

The feasibility of falciformopexy in the repair of peptic ulcer perforation

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ABSTRACT

BACKGROUND: Modified Graham omentopexy is the most commonly used operative technique in the repair of peptic ulcer perforation (PUP); however, there is little data on falciformopexy in the literature. The aim is to investigate the feasibility of falciformopexy in the repair of PUP, comparing with modified Graham omentopexy.

METHODS: Data of 471 patients who were operated for PUP were retrospectively analyzed. Patients' demographics, pre-operative basic laboratory findings, American Society of Anesthesiologists (ASA) status, operative findings, and post-operative complications were recorded. The patients were classified into two groups modified Graham omentopexy and falciformopexy, and then compared with each other in terms of clinical characteristics, operative findings, and post-operative complications.

RESULTS: Modified Graham omentopexy and falciformopexy were performed in 425 (90.2%) and 46 (9.8%) patients, respectively. The two groups were similar in terms of basic patient characteristics and pre-operative laboratory findings ($P>0.05$). ASA physical status was significantly different between the groups ($P=0.001$). No statistically significant difference was found between the groups in terms of complications, except for an anastomotic leak. Anastomotic leak was observed more frequently in patients who underwent falciformopexy than in patients with modified Graham omentopexy ($P=0.017$).

CONCLUSION: Although falciformopexy technique has a higher rate of leak compared to the modified Graham omentopexy method, it should be kept in mind as an alternative method for repair of PUP, especially in cases where omentopexy cannot be applied for various reasons such as the presence of unavailable or unsuitable omentum.

Keywords: Falciformopexy; modified graham omentopexy; peptic ulcer perforation.

INTRODUCTION

Peptic ulcer, defined as the defect in the gastric or duodenal mucosa, occurs as a result of increased acid-peptic activity in the gastric fluid and extends to the muscularis mucosa. The most important etiological factors are helicobacter pylori infection and the use of non-steroid anti-inflammatory drugs.

Steroids, Epstein-Barr and cytomegalovirus, acid hypersecretion, stress, and ischemic situations are also other causes of this entity.^[1] Peptic ulcer disease is very common with an estimated lifetime prevalence of 5–10% in the entire population.^[2] Approximately 70% of the patients are asymptomatic or have non-specific symptomatology. The most common complaints in symptomatic cases are epigastric pain radiating to the back,

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bloating, early satiety, nausea, and vomiting.^[3]

Upper gastrointestinal bleeding is the most frequent complication in peptic ulcer disease. Perforation, gastric outlet obstruction, penetration, and fistulization are other serious complicated situations. Although peptic ulcer perforation (PUP) is less common than upper gastrointestinal bleeding, the need for surgical treatment is 6 times higher. PUP is also the most common cause of peptic ulcer-related morbidity and mortality.^[4] It accounts for nearly 40% of ulcer-related mortality and is the third most common cause among all abdominal urgent surgical situations.^[5]

The mainstay treatment of PUP is surgery with different operative techniques such as Graham omentopexy, modified Graham omentopexy, falciformopexy, resections, and laparoscopic modifications.^[6,7] Although Graham omentopexy was described many years ago, it remains one of the most commonly used surgical options today. This surgical approach is based on closing the perforation area with an omentum piece and fixing this piece with a suture.^[8] Other surgical methods were found by following this logic. The modified Graham omentopexy method, on the other hand, is a method in which the perforation is primarily sutured, and then the omental patch is fixed with the same sutures on this suturation.^[9]

Falciformopexy method, specifically discussed in the present study, is a repair method in which the falciform ligament is used similar to the omentum in the modified Graham omentopexy method.^[10] Although good results were presented in most studies in which falciform flap was used to cover PUP, the majority of these works comprised small case series pertaining to small perforations and early onset of under 12-h duration.^[11-14] There are also few studies that reported contrary results on the use of falciform ligament as a replacement for omentum.^[15]

In this study, it was aimed to compare modified Graham omentopexy and falciformopexy techniques in patients who were operated on the diagnosis of PUP.

MATERIALS AND METHODS

Ethics committee approval was obtained from Ankara City Hospital No. 1 Clinical Research Ethics Committee (protocol number: E1-22-3086, date: December 14, 2022). The study was carried out in accordance with the 1964 Declaration of Helsinki and its amendments.

