

WHAT IS THE IDEAL SURGICAL APPROACH FOR PERFORATED GASTRO-DUODENAL ULCER?

C. FUGĂREȚU^{1,2} A. SEFCIUC² C. MIŞARCA^{1,2}

Abstract: *This is a single-center, non-randomized retrospective study that compares various clinical and evolutionary aspects of patients with perforated gastro-duodenal ulcers in order to determine the best surgical approach. The study included 35 patients who underwent surgical treatment for a perforated gastro-duodenal ulcer at Braşov County Emergency Clinical Hospital (SCJU BV) between January 2021 and January 2023. They were then divided into two groups based on whether the surgery was laparoscopic or traditional. A variety of clinical and paraclinical data were collected and compared. There were no variations in gender distribution, age, or site of the ulcer perforation across the groups. Patients who underwent a laparoscopic procedure had a smaller ulcer perforation, a faster resumption of intestinal transit, and a shorter hospital stay than those who underwent a standard procedure. At 3 days postoperatively, the Neutrophil-to-Lymphocyte Ratio (NLR) and the Systemic Inflammation Response Index (SIRI) were significantly lower in the laparoscopic group. Patients who underwent traditional surgery had a higher Boey score, needed more complex interventions, and had a higher rate of postoperative complications and mortality. In perforated gastro-duodenal ulcer cases, the laparoscopic approach is a viable option with numerous advantages, particularly in patients with a low Boey score. Meanwhile, the traditional approach may be reserved for cases with a high Boey score and complex surgical interventions.*

Key words: *gastro-duodenal ulcer, peptic ulcer disease, Boey score, Neutrophil-to-Lymphocyte Ratio, Systemic Inflammation Response Index.*

1. Introduction

Peptic ulcer disease (PUD) has undergone several changes in terms of morbidity and mortality with the widespread use of antiulcer medications, the effectiveness of *Helicobacter pylori* infection treatment, and the increasing

use of Nonsteroidal anti-inflammatory drugs (NSAIDs). However, it is essential to consider the four major complications of peptic ulcer disease, namely hemorrhage, perforation, penetration, and stenosis. Thus, a percentage ranging from 10-20% of individuals diagnosed with gastro-duodenal ulcer will develop one of the

¹ Transilvania University, Faculty of General Medicine Braşov.

² General Surgery Clinic I, Braşov County Emergency Clinical Hospital.

complications mentioned above [1].

The number of surgical interventions for uncomplicated peptic ulcers has significantly decreased in the last two decades due to the substantial improvement in medical treatment for this pathology. However, the same cannot be said for the number of surgical interventions performed for perforated ulcers, which not only has remained constant but there are studies indicating that it has increased [2].

The nonoperative management of perforated peptic ulcers is not routinely recommended. It appears that mortality increases with each hour of delayed surgical treatment, with survival decreasing by 2.4% for every hour lost (3).

The Boey score was introduced in 1987 and serves as a simple and useful tool in predicting the morbidity and mortality of perforated ulcers. It has a value ranging from 0-3, taking into consideration three independent risk factors:

- presence of other comorbidities;
- shock status at presentation with systolic blood pressure < 90 mmHg;
- duration of perforation exceeding 24 hours.

The presence of one of the above criteria receives one point each [4].

It has been observed that with an increase in the Boey score, the mortality in perforated peptic ulcer also increases [4].

The neutrophil-to-lymphocyte ratio (NLR) is an easily calculable inflammatory marker derived from the leukocyte formula. It is known that the number of neutrophils increases in inflammatory diseases, and only in specific situations such as immunosuppression or cachexia, does their value remain unchanged. The number of lymphocytes reflects the immune status of a patient with sepsis,

and these decrease as the inflammatory disease progresses. This ratio increases in inflammatory diseases with the progression of inflammation and seems to be more useful in assessing the patient's progression compared to the separate counts of neutrophils and lymphocytes [5].

The neutrophil-to-lymphocyte ratio (NLR) reflects the immune response to various stimuli, both infectious and non-infectious. Thus, in various infectious or non-infectious pathological contexts, this cellular ratio reflects the existing dynamics between the innate cellular immune response represented by neutrophils and the adaptive immune response developed during the disease represented by lymphocytes [6].

The normal value of the neutrophil-to-lymphocyte ratio (NLR) has been estimated to be 1.65 in the young and healthy population [7]. A value greater than 3 or less than 0.7 is considered pathological [6].

