

Open versus laparoscopic technique in peptic ulcer perforation, how effective are score systems? Single-center experience and literature review

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ABSTRACT

BACKGROUND: One of the most common peptic ulcer complications is perforation (PUP) which also remains an important cause of morbidity and mortality. In this study, it was aimed to compare the results of patients who had similar pre-operative scoring index results (Boey, Charlson Comorbidity Index (CCI) and Mannheim Peritonitis Index (MPI), and type of surgery.

METHODS: Pre-operative Boey, CCI, and MPI scores were calculated by retrospectively examining the files of patients who were operated under emergency conditions with the diagnosis of PUP. The patients divided into two groups those who underwent laparoscopic surgery/Group-1 and open surgery/Group-2.

RESULTS: There was no statistical difference between the groups in terms of demographic data, hospital admission time, and length of hospital stay. The operation time was found to be longer in the laparoscopic group (110,2 SD20,6/75–150 min) than open group (54,2 SD15,7/30–120 min) ($p<0.001$). Morbidity was less in laparoscopic group (4% versus 14.6%) ($p<0.001$).

CONCLUSION: The laparoscopic method may be used safely in PUP due to the lower post-operative complication rates and known advantages of minimally invasive surgery.

Keywords: Boey score; Charlson comorbidity index; laparoscopy; Mannheim peritonitis index; minimally invasive surgery; peptic ulcer perforation.

INTRODUCTION

Over time, with the developments in medical treatment, emergency surgical interventions for complications rather than elective surgical interventions in the treatment of peptic ulcer disease have started to be applied more frequently.^[1] One of the most common complications of peptic ulcer disease is perforation and constitutes an important part of emergency surgical procedures related to peptic ulcer. The morbidity and mortality rates of emergency surgical procedures due to peptic ulcer perforation (PUP) are still not at the desired level despite improvements in all surgical techniques and post-operative care facilities.^[2,3] Different success and complication rates have

been reported with various surgical techniques performed, but the most controversial issue was which PUP patients could be candidates for minimally invasive surgery.^[4] It has been discussed in the literature that various scoring systems such as Boey score, Charlson comorbidity index (CCI), and Mannheim peritonitis index (MPI) can be decide to perform on minimally invasive surgery.^[5-7] This study is aimed to compare the results of patients who underwent laparoscopic and open surgery for PUP with “low” Boey, CCI, and MPI scores.

MATERIALS AND METHODS

The data of the patients who underwent an emergency surgery with the diagnosis of PUP between September 2018

Cite this article as: Akin E, Altintoprak F, Akdeniz Y, Mantoglu B, Ozdemir K, Firat N, et al. Open versus laparoscopic technique in peptic ulcer perforation, how effective are score systems? Single-center experience and literature review. *Ulus Travma Acil Cerrahi Derg* 2022;28:1437-1441.

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Ulus Travma Acil Cerrahi Derg 2022;28(10):1437-1441 DOI: 10.14744/tjtes.2021.78938 Submitted: 31.05.2021 Accepted: 03.12.2021

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and February 2020 at Sakarya University Faculty of Medicine, Department of General Surgery were retrospectively analyzed. Informed consent was obtained from the participants and the Ethics Committee of the Institution approved the study. The patient records were evaluated in terms of demographic data, score systems, surgical method (open-laparoscopic), surgical outcome, and early post-operative data.

Boey, CCI, and MPI scores were calculated by evaluating pre-operative and surgical observation. Patients with a Boey score of 0–1, CCI score of <3, and MPI score of <21 were included in the study. Patients with shock index at admission, with perforation away from the pylorus, with concomitant peptic ulcer bleeding, and patients with moderate or high Boey, CCI, and MPI scores were excluded from the study.

The patients who were operated laparoscopically are Group 1, and those that who were performed conventionally are Group 2. While establishing the study groups, a 3:1 propensity score matching applied to reduce the heterogeneity among the baseline variables in Group 2 that met the inclusion and exclusion criteria.

Pre-operative Preparation and Surgical Technique

Pre-operative nasogastric tube and urinary catheter were placed in the patients in both groups, antibiotic prophylaxis and resuscitation were administered, and intravenous proton pump inhibitor infusion was started. In laparoscopy, patients were placed in the supine and 30° reverse Trendelenburg positions with their legs open (French position) allowing the surgeon to operate. After pneumoperitoneum was created at 12 mm/Hg with a Veress needle placed in the supra-umbilical region, operations were performed using a total of four ports (2 10 mm, 2 5 mm). Sutures were applied to the perforation area with an endo-needle holder and using 3/0 atraumatic silk or polyglactin sutures. The sutures were passed through the perforation site, then the omental patch was closed, and the sutures were tied, as shown in Figure 1a and b. The abdomen was irrigated with warm saline, and one drain was placed in all patients. The procedures were performed with a partial median epigastric incision in the open group, and other steps are similar to the laparoscopic group.