Data of 493 patients who were operated for PUP in Ankara Numune Training and Research Hospital and Ankara City hospital between January 1, 2008, and June 1, 2022, were retrospectively analyzed. Twenty-two patients were excluded from the study due to the irregular medical records. As a result, 471 patients were included in the study. Patients' demographics including age and gender, pre-operative basic laboratory findings including hemoglobin (Hb), white blood cell count (WBC), creatinine, and albumin, American Society of Anesthesiologists (ASA) physical status, Charlson comor-

bidity index (CCI), time from onset of complaints to operation, operative findings including type of surgery (open or laparoscopic), localization and size of perforation, duration of surgery, and length of hospitalization, and post-operative complications including surgical site infection, evisceration, atelectasis, pneumonia, post-operative ileus, and anastomotic leakage were recorded.

Modified Graham omentopexy was the primary operative method for PUP. Falciformopexy was only performed in patients where omentopexy could not be applied for various reasons including the presence of unavailable or unsuitable omentum. The patients were classified into two groups "modified Graham omentopexy (Group 1)" and "falciformopexy (Group 2)," and then compared with each other in terms of all basic characteristics, operative findings, and complications. In modified Graham omentopexy, the perforated area was primarily sutured, and then the omental patch was fixed with the same sutures on this suturation. In falciformopexy, the perforation was first closed with primary sutures. Then, a falciform flap was prepared as follows: The falciform ligament was dissected from the umbilicus to the umbilical fissure on the diaphragmatic surface of the liver. A falciform ligament pedicle of approximately 20–30 cm with preserved vascular supply was obtained by transecting the ligament from the anterior abdominal wall. Thereafter, this falciform flap was fixed on the suturation similar to modified Graham omentopexy.

The obtained data were analyzed in the SPSS 23.0 software package (IBM Corp., Armonk, NY, USA). Kolmogorov–Smirnov test was used to determine the conformity of the data to the normal distribution. Categorical variables were presented as frequencies and percentages. If continuous data are non-normally distributed presented as median value (interquartile range) otherwise presented as mean \pm standard deviation. Differences between non-normally distributed data were analyzed by means of Mann–Whitney U test. Differences between normally distributed data were analyzed by means of student t-test. Categorical variables were analyzed with χ^2 or Fischer's exact test. $P < 0.05$ was considered to indicate statistical significance.

RESULTS

A total of 471 patients who were operated for PUP were included in the study. There were 381 (80.9%) males and 90 (19.1%) females, with an overall mean age of 52 years old (16–95). Modified Graham omentopexy (Group 1) was performed in 425 (90.2%) patients, while 46 (9.8%) cases underwent falciformopexy (Group 2). Open surgery ($n=464$, 98.5%) was performed in the majority of cases whereas only seven patients (1.5%, all in the modified Graham omentopexy group) underwent laparoscopic surgery. The two groups were similar in terms of age, gender, and pre-operative basic laboratory findings including Hb, WBC, creatinine, and albumin ($P > 0.05$). ASA physical status was significantly different between the groups ($P=0.001$). There were 38 (9%) patients who had ASA

Table 1. Comparison of patient characteristics and operating data between the groups

Parameters	Group 1 (n=425)	Group 2 (n=46)	P-value
Age (y)	52.06±20.5 (16–95)	51.4±19.5 (19–90)	0.817
Gender (M/F)	342 (80.5%)/83 (19.5%)	39 (84.8%)/7 (15.2%)	0.559
ASA status (%)			
ASA 1	103 (24.2)	18 (39.1)	0.001
ASA 2	155 (36.5)	5 (10.9)	
ASA 3	63 (14.8)	2 (4.3)	
ASA 4	30 (7.1)	1 (2.2)	
ASA 5	8 (1.9)	0	
Pre-operative Hb (g/dL)	14.3±2.6 (3.6–21.2)	15±2.2 (6.8–20)	0.110
Pre-operative WBC (10 ³ /μL)	13.6±6.7 (1.6–37.9)	15.1±8.2 (1.3–47.8)	0.271
Pre-operative Cr (mg/dL)	1.2±0.8 (0.1–10.4)	1.1±0.5 (0.1–2.3)	0.468
Pre-operative Alb (g/dL)	2.9±1.4 (0.7–6.1)	2.8±0.8 (1.2–4.6)	0.891
Size of PUP (mm)	7.4±6.7 (1–70)	7.2±8 (1–56)	0.738
Duration of surgery (min)	82.7±32.3 (20–225)	72.9±20.7 (45–130)	0.215
Length of hospitalization (d)	8.2±8 (1–93)	6.6±2.3 (4–16)	0.554
Reoperation	4 (0.9%)	2 (4.3%)	0.109