Additionally, it appears that patients diagnosed with sepsis who have initially high values of the neutrophil-to-lymphocyte ratio (NLR) have an increased risk of mortality and a poorer prognosis compared to those with lower NLR values [7].

The Systemic Inflammation Response Index (SIRI) is calculated using the values of neutrophils, monocytes, and lymphocytes determined in peripheral blood according to the following formula:

$$\text{SIRI} = (\text{Number of Neutrophils} \times \text{Amount of Monocytes}) / \text{Number of Lymphocytes}$$
 [8].

The present study is a retrospective, single-center, non-randomized study that aims to comparatively evaluate the clinical outcomes and evolutionary aspects of patients diagnosed with perforated gastro-duodenal ulcer, treated through

either laparoscopic or traditional approaches, with the goal of establishing an optimal surgical approach.

2. Materials and Methods

For the conduct of this retrospective study, we identified all patients diagnosed with perforated gastro-duodenal ulcer who were treated in the Surgery Department I of SCJU BV between January 2021 and January 2023.

The study included patients aged between 18-90 years, clinically and radiological diagnosed with perforated gastric or duodenal ulcer, who underwent surgical treatment.

Patients with incomplete clinical and paraclinical data, those who did not undergo surgical treatment, those known to have hematological diseases, as well as those undergoing chemotherapy or immunosuppressive treatments, were excluded from the study.

Subsequently, the patients included in the study were divided into two lots. Lot 1 included patients who underwent laparoscopic surgical approach, and Lot 2 included patients who underwent traditional surgical approach.

A series of demographic data were obtained from the patients' observation sheets, including name, age, gender, as well as the presence of other comorbidities, blood pressure values at presentation, and the duration in hours between the onset of perforation and surgical intervention—all necessary for calculating the Boey score. Additionally, the duration of the surgical procedure, day of intestinal transit resumption, number of hospitalization days, postoperative complications, and whether death occurred during hospitalization

were also recorded.

For the determination of the Systemic Inflammation Response Index (SIRI) and the initial neutrophil-to-lymphocyte ratio (NLR), the values of neutrophils, monocytes, and lymphocytes determined at presentation in the Emergency Department were used. Subsequently, these inflammatory markers were determined for all patients between the 3rd and 4th postoperative day.

The calculation of NLR and SIRI was performed according to the formula below.

$$\text{NLR} = \frac{\text{No. of Neutrophils}}{\text{No. of lymphocytes}}$$

$$\text{SIRI} = \frac{\text{No. of Neutrophils} \times \text{No. of Monocytes}}{\text{No. of lymphocytes}}$$

We specify that all patients received antibiotic treatment initiated immediately preoperatively with Cefuroxime 1.5 g x3/day and Metronidazole 500 mg x3/day, continued postoperatively until discharge, as well as treatment with proton pump inhibitors Pantoprazole IV 40 mg x2/day.

3. Results

In total, a number of 38 patients were identified, of whom 3 were excluded from the study due to associated pathological antecedents, namely, hepatic cirrhosis in one case, another case known with lung cancer, and another case known with rectal cancer. Thus, the study included a total of 35 patients who were subsequently divided into two lots.

In Lot 1, 17 patients were included, in whom the surgical approach was laparoscopic, and in Lot 2, 18 patients were included with a traditional surgical approach (Figure 1).

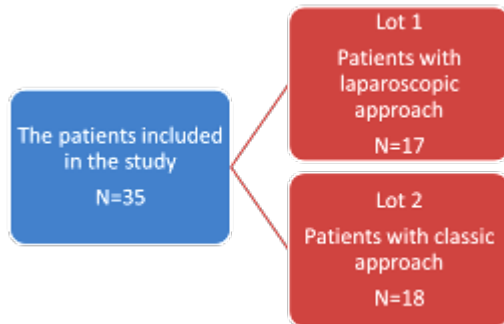


Fig. 1. Division into two Lots of patients included in the study

Patients' characteristics

The distribution by gender in the two Lots is presented in Figure 2. It is observed that in Lot 1, it was relatively equal, with men accounting for 52.94%, and women for 47.05%. In Lot 2, the percentage of male patients was double that of females, at 66.66% compared to 33.33%.

The average age was lower in Lot 1 compared to Lot 2.

