
Late	20 (66.67%)	15 (50%)	

Hemoglobin levels and albumin were lower in the Omentopexy group compared to the Falciformpexy group, with a statistically significant difference observed. Other laboratory investigations showed no significant difference. (**Table.3).**

Table 3. Comparison between Omentopexy and Falciformpexy Groups regarding Laboratory Values

Variables	**Omentopexy group (N = 30)**	**Falciformpexy Group (N = 30)**	**P. Value**
Laboratory values			
White blood cell, (10^9/L)	19.23 ± 2.86	19.17 ± 3.05	0.8581[MWU]
Hemoglobin, (g/dL)	12.34 ± 1.66	13.14 ± 0.95	0.0281*[w.t]
Creatinine, (mg/dL)	2.23 ± 0.57	2.18 ± 0.63	0.6347[MWU]
Albumin, (g/dL)	3.07 ± 0.71	3.47 ± 0.66	0.0236*[MWU]
INR	1.05 ± 0.24	0.94 ± 0.2	0.0712[MWU]

There is no significant difference between the 2 groups regarding, operative duration, hospital stay, and oral intake. The incidence of the leak was 10% in both the Omentopexy and Falciformpexy groups (3 patients each), (p = 0.99). Ileus occurred in 13.33% of the Omentopexy group (4 patients) and 6.67% of the Falciformpexy group (2 patients), but the difference was not statistically significant (p = 0.398). Pulmonary complications occurred in 23.33% of the Omentopexy group (7 patients) and 10% of the Falciformpexy group (3 patients), although the difference was not statistically significant (p = 0.1715). Similarly, evisceration and wound infection showed no statistically significant difference. **(Table.4).**

Table 4. Comparison between Omentopexy and Falciformpexy Groups regarding operative data and postoperative complication:

Variables	Omentopexy group (N = 30)	Falciformpexy Group (N = 30)	P. Value
Operative duration, min. From skin to skin	90.03 ± 12.49	89.37 ± 11.18	0.9587[MWU]
Hospital stays, Days	9.6 ± 3.55	9.63 ± 3.62	0.9344[MWU]
Oral intake	3.2 ± 1.3	3.37 ± 1.25	0.5136[MWU]
Postoperative complication:			
Leak	3 (10%)	3 (10%)	0.99[X]
Ileus	4 (13.33%)	2 (6.67%)	0.398[X]
Evisceration	4 (13.33%)	3 (10%)	0.6591[X]
Pulmonary complications	7 (23.33%)	3 (10%)	0.1715[X]
Surgical site infection	3 (10%)	3 (10%)	0.99[X]
thirty-day mortality	3 (10%)	2 (6.67%)	0.6472[X]

Discussion

(PUP) is a common surgical emergency all over the world, with early surgical intervention associated with a good prognosis. Roscoe R. Graham in 1937 described a technique that depended on using the omentum to cover the perforation **(Ölmez et al. 2019).** This technique expands worldwide with low morbidity and mortality but in cases of unhealthy, gangrenous, or surgically removed omentum the risk of postoperative leakage increases. Also, postoperative ileus and abdominal distention may stretch the omentum and increase the incidence of leakage. **(Son et al. 2021).**

The falciform ligament can be used as a good alternative to omentum for the management of PUP. Anatomically, the falciform ligament's location above the gastroduodenal junction and its serosal layer support perforation healing **(Baskaran et al., 2021).**

In the present study, in the Omentopexy group (n=30), the mean age was 44.67 years (SD ± 13.79), with 63.33% male and 36.67% female, while in the Falciformpexy group (n=30), the mean age was 43.8 years (SD ± 15.25), with 43.33% male and 56.67% female. The differences in age and sex distribution between the groups were not significant (p = 0.4066 and p = 0.1246, respectively). Co-morbidity prevalence was similar between groups, with no significant differences.

Our study findings are supported by **Ölmez et al. (2019),** who found a mean age of 54.8 years (SD ± 20.4) and reported no significant differences between Omentopexy and Falciformpexy groups regarding age, sex, or comorbidities (P>0.05). However,

their study noted that 83.4% of patients were male.

In our study, the Omentopexy group had 56.67% of patients with duodenal ulcers and 43.33% with gastric ulcers, while the Falciformpexy group had 53.33% with duodenal ulcers and 46.67% with gastric ulcers. The mean perforation diameter was similar in both groups (Omentopexy: 0.9 cm, SD ± 0.29; Falciformpexy: 0.93 cm, SD ± 0.22), with no significant difference (p = 0.3048). The early presentation was 33.33% in Omentopexy and 50% in Falciformpexy, showing no significant difference (p = 0.1967).

Our findings align with **Khan and Gupta (2019),** who reported that 89.86% of perforations were from the duodenal or pre-pyloric group, with most perforations being ≤5 mm in size.