Statistical Analysis

Descriptive analyses were performed to provide information on the general characteristics of the study population. Kolmogorov–Smirnov test was used to evaluate whether the distribution of numerical variables was normal. Accordingly, either the Mann–Whitney U-test or independent samples t-test was used to compare the numeric variables between two groups. The numeric variables were presented as the mean±standard deviation or median (min–max). Fisher's exact test was used to compare the categorical variables between two groups. The categorical variables were presented as the frequency (% percentage). We used propensity-score match-

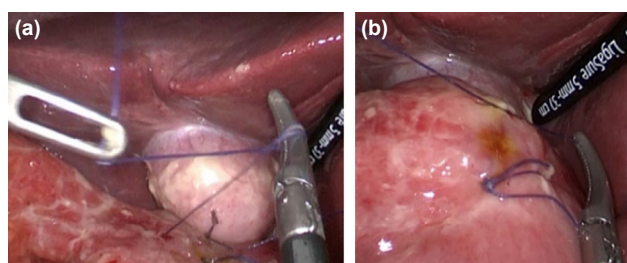


Figure 1. Intraoperative imagings (a) perforation site and (b) tied sutures.

ing to reduce the heterogeneity among the baseline variables. To calculate propensity scores, we used a fuzzy algorithm. P-value <0.05 was considered significant. Analyses were performed using SPSS statistical software (IBM SPSS Statistics, Version 23.0. Armonk, NY: IBM Corp.)

RESULTS

The records of 150 patients who were operated for peptic ulcer perforation between the specified dates were evaluated retrospectively, while 50 patients (40%) who met the exclusion criteria from the patients operated with the open technique (13 patients who had in the shock index at the time of admission, nine patients who had perforation far than 3–5 cm from pylorus, three patients who had concomitant peptic ulcer bleeding, also 25 patients whose Boey, CCI, and MPI scores were classified as medium or high) were excluded from the study. One hundred patients who underwent open and laparoscopic surgery by the same teams were included in the study. The teams consist of three surgeons with more than advanced laparoscopy experience. Twenty-five patients (25%) were operated laparoscopically (Group 1), and 75 patients (75%) were operated open (Group 2). Eighty-four (84%) patients were male and 16 (16%) were female, with a mean age of 46.28 SD18.36 (18–89 years). The mean operation time was 68.2 SD29.69 (60–150 min). The mean hospital stay of the total patients was 6.25 SD0.96 (3–34 days), and when 12 patients with wound infection, pleural effusion, bile leakage, and pulmonary complications were excluded from the study, the hospital stay was 5.57 SD1.14 (3–7 days) in patients without complication.

In Group 1, 21 (84%) patients were male, the female-male ratio of the groups was 4/21, and the mean age of the patients was 41.96 SD15.73 (18–79 years). The mean time to onset of clinical complaints and the time to operation was 1.81 SD0.76 (0–3 days). Boey score was 0.63 SD0.21 (0–1) in Group 1 and 0.57 SD0.24 (0–1) in Group 2. CCI was 1.72 SD0.78 (0–3) in Group 1 and 1.64 SD0.98 (0–3) in Group 2. MPI was 14.32 SD3.22 (4–21) in Group 1 and 16.73 SD2.76 (4–21) in Group 2. When the operation time was evaluated, the mean operative time was 110.2 SD20.6 (90–130 min) in 25 patients, but it was determined as 86.4 SD12.3 min (75–120) in the last ten patients. The average length of hospital stay was recorded as 6.24 SD3.2 (4–21 days). In Group 1, the mean hospital stay

was prolonged due to a patient with bile leakage, when this patient was excluded from the calculation that the average length of hospital stay was 5.6 SD0.96 (4–7 days).

Sixty-three (84%) patients in Group 2 were male, with a female-male ratio of the group was 4/21. While the mean age of the patients was 47.72 SD19.04 (18–79 years), the mean time to start the clinical complaints of patients and the time interval to the operation was 1.51 SD0.64 (0–3 days), the average

time of surgery was 54.2 SD15.7 (30–120 min). The average length of hospital stay was recorded as 6.8 SD5.4 (3–33 days).