The duration of perforation, calculated from the onset of pain to the surgical intervention, was on average three times higher in the traditional approach group (Lot 2) compared to the laparoscopic treatment group (Lot 1). All these data are presented in Table 1.

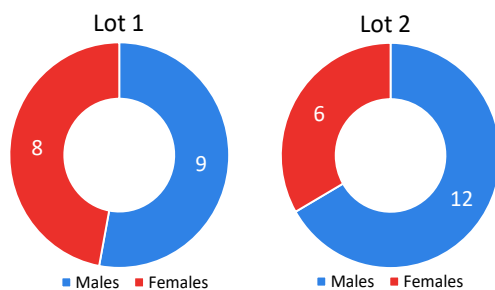


Fig. 2. Gender distribution in the two groups

Table 1

Average age and duration of ulcer perforation

	Lot 1	Lot 2
Average age in years	53,5 Years (28-86 Years)	65,11 Years (32-88 Years)
Duration of ulcer perforation (in hours)	13,35 hours (3-48 hours)	42,52 hours (6-96 hours)

Regarding the location of the ulcer perforation in Lot 1, a relatively similar distribution was observed. Thus, in 7 cases, accounting for 41.17%, the ulcer perforation was located in the duodenum. In 10 cases (58.82%), it was located in the stomach, more precisely, the pyloric location was confirmed in 8 cases, and another gastric location in 2 cases.

In Lot 2, on the other hand, duodenal localization predominated, encountered in 13 cases (72.22%), including one case of kissing ulcer. Gastric perforation was confirmed in 5 cases (27.77%), of which 2 were located at the pyloric level, one with a posterior gastric location, and two with other locations in the stomach. Figure 3 graphically represents the distribution of the ulcer perforation location in the two Groups.

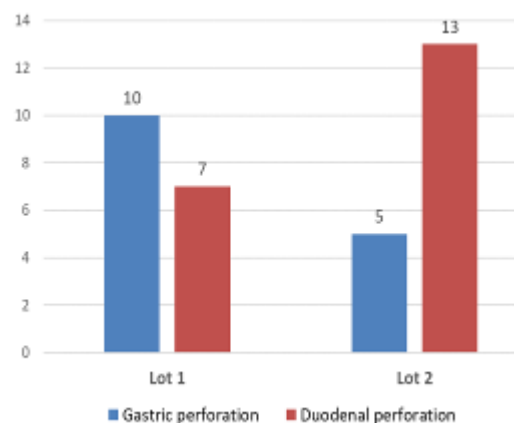


Fig. 3. Localization of ulcer perforation in the two Groups

The Boey Score was determined for each patient in each group according to the criteria presented above. This score can have a value ranging from 0 to 3. The graphical representation of the Boey Score from the two groups is available in Figure 4.

In Lot 1, the group where the surgical approach was laparoscopic, 12 patients, accounting for 70.58%, had a Boey Score of 0. Also in Lot 1, 4 patients presented associated comorbidities, of which 2 had a perforation duration exceeding 24 hours. A single patient received 3 points, having a systolic blood pressure < 90 mmHg at presentation.

In Lot 2, it was observed that almost half of the patients, specifically 44.44% of them, had a Boey Score of 3, and only 22.22% achieved a Boey Score of 0.

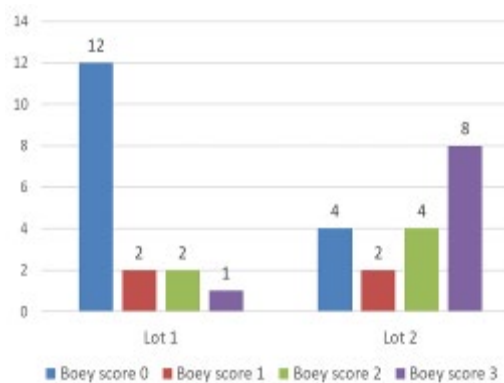


Fig. 4. Boey Score

Intraoperative aspects

Regarding the diameter of the ulcer perforation, it averaged 1.16 cm in Lot 1 and 1.52 cm in Lot 2, with values ranging from 0.2-3 cm in Lot 1 and 0.5-4 cm in Lot 2.