Gender, ASA status, and reoperation were presented as n (%), other variables were presented as mean±standard deviation (minimum-maximum). y: year, M: male, F: female, ASA: American Society of Anesthesiologists, Hb: Hemoglobin, WBC: White blood cell count, Cr: Creatinine, Alb: Albumin, mm: millimeter, min: minute, d: day. PUP: Peptic ulcer perforation.

4 or 5 status in the patients with modified Graham omentopexy while only one (2.2%) patient was classified as ASA 4 status in the falciformopexy group. There was no difference in the localization (P=0.490) and median size (P=0.738) of perforation between the patient groups. Mechanical ventilator dependence was observed in 50 (12.7%) patients who underwent modified Graham omentopexy whereas 4 (8.7%) patients with falciformopexy needed mechanical ventilation (P=0.806). No significant difference in length of hospitalization was found between the groups (Table 1).

The two groups were also evaluated in terms of complications including surgical site infection, evisceration, atelectasis, pneumonia, post-operative ileus, and anastomotic leakage. Except for anastomotic leakage, no significant differences in post-operative complications were found between the two groups. Anastomotic leakage was observed more frequently in patients who underwent falciformopexy than in patients with modified Graham omentopexy, with a statistically signifi-

cance (P=0.017). Mortality was statistically similar between the two groups (Table 2).

DISCUSSION

PUP is a life-threatening emergency situation, and surgical treatment still maintains its importance as the most effective therapeutic option.^[16] Among surgical approaches, omentopexy-based methods such as Graham and modified Graham patches are usually preferred.^[17] On the other hand, there are reports demonstrating that repair of PUP using the falciform ligament is as effective as the omentopexy.^[18] In this study, the most frequently used technique for the PUP repair, the modified Graham omentopexy, was compared with the less used alternative method, falciformopexy.

Today, it is known that falciform ligament contains abundant adipose tissue and rich vascular and lymphatic networks, allowing a very suitable tissue for using as a flap and graft. Its

Table 2. Comparison of post-operative morbidity and mortality between the groups

Variables	Group 1 (n=425) (%)	Group 2 (n=46) (%)	P-value
Surgical site infection	24 (5.6)	4 (8.7)	0.507
Evisceration	13 (3.1)	2 (4.3)	0.647
Atelectasis	25 (5.9)	1 (2.2)	0.157
Pneumonia	30 (7.1)	2 (4.3)	0.757
Post-operative ileus	9 (2.1)	3 (6.5)	0.104
Anastomotic leakage	7 (1.6)	4 (8.7)	0.017
MV dependence	50 (11.8)	4 (8.7)	0.806
Mortality	32 (7.5)	4 (8.7)	0.770

All parameters were presented as n (%). MV: Mechanical ventilator.

thin double membranous structure is also an important feature that supports its use as a graft.^[18] Anatomically, the falciform ligament is located just above the gastroduodenal junction, where PUPs are most common. Thus, a flap prepared from the falciform ligament can be placed easily and without tension over the perforation, making it ergonomic for surgeons. The peritoneal surfaces on both sides of the falciform ligament also provide the necessary serosal layer to support the healing of the perforation.^[19] In fact, the idea of using the falciform ligament for surgical procedures is not new. However, the general belief that it is a poor alternative to the omentum has limited its practical use for many years. With the better understanding of the richness of its anatomical and histological structures, its use in routine surgical procedures has again gained interest in recent years.^[19]

In the literature, there is the limited number of clinical studies on the use of falciform ligament patch for repair of PUP. The majority of these studies are single case reports or small case series, with good surgical outcomes.^[10-14,20] There are only two clinical studies reported negative views on the feasibility of falciformopexy for PUP repair.^[15,21] It should be noted here that at the time of the publications of these studies, falciform ligament flap techniques were just developing and surgeons did not have enough information about the physiological functions of these flaps. In many studies, it was observed that falciformopexy and modified Graham omentopexy methods had no effect on mortality and hospitalization.^[22] The present study has the highest number of cases among studies that examined mortality and length of hospital stay, and no significant differences were found between the two techniques in terms of these variables.

