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Predictors of mortality after traumatic splenectomy and factors affecting prognosis

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Abstract
Aim: The spleen is the second most commonly injured abdominal organ in both penetrating and blunt trauma. Although mortality rates after splenectomy vary according to the indications for splenectomy, they are 0.97-6.04 times higher than in the general population. The aim of this study is to determine the mortality determinants and factors affecting prognosis after traumatic splenectomy.
Material and Methods: A retrospective study was designed. Patients who underwent emergent surgery for traumatic splenectomy in our clinic were evaluated between July 2009 and December 2020
Results: A total of 107 patients were included in the study. The mean age was 30.16 ±12.11 years (min-max: 16-68 years). In the postoperative period, according to the Clavien-Dindo classification, 34 (31. 80%) complications were grade 1-2 and 5 (4.70%) were grade 3 and early mortality was seen in 19 (17.80%) patients. When the data were analyzed, it was found that the development of postoperative complications, the development of complications of 3 or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury were found to be statistically significant for worsening prognosis and development of mortality ($p<0.0001$ for all three factors).
Discussion: Our study has shown that the development of postoperative complications, the development of complications of three or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury are poor prognostic factors in determining the prognosis after splenectomy due to trauma and are factors that increase mortality.

Keywords
Traumatic Splenectomy, Predictors, Mortality, Prognosis

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Introduction

The spleen is the second most commonly injured abdominal organ in both penetrating and blunt trauma. In 1783, Scottish surgeon John Ferguson performed the first splenectomy for trauma [1]. After that, splenectomy was used as the main surgery for spleen injuries, even if there were minor injuries for years [2]. Spleen injury occurs in approximately 32% of patients with blunt abdominal trauma [3]. The role of the spleen in the immune response has led to greater efforts to protect the spleen after injury [3]. Today, methods such as non-surgical monitoring of the injured spleen, splenorrhaphy or partial splenectomy are used according to the etiology of the injury and the severity of the injury [4, 5]. Preserving spleen function, avoiding sepsis after splenectomy, and preventing complications of thrombosis or laparotomy can be counted among the advantages of spleen preservation [5]. Late intra-abdominal bleeding is the main problem in non-surgical follow-up or after spleen-sparing surgery. Therefore, splenectomy should be considered if a good follow-up cannot be done or the stage of the injury is not suitable for spleen-sparing treatment [4, 5].

Although the mortality rates after splenectomy vary according to the indications for splenectomy, they are 0.97-6.04 times higher than in the general population [5]. Death rates associated with spleen injury in a previous study were 18%; these high death rates were probably secondary to associated injuries and related post-traumatic complications [6, 7, 8].

The aim of this study is to determine the mortality determinants and the factors affecting the prognosis after traumatic splenectomy.

Material and Methods

A retrospective study was designed after receiving the local ethical committee's approval. Patients who underwent emergent surgery for traumatic splenectomy in our clinic were evaluated between July 2009 and December 2020. The study was approved by the Ethics Committee of the Medical Faculty of ... University (Date: 21/06/2021; Decision No: HHRU/21.12.01).

Inclusion criteria: Patients over 16 years of age who underwent emergency surgery for traumatic splenectomy were included.

Exclusion criteria: Elective cases, splenectomy performed for benign reasons, splenectomy due to other cancer involvements, patients who performed splenography or partial splenectomy, patients with immunocompromised status or pregnancy and patients with missing data were excluded.

Open laparotomy was preferred in all operations. All operations were performed with a midline laparotomy incision. After surgery, all patients were vaccinated to prevent encapsulated bacterial infections.

Age, gender, peroperative amount of blood loss, cause of the accident, mechanism of injury, stage of the splenic injury, additional organ injury, number of transfusions, surgical procedure, hospitalization period, complication in the postoperative period, state of the early mortality and cause of early mortality were retrospectively collected and evaluated. Patients who developed complications and mortality after splenectomy were found and the factors affecting mortality and prognosis in these patients were examined.

Statistical Analysis

Data were analyzed with SPSS 21.0 for Windows (SPSS, IBM). Quantitative data were presented as mean±standard deviation (SD) and qualitative data were presented as numbers and percentages. Continuous variables were compared using Unpaired - T tests and p values were calculated. Categorical variables were compared using the Fisher exact test and p-value was estimated. The $p<0.05$ was considered statistical significance.