The types of surgical interventions performed in the two groups are presented in Table 2. In Lot 1, the suturing of the ulcer with omentoplasty was

performed in all cases, unlike in Lot 2, where ulcer suturing with omentoplasty was performed in 9 cases. Additionally, in Lot 2, simple suturing of the perforation was performed in 2 cases, excision of the ulcer with pyloroplasty in 2 cases, gastric resection in 2 cases (including the perforated lesion) followed by gastro-duodenal anastomosis. Also in Lot 2, in 3 cases of duodenal ulcer, antral gastric resection was performed with exclusion anastomosis, with gastro-jejunal anastomosis in two cases and gastroduodenal anastomosis in one case.

Regarding the operative time, it is observed that the average duration was 107.35 minutes (ranging from 65 to 150 minutes) in Lot 1 and slightly less at 101.50 minutes in Lot 2 (with limits between 60 and 180 minutes). It should be noted that the operative time was calculated from orotracheal intubation to patient extubation.

Surgical procedures performed Table 2

	Lot 1	Lot 2
<i>Suturing of the ulcer with omentoplasty</i>	17	9
<i>Simple suture of the perforation</i>	0	2
<i>Excision of the ulcer lesion with pyloroplasty suture</i>	0	1
<i>Hemigastrectomy with elevation of the lesion and Pean anastomosis</i>	0	2
<i>Antral gastric resection for exclusion</i>	0	3
Total	17	18

Clinical and evolutionary aspects

Clinical and evolutionary aspects were monitored in both Groups, and the main findings are presented in Table 3.

Main clinical and evolutionary aspects Table 3

	Lot 1	Lot 2
<i>Bowel movement recovery (days)</i>	2,7 days postoperative	3,8 days postoperative
<i>Postoperative complications</i>	2 (11,76%)	10 (55,55%)
<i>Duration of hospitalization (days)</i>	6,1 days	12,7 days
<i>Death during hospitalization</i>	2 (11,76%)	8 (44,44%)

In Lot 2, the rate of postoperative complications was much higher, reaching 55.55% (10 patients). In Lot 1, only 2 patients experienced complications. All these data are presented in Table 4.

Postoperative Complications Table 4

	Lot 1		Lot 2	
<i>Postoperative Fistula</i>	1	(5,88%)	3	(16,66%)
<i>Intraabdominal Abscess</i>	1	(5,88%)	2	(11,11%)
<i>Infections of operative wounds</i>	0	0%	3	(16,66%)
<i>Evisceration (free/fixed)</i>	0	0%	1	(5,55%)
<i>Other complications</i>	0	0%	1	(5,55%)
Total	2	(11,76%)	10	(44,44%)

Analyzing Figures 5 and 6, we can observe the variations in the average values of the neutrophil-to-lymphocyte ratio (NLR) and Systemic Inflammation Response Index (SIRI) preoperatively and postoperatively. It is important to note that the complete blood count collected at the presentation in the Emergency Department and the complete blood count collected on the 3rd or 4th postoperative day were used for these calculations. It is easily noticeable that in the case of Lot 1, both NLR and SIRI values

decreased by 14% and 15.7%, respectively, while in Lot 2, only the NLR value decreased by 1.45%, and the SIRI value increased by 22.9%. Also, both the mean values of NLR and SIRI were approximately 2 and 3 times higher in the classic approach group compared to the laparoscopic approach group.

Since we know that in Lot 2 the number of patients with postoperative complications was higher, which could be responsible for the changes in the values of these inflammatory parameters, we decided to divide the two Groups into two additional subgroups: one consisting of those without postoperative complications and the other consisting of those with postoperative complications.

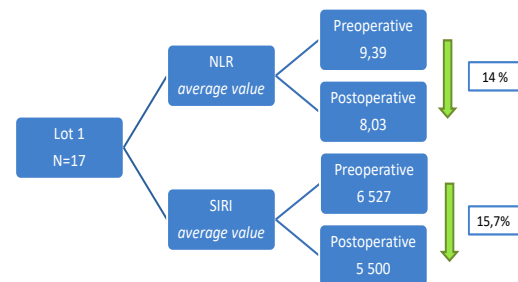


Fig. 5. Preoperative and postoperative variations in the average values of NLR and SIRI in Lot 1