In the present study, the average operative duration was 90.03 minutes (SD ± 12.49) for Omentopexy and 89.37 minutes (SD ± 11.18) for Falciformpexy, with no significant difference (p = 0.9587). Hospital stays averaged 9.6 days (SD ± 3.55) for Omentopexy and 9.63 days (SD ± 3.62) for Falciformpexy, also not significantly different (p = 0.9344). Oral intake resumption was at 3.2 days (SD ± 1.3) for Omentopexy and 3.37 days (SD ± 1.25) for Falciformpexy, with no significant difference (p = 0.5136).

Our study findings were consistent with **Son et al. (2021),** who reported an average operative duration of 88.6 minutes (range 45–180 minutes), a hospital stay of 9.6 days (range 2–35 days), and oral intake resumption at 4.1 days (range 3–8 days).

In line with our results, **Terzioğlu et al. (2023)** found no significant difference between modified Graham omentopexy and falciformopexy regarding surgery duration and hospital stay (P>0.05).

In our study, leak incidence was 10% in both the Omentopexy and Falciformpexy groups (3 patients each), with no significant difference (p = 0.99). Ileus occurred in 13.33% of Omentopexy (4 patients) and 6.67% of Falciformpexy (2 patients), not statistically significantly different (p = 0.398). Evisceration rates were 13.33% in Omentopexy (4 patients) and 10% in Falciformpexy (3 patients), with no significant difference (p = 0.6591). Pulmonary complications were observed in 23.33% of Omentopexy (7 patients) and 10% of Falciformpexy (3 patients), also not statistically significant (p = 0.1715). Surgical site infection rates were 10% in both groups (3 patients each), with no significant difference (p = 0.99).

Our study findings were aligned with **Ölmez et al. (2019),** who reported no statistically significant differences between Omentopexy and Falciformpexy groups regarding operative time, hospital stay, oral intake, 30-day mortality, ileus, wound infection, evisceration, and pneumonia (P>0.05). However, their study found a significant difference in atelectasis, which was higher in the Omentopexy group (P=0.04).

Terzioğlu et al. (2023) assessed the post-operative complications including surgical site infection, evisceration, atelectasis, pneumonia, ileus, and leakage. They found no significant differences between the groups, except for a higher incidence of suture line leakage in the Falciformpexy group compared to modified Graham omentopexy (P=0.017).

Bingener et al. (2013) studied NOTES omental plug repair for perforated peptic ulcers and found that the falciform ligament was more suitable than omentum for transluminal PUP repair, with no leakage during follow-up. **Çalış et al. (2016)** reported using the falciform ligament for marginal ulcer perforation repair, noting that it was a cost-effective and straightforward alternative to omentopexy with no

postoperative issues. **Rajput et al. (2021)** found the falciform ligament patch technique to be a viable alternative when omentum was unavailable, associated with lower morbidity compared to other techniques.

Son et al. (2021), observed a 30-day mortality rate of 17.5% and assessed complications including pneumonia (25%), multiorgan failure (15%), acute liver failure (5%), wound infection (7.5%), and no leakage. They found that ASA ≥ III and comorbidities were associated with mortality, while multivariate analysis identified multiorgan failure as the sole factor associated with mortality.

In our study, the 30-day mortality rate was 10% for omentopexy and 6.67% for falciformpexy, with no significant difference (p = 0.6472). Leakage, pulmonary complications, and multiorgan failure were the main causes of mortality among the two groups. Leakage associated with perforation larger than 1 cm and delayed presentation. Six cases presented by leakage, 4 of them needed no operative intervention and were managed by conservation and follow-up. Only 2 cases needed reoperation one was managed by primary repair with flaciformopexy and gastrojejunostomy and the other needed distal antrectomy.

Ogbuanya et al. (2024) reported that leak repairs following omentopexy were significantly associated with larger perforation diameters, delayed presentation, sepsis, immunosuppressive therapy, and perioperative shock. The leak repair rate was 11.7%, with increased risks linked to perforation diameter (>2.1 cm), delayed presentation (>48 hours), sepsis, and perioperative shock. Those without immunosuppression had a lower likelihood of leaked repair (aOR=0.34; 95% CI: 0.16 - 0.72; p = 0.003), while those with sepsis had a higher likelihood (aOR=4.16; 95% CI: 1.06 - 12.36; p = 0.018).

Conclusion

Our study demonstrated that the use of the falciform ligament for the management of peptic ulcer perforation (PUP) is comparable to the traditional omental patch repair in terms of perioperative outcomes, including operative time, hospital stays, resumption of oral intake, and complication rates. Both surgical techniques proved to be effective and safe, offering viable options for the treatment of PUPs without significant differences in patient recovery or postoperative complications.

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