While mortality was not detected during early post-operative follow-up (first 30 days), complications were observed in one patient in the laparoscopic group due to bile leakage (4%) and pulmonary complications in four patients, hemorrhage in one patient, ileus in one patient, evisceration in two patients, myocardial infarction in one patient, and wound infection in

Table 1. The results of the groups

	Laparoscopic PUP Group 1 (n=25)	Open PUP Group 2 (n=75)	p
Gender, f, n (%)	4 (16)	12 (16)	1
Age, year mean SD (min-max)	41.96 SD 15.7 (18–79)	47.72 SD 19.04 (18–89)	0.176
History, day mean SD (min-max)	1.81 SD 0.76 (0–3)	1.5 SD 0.64 (0–3)	0.263
Boey score mean SD (min-max)	0.63 SD 0.21 (0–1)	0.57 SD 0.24 (0–1)	0.197
^a CCI mean SD (min-max)	1.72 SD 0.78 (0–3)	1.64 SD 0.98 (0–3)	0.152
^b MPI mean SD (min-max)	14.32 SD 3.22 (4–21)	16.73 SD 2.76 (4–21)	0.232
Operation time, min.mean±std (min-max)			
All patients	110.2 SD 20.6 (90–130)	54.2 SD 15.7 (30–120)	<0.001
Last 10 op	86.4 SD 7.3 (75–120)		
Hospital day, day SD (min-max)	6.24 SD 3.2 (4–21)	6.8 SD 5.4 (3–33)	0.785
Complications %			<0.001
Bile leak	1 (4)	–	
Wound infection	–	2 (2.6)	
Pulmoner	–	4 (5.3)	
Hemorrhage	–	1 (1.3)	
Evisceration	–	2 (2.6)	
Ileus	–	1 (1.3)	
Infarction	–	1 (1.3)	

^aCharlson Co-morbidity Index, ^bMannheim Peritonitis Index. PUP: Peptic ulcer perforation; CCI: Co-morbidity index; MPI: Mannheim peritonitis index; SD: Standard deviation.

Table 2. The results of the groups with propensity score matching

	Laparoscopic PUP Group 1 (n=25)	Open PUP Group 2 (n=25)	p
Fender, f, n (%)	4 (16)	3 (12)	0.575
Age, year mean SD (min-max)	41.96 SD 15.7 (18–79)	47.98 SD 20.12 (18–89)	0.362
History, day mean SD (min-max)	1.81 SD 0.76 (0–3)	1.6 SD 0.72 (0–3)	0.491
Operation time, min. mean SD (min-max)			
All patients	110.2 SD 20.6 (90–130)	60.7 SD 16.9 (30–120)	<0.001
Last 10 op	86.4 SD 7.3 (75–120)		
Hospital day, day SD (min-max)	6.24 SD 3.2 (4–21)	5.7 SD 4.8 (3–33)	0.515
Complications %			0.490
Bile leak	1 (4)	–	
Wound infection	–	2 (8)	

PUP: Peptic ulcer perforation; SD: Standard deviation.

two patients totally in 11 patients (14.6%) in the open group. The results of the groups are shown in Table 1.

In statistical analysis, there was no difference between the groups in terms of demographic data, hospital admission time, score systems, and length of hospital stay. The operation time was longer 110.2 SD20.6 (90–130 min) in Group 1 versus 54.2 SD15.7 (30–120 min) in Group 2 ($p < 0.001$). Post-operative morbidity was less in Group 1 (4% in Group 1, 14.6% in Group 2) ($p < 0.001$).

The comparison results of the characteristics and other parameters between the two groups (propensity scores for all variables) are shown in Table 2. The average age of the group was 47.98 SD20.12 (18–89 years). The patients' history was 1.6 SD0.72 (0–3 days) and the operation time was 60.7 SD16.9 (30–120 min). The length of hospital stay was 5.7 SD4.8 (3–33 days). In propensity matching group, the complication was wound infection in two patients (8%). As a result of the of the propensity score matching application, statistical significance was observed only between the operation times ($p < 0.001$).

DISCUSSION

Minimally invasive approaches in the surgical treatment of peptic ulcer perforations were first defined three decades ago and are increasingly preferred in parallel with technological developments.^[8,9] Over time, the widespread use of minimally invasive surgical techniques and the feasibility and safety of laparoscopic methods in the treatment of PUP for emergency surgical procedures have been demonstrated.^[10–12] Siu et al.^[13] reported the conversion rate as 14% in a randomized controlled trial and it was shown that the laparoscopic surgery group was superior to open surgery in terms of post-operative analgesia needs, mortality, and morbidity rates. Bertleff et al.^[14] reported that similar results were obtained in a randomized controlled trial, but it was stated that the operation time was longer in the laparoscopic group. Vakayil et al.^[15] reported the results of 2462 patients and showed that the operation time is longer in laparoscopic surgery, but they reported that laparoscopic surgery can be performed safely with low complication rate, shorter hospital stays, and less mortality rates in the presence of PUP. Similarly, in the present study, although the operative time was longer in the laparoscopic surgery group, the morbidity, hospital stay, and complication rates were lower than in the open group.