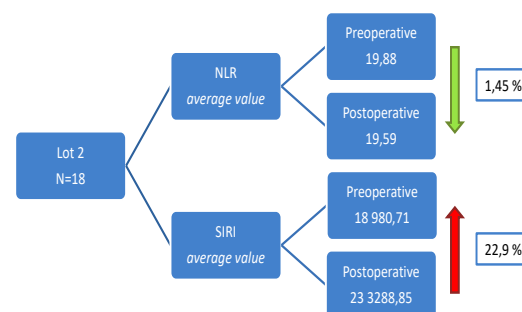


Fig. 6. Preoperative and postoperative variations in the average values of NLR and SIRI in Lot 2

If we look at Figures 7 and 8, we can observe that although the preoperative mean values of NLR in the group of patients without postoperative complications are similar in the case of the laparoscopic approach, they decrease considerably postoperatively by 32.23%, unlike the classic approach group where

the recorded decrease is 12.08%, which is 2.6 times less. Thus, we can conclude that the laparoscopic approach leads to a more pronounced decrease in inflammatory markers compared to the classic approach.

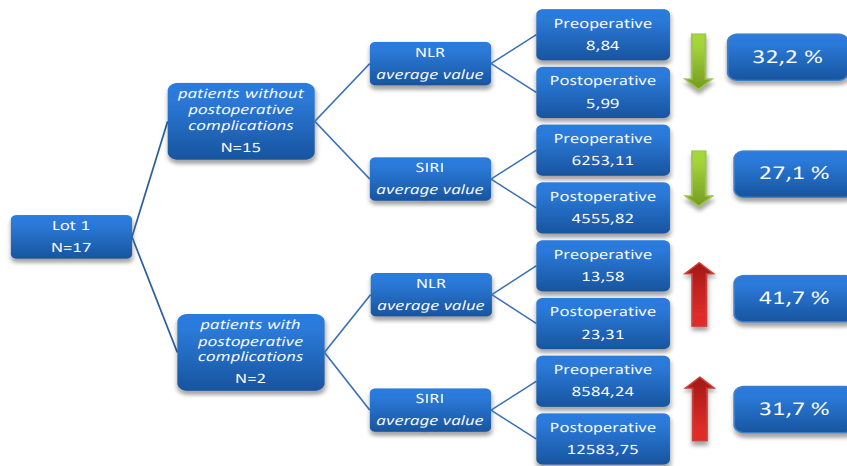


Fig. 7. Preoperative and postoperative variations in the average values of NLR and SIRI in Lot 1 after dividing it into two subgroups: the group of patients without postoperative complications and the group of patients with postoperative complications

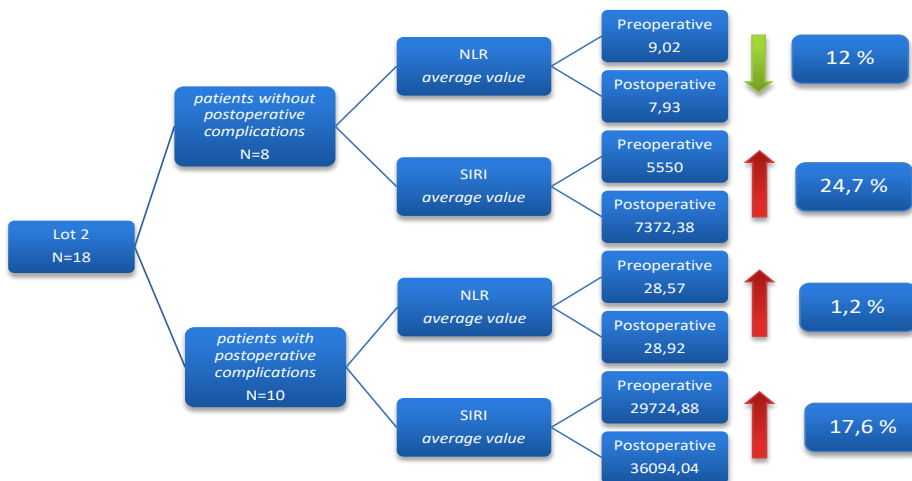


Fig. 8. Preoperative and postoperative variations in the average values of NLR and SIRI in Lot 2 after dividing it into two subgroups: the group of patients without postoperative complications and the group of patients with postoperative complications

In the case of the mean values of SIRI, it is observed that they decreased in the laparoscopic approach for patients without postoperative complications by 27.14%, and paradoxically increased in the same category of patients in Lot 2 by 24.71%.