To the best of our knowledge, there is only one study that compared the falciformopexy technique with modified Graham omentopexy.^[14] In that study conducted on 289 cases, modified Graham omentopexy and falciformopexy groups were found similar in terms of most clinical variables. Statistically, post-operative atelectasis was higher in the modified Graham omentopexy group, while the leakage rate was found to be higher in the falciformopexy group.^[14] In our study, no significant differences were found between the two groups in terms of atelectasis and other post-operative complications. However, in accordance with the same study, anastomotic leakage was observed significantly higher in the patient group who underwent falciformopexy. This result may be due to the fact that the number of patients to whom the falciform flap was applied was significantly less than in the modified Graham omentopexy group. In other words, insufficient experience with the falciformopexy technique may have contributed to this result. In addition, the general health status of the patients might also be contributed to this result. Although CCI scores were statistically similar between the two groups, the patients in the modified Graham omentopexy group had worse ASA status in comparison to falciformopexy patients. It should also be noted here that the presence of poor health

status may have led to the avoidance of falciformopexy that is a relatively new technique with uncertain surgical results.

This study has several limitations. First, it was conducted in a single center, which may limit the generalizability of the statistical results. The smaller sample size in the falciformopexy group compared with the modified Graham omentopexy group may be another limitation. However, considering that there is only one work compared these methods in the repair of PUP; the present study can provide important scientific contributions to the literature and may be supportive for the future studies on this issue.

CONCLUSION

Although the falciformopexy technique had a higher rate of leak compared with the modified Graham omentopexy method, it should be kept in mind as an alternative method for repair of PUP, especially in cases where omentopexy cannot be applied for various reasons such as the presence of unavailable or unsuitable omentum.

Ethics Committee Approval: This study was approved by the Ankara City Hospital Ethics Committee (Date: 14.12.2022, Decision No: E1-22-3086).

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ORJİNAL ÇALIŞMA - ÖZ

Peptik ülser perforasyonu onarımında falsiformopeksinin uygulanabilirliği

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AMAÇ: Modifiye Graham omentopeksi, peptik ülser perforasyonu onarımında en sık kullanılan ameliyat tekniğidir; ancak literatürde falsiformopeksi ile ilgili çok az veri bulunmaktadır. Amaç, falsiformopeksinin peptik ülser perforasyonu onarımındaki uygulanabilirliğini modifiye Graham omentopeksi ile karşılaştırarak araştırmaktır.

GEREÇ VE YÖNTEM: Peptik ülser perforasyonu nedeniyle opere edilen 471 hastanın verileri retrospektif olarak incelendi. Hastalar modifiye Graham omentopeksi ve falsiformopeksi olarak sınıflandırılarak klinik özellikleri, ameliyat bulguları ve ameliyat sonrası komplikasyonlar açısından birbirleriyle karşılaştırıldı.

BULGULAR: Modifiye Graham omentopeksi ve falsiformopeksi sırasıyla 425 (%90.2) ve 46 (%9.8) hastaya uygulandı. İki grup temel hasta özellikleri ve ameliyat öncesi laboratuvar bulguları açısından benzerdi ($p>0.05$). ASA fiziksel durumu gruplar arasında anlamlı olarak farklıydı ($p=0.001$). Anastomoz kaçağı dışındaki komplikasyonlar açısından gruplar arasında istatistiksel olarak anlamlı fark bulunmadı. Anastomoz kaçağı falsiformopeksi yapılan hastalarda modifiye Graham omentopeksi yapılan hastalara göre daha sık gözlemlendi ($P=0.017$).

SONUÇ: Falsiformopeksi tekniği, modifiye Graham omentopeksi yöntemine göre daha yüksek anastomoz kaçağı oranına sahip olmasına rağmen, peptik ülser perforasyonlarının onarımında, özellikle omentumun yokluğu veya uygun olmayan omentum varlığı gibi çeşitli nedenlerle modifiye Graham omentopeksi uygulanamayan durumlarda alternatif bir yöntem olarak akıldta tutulmalıdır.

Anahtar sözcükler: Falsiformopeksi, modifiye Graham omentopeksi, peptik ülser perforasyonu

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