By answering the feasibility and safety questions, it was started to investigate, in which PUP patient could be a candidate for minimally invasive surgery, and severe definitions were made.^[16,17] Although the results of open and laparoscopic methods in PUP patients are compared in different studies in the literature, both the heterogeneity of the patient population, they include and the difficulties in randomizing these patients, prevent the generalization of the results.^[18,19] Thus, the use

of various scoring systems come to the fore to identify PUP patients who may be the candidates for laparoscopic surgery. Boey score was used for this purpose and Mirabella et al.^[20] stated that post-operative high morbidity and mortality rates were associated with an increased Boey score. It has been reported that the minimally invasive method is safe in patients with a Boey score of < 1 .^[21] It has been emphasized in several studies that CCI > 3 and MPI > 21 have high morbidity, especially in elderly patients, and it has also been shown that MPI and CCI scores are useful in predicting the prognosis and outcomes of PUP and, therefore, may help determine the surgical option.^[1,22] However, Wang et al.^[23] stated that age is not an obstacle in patients who are considered suitable for minimally invasive surgery according to the scoring systems, and the method is safe and effective in elderly patients. According to the current paper, patients had aged 75 years or older in both groups, and the authors did not encounter any age-related complications, solely. In laparoscopic PUP surgery, as in other minimally invasive procedures, the operation times are longer in the early experience periods, while the parameter is decreasing with high experience and reaches similar rates with open surgery.^[24] The authors' experience is consistent with this issue, and a significant reduction in operative time was observed after the initial fifteen surgeries.

Due to the selection of patients who were not in the shock in both groups, and the patients with no accompanying secondary perforation site had low Boey, CCI, MPI scores, and no severe cardiopulmonary disease, the groups had homogenized, and the determination of the results had increased. However, the low patient volume and retrospective nature of the study statistically weakened the power of the study.

Conclusion

Minimally invasive methods may be applied safely in peptic ulcer perforation, where patients are determined with suitable scoring systems.

Ethics Committee Approval: This study was approved by the Sakarya University Faculty of Medicine Non-interventional Clinical Research Ethics Committee (Date: 04.04.2020, Decision No: E.3931).

Peer-review: Internally peer-reviewed.

Authorship Contributions: Concept: E.A, F.A.; Design: F.A.; Supervision: Y.A., K.O.; Resource: B.M., N.F., R.Ç.; Materials: Y.A.; Data: K.O.; Analysis: B.M.; Literature search: N.F., R.Ç.; Writing: E.A.; Critical revision: F.A.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

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ORIJİNAL ÇALIŞMA - ÖZ

Peptik ulkus perforasyonunda laparoskopik ve açık tekniğin karşılaştırılması, skor sistemleri ne kadar etkin? Tek merkez deneyimi ve literatür derlemesi

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AMAÇ: En sık görülen peptik ülser komplikasyonlarından birisi perforasyondur (PÜP) ve önemli bir morbidite-mortalite nedeni olmaya devam etmektedir. Bu çalışmada benzer ameliyat öncesi skorlama indeksi sonuçlarına (Boey, Charlson co-morbidite indeksi ve Mannheim peritonit indeksi) sahip olup laparoskopik ve açık cerrahi uygulanmış olan hastaların sonuçlarının karşılaştırılması amaçlanmıştır.

GEREÇ VE YÖNTEM: PÜP tanısı ile acil şartlarda ameliyata alınmış olan hastaların dosyaları geriye dönük olarak incelenerek ameliyat öncesi Boey, CCI ve MPI skorları hesaplandı. Belirtilen skorlama indekslerinin skorları 'düşük' olarak belirlenen hastalar laparoskopik ve açık cerrahi yapılanlar olmak üzere iki gruba ayrıldı (laparoskopik cerrahi uygulananlar/Grup-1 ve açık cerrahi uygulananlar/Grup 2). Grupların peroperatif ve erken ameliyat sonrası sonuçları karşılaştırıldı.

BULGULAR: Gruplar arasında demografik veriler, hastaneye başvuru süresi ve hastanede yatış süresi açısından istatistiksel fark saptanmadı. Operasyon zamanı Grup 1'de (110.2 dk, std ±20.6 / 75–150 dk) Grup 2'ye göre (54.2 dk, std ±15.7 / 30–120 dk) uzun bulundu (p<0.001). Morbidite Grup 1'de daha az bulundu (%4'e %14.6) (p<0.001).

TARTIŞMA: Peptik ülser perforasyonunda laparoskopik yöntem seçilmiş olgularda ameliyat sonrası komplikasyon oranlarının daha az olması ve minimal invaziv cerrahinin bilinen avantajları nedeniyle güvenle uygulanabileceğini düşünüyoruz.

Anahtar sözcükler: Boey skoru; Charlson co-morbidite indeksi; laparoskopi; Mannheim peritonit indeksi; minimal invaziv cerrahi; peptik ülser perforasyonu.

Ulus Travma Acil Cerrahi Derg 2022;28(10):1437-1441 doi: 10.14744/tjtes.2021.78938