In the case of patients who presented postoperative complications, as expected, the mean values of NLR increased in both Groups, by 41.74% in Lot 1 and 1.21% in Lot 2. What needs to be taken into account is that the initial mean values of NLR in the group of patients with postoperative complications were double compared to the same group in Lot 1, and also the number of patients was five times higher.

Regarding the mean values of SIRI in patients from the group who presented postoperative complications, it is observed that they increased postoperatively by 31.78% in Lot 1 and 17.64% in Lot 2. Additionally, the initial mean values were approximately 3.3 times higher in the case of patients from Lot 2 who presented postoperative complications compared to the same group in Lot 1.

In conclusion, we can state that the presence of postoperative complications led to an increase in the values of NLR and SIRI in both groups. However, the initial mean values were lower in Lot 1, approximately 2 times lower for NLR and 3.3 times lower for SIRI. The increase postoperatively was 40 times higher in the case of NLR in Lot 1 and nearly 2 times higher in the case of SIRI.

If we analyze Table 5, we can observe that there is a statistically significant correlation between the classic approach and the presence of comorbidities, the occurrence of postoperative complications, a Boey score of 3, as well as death during hospitalization. There is no correlation between the surgical approach and the patients' gender, nor regarding the location of the peptic ulcer perforation.

Table 5
Surgical absorption mode and its correlation with clinical and biological para

	Lot 1 (N=17)	Lot 2 (N=18)	p-value (test)
<i>Gender</i>	8	6	
<i>F</i>	(45,05%)	(33,3%)	.407434
<i>M</i>	(52,94%)	(66,6 %)	
<i>The location of the gastric and duodenal perforation</i>	10 (58,82%)	5 (27,7%)	.063601
	7 (41,17%)	13 (72,2%)	
<i>Comorbidities</i>	2 (11,76%)	14 (77,7%)	.000089
<i>Postoperative complications</i>	2 (11,76%)	10 (55,5%)	.006374
<i>Boey Score 3</i>	1 (5,88%)	8 (44,4%)	.009085
<i>Death during hospitalization</i>	2 (11,76%)	8 (44,4%)	.032439

4. Discussion

Surgical intervention in perforated ulcers is recommended to be performed as quickly as possible, as any delay is correlated with a significant increase in mortality rates [9].

Regarding the laparoscopic treatment of perforated duodenal ulcers, it appears that ulcers with a perforation duration of over 9 hours have a higher risk of developing fistulas, and in the case of those with a perforation diameter exceeding 8 mm, the conversion rate was significantly higher [10].

Regarding the approach, the World Society of Emergency Surgery (WSES) guidelines recommend the laparoscopic approach for stable patients and the classic approach for unstable patients or in situations where the lack of skills or necessary surgical equipment hinders minimally invasive approaches [11].

In our study, it is easily noticeable that the laparoscopic approach was preferred for patients with a low Boey score, while patients with a high Boey score

underwent the classic approach.

A meta-analysis from 2018, which included a large number of patients (615 in total, with 307 undergoing laparoscopic treatment and 308 undergoing open surgical treatment), concluded that in the laparoscopic group, postoperative pain and wound infections were less common. However, there were no significant differences between the two groups in terms of postoperative mortality, the risk of fistula, the occurrence of intra-abdominal abscesses, or the need for surgical reintervention [12].

Another meta-analysis published in 2017, which included 7 randomized clinical trials, concluded that the laparoscopic approach to perforated ulcers is associated with lower morbidity and shorter hospitalization compared to the classic approach. However, there were no significant differences between the two surgical interventions in terms of mortality rate, sepsis, development of intra-abdominal abscesses, or the rate of reinterventions [13].

Our study reveals a complication rate five times higher and a mortality four times higher among patients with the classic surgical approach compared to those with the laparoscopic approach. This is attributed to more severe cases with a higher Boey score in the classic approach group. It's important to note that your study is not randomized. Additionally, you observed a faster resumption of intestinal transit, shorter hospitalization duration for patients with the laparoscopic approach, and a statistically significant correlation between the classic approach and the presence of comorbidities, postoperative complications, and recorded deaths during hospitalization.

In this study, a more rapid decrease in NLR and SIRI values was easily observed in

the group of patients who did not present postoperative complications and underwent a laparoscopic approach, compared to the same group of patients in the classic approach group.