Results

A total of 107 patients were included in the study. Among these patients, who emergent open splenectomy for splenic injury, males predominated; 92 (86%) were male, 15 (14%) were female. The male to female ratio was 6.13:1. The mean age was 30.16 ±12.11 years (min-max: 16-68 years). Demographic and clinical findings of the patients are summarized in Table 1. The stage of the splenic injury was grade 3 in 17 (48.59%), grade 4 in 55 (51.40%) and grade 5 in 40 (37.38%) patients The mean operative time was 155.60 ± 88.16 (min-max: 80-720) minutes. The median amount of blood loss during the operation was 600 ml (min-max: 200-5000 ml). The median number of transfusions of the erythrocyte suspension was 2 bags (min-max: 0-6 bags). The most common additional organ injury was the left kidney in both blunt and penetrating trauma (Table 2). The mean postoperative hospital stay was 11.65 ± 9.33 days (min-max: 1-57). In the postoperative period, according to the Clavien-Dindo classification, 34 (31. 80%) complications were grade 1-2 and 5 (4.70%) were grade 3, and early mortality was seen in 19 (17.80%) patients. The commonest complication was surgical site infection in 14 cases (13.1%), while atelectasis was observed in 10 cases (9.3%). Forty-nine cases (45.8%) of patients had no complications. All surgical site infections were healed with drainage, dressing of the wound and antibiotics. Postoperative complications are summarised in Table 3. The first 30-day mortality during the postoperative period was 19

Table 1. Demographic and clinical characteristics of the patients

Parameters	Emergent surgery group (n=79)
Mean age ± SD (years) (min-max)	30.16 ±12.11 (16-68)
Gender (mean, %)	
Male	92 (86%)
Female	15 (14%)
Median value of the perop blood loss (ml) (min-max)	600 (200-500)
Median value of the blood replacement (min-max)	2 Unity (0-6)
Mean operation time (minute) (min-max)	155.60 ± 88.16 (80-320)
ICU (%)	92 (85.98%)
First 30-day mortality n,(%)	19 (17.80%).
First day mortality n, (%)	14 (13.08%)
Hospital stay ± SD (days)	8.17 ± 6.71
Mode of injury n,%	
Traffic accident	51 (47.7%)
Fall from height	18 (16.8%)
Stab injury	5 (4.7%)
Gunshot injury	33 (30.8%)

Table 2. Coexisting injuries along with splenic injuries in patients

Coexisting injury	n, (%)
Bone fracture	16 (14.95%)
Left nephrectomy	20 (18.69%)
Grade II-III liver injury	17 (15.88%)
Small intestinal or colonic injury	15 (14.01%)
Diaphragmatic Laceration	6 (5,60%)
Head injury	7 (6.54%)
Hemo/pneumothorax	14 (13.08%)
Pancreas injury	2 (1,86%)
Gastric injury	3 (2.80%)
Retroperitoneal Hematoma	10 (9.34%)
None	

Table 3. Complications after the management of splenic injuries

Complications	n, (%)
Surgical site infection	14 (13.08%)
Atelectasis	10 (9.34%)
Pneumonia	5 (4.67%)
Intraabdominal Hemorrage	3 (2.80%)
Intraabdominal Abscess	3 (2.80%)
Pancreatic Fistula	2 (1,86%)
Sepsis	2 (1,86%)
Paralytic ileus	2 (1,86%)
Myocardial infarction	1 (0.93%)
Pulmonary embolism	2 (1,86%)
Gastric atoni	1 (0.93%)
Multi-organ disfunction syndrome	14 (13.08%)
None	49 (45.79%)

(17.80%). The cause of mortality was multi-organ dysfunction syndrome in the postoperative first day in 14 patients, sepsis in 2 patients, massive pulmonary embolism in 2 patients and myocardial infarction in 1 patient.

When the data were analyzed, it was found that the development of postoperative complications, the development of complications of 3 or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury were found to be statistically significant for worsening prognosis and development of mortality. ($p<0.0001$ for all three factors). No statistical significance was found in terms of age, gender, mean amount of bleeding during surgery, mean amount of erythrocyte suspension replaced during surgery, and the effect of operative time on prognosis or mortality. (0.39, 0.46, 0.27, 0.43, 0.74, respectively).

Discussion

The spleen is one of the most frequently injured organs after trauma. The mortality rate after spleen injury has been reported between 7.6%-13% [8,9,10]. This study was designed to determine the factors affecting the prognosis and mortality in patients who underwent post-traumatic splenectomy and development of postoperative complications, the development of complications of 3 or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury were found to be statistically significant for worsening prognosis and development of mortality. Our mortality rate was 17.7%.

In the previous study, male dominance was seen in traumatic splenectomy patients [11]. In our study, 92 (86%) of the patients were male, 15 (14%) were female, and the male to female ratio was 6.13:1.

In our study, complications in the postoperative period were seen in 54.20 % of the cases. Our results are similar to those given in the literature [11,12]. Recent literature reported that the most common complication was pneumonia, followed by Surgical site infections. In our study, the results were different from this. The most common complications were surgical site infections, followed by atelectasis and pneumonia [11]

There are articles in the literature suggesting that patients with Grade III spleen injury and traumatic brain injury should undergo splenectomy, since hypotension due to traumatic brain injury will double the mortality [13,14]. In our study, 7 patients had spleen injury and traumatic brain injury, and splenectomy was performed in all these patients.

In the literature, Omer at al. reported that the mortality rate in their study was 7.9%. Our mortality rate was 17.7% [15]. This difference in mortality rate is due to the difference in mortality determining factors in the two study groups. Therefore, risk factors determining mortality were investigated in our study, and the development of postoperative complications, the development of complications of three or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury were to be statistically significant for worsening prognosis ($p<0.0001$ for all three factors).