In the case of patients who developed postoperative complications, the NLR and SIRI values, as expected, increased in both groups. The main limitations of this study are represented by the small number of enrolled patients and the non-randomized nature of the study.

5. Conclusion

In conclusion, we can state that laparoscopic approach is preferred in patients with a low Boey score, offering advantages such as faster resumption of intestinal transit, fewer complications at the surgical site, shorter hospitalization duration, and a quicker decrease in inflammatory markers like NLR and SIRI.

The classic approach remains an important option for patients with a Boey score of 3, indicating higher surgical risks and in cases where more complex surgical techniques are required.

Conflicts of Interest and Source of Funding

The authors have no conflict of interests to disclose. The authors did not receive any funding for this work.

Ethics Approval

The study has been performed by following the ethical norms of scientific research.

References

1. Lau JY et al. Systematic review of the epidemiology of complicated peptic ulcer disease: incidence, recurrence, risk factors and mortality. *Digestion*.

- 2011; 84(2): 102-13. doi:10.1159/000323958
2. Rajesh V et al. Risk factors predicting operative mortality in perforated peptic ulcer disease. *Tropical gastroenterology: official journal of the Digestive Diseases Foundation*. 2003; 24(3): 148-50.
 3. Buck, DL et al. Surgical delay is a critical determinant of survival in perforated peptic ulcer. *The British journal of surgery*. 2013; 100(8): 1045-9. doi:10.1002/bjs.9175
 4. Agarwal A et al. Validation of Boey's score in predicting morbidity and mortality in peptic perforation peritonitis in Northwestern India." *Tropical gastroenterology: official journal of the Digestive Diseases Foundation* vol. 36,4 (2015): 256-60. doi:10.7869/tg.300
 5. Brodska, H., Valenta, J., Pelinkova, K., Stach, Z., Sachl, R., Balik, M., Zima, T., Drabek T. Diagnostic and prognostic value of presepsin vs. established biomarkers in critically ill patients with sepsis or systemic inflammatory response syndrome. *Clinical chemistry and laboratory medicine*. 2018; 56(4): 658-668. <https://doi.org/10.1515/cclm-2017-0839>
 6. Zahorec R. Neutrophil-to-lymphocyte ratio, past, present and future perspectives. *Bratislavske lekarske listy*. 2021. 122(7), 474-488. https://doi.org/10.4149/BLL_2021_078
 7. Huang Z., Fu Z., Huang W., Huang K. Prognostic value of neutrophil-to-lymphocyte ratio in sepsis: A meta-analysis. *The American journal of emergency medicine*. 2020; 38(3): 641-647. <https://doi.org/10.1016/j.ajem.2019.10.023>
 8. Chen Y, Jin M, Shao Y, Xu G. Prognostic Value of the Systemic Inflammation Response Index in Patients with Adenocarcinoma of the Oesophagogastric Junction: A Propensity Score-Matched Analysis. *Dis Markers*. 2019 Nov 4;4659048. doi: 10.1155/2019/4659048. PMID: 31781301; PMCID: PMC6875417.
 9. Sivaram, P, Sreekumar A. Preoperative factors influencing mortality and morbidity in peptic ulcer perforation. *European journal of trauma and emergency surgery: official publication of the European Trauma Society*. 2018; 44(2): 251-257. doi:10.1007/s00068-017-0777-7
 10. Lunevicius R., Morkevicius M. Risk factors influencing the early outcome results after laparoscopic repair of perforated duodenal ulcer and their predictive value. *Langenbeck's archives of surgery*. 2005; 390(5): 413-20. doi:10.1007/s00423-005-0569-0
 11. Tarasconi A. et al. Perforated and bleeding peptic ulcer: WSES guidelines. *WJES*; 2020; 15(3). doi:10.1186/s13017-019-0283-9
 12. Cirocchi R. et al. Meta-analysis of perioperative outcomes of acute laparoscopic versus open repair of perforated gastroduodenal ulcers. *The journal of trauma and acute care surgery*. 2018; 85(2): 417-425. doi:10.1097/TA.0000000000001925
 13. Quah GS., Eslick, GD., Cox M.R. Laparoscopic Repair for Perforated Peptic Ulcer Disease Has Better Outcomes Than Open Repair. *Journal of gastrointestinal surgery: official journal of the Society for Surgery of the Alimentary Tract*. 2019; 23(3): 618-625. <https://doi.org/10.1007/s11605-018-4047-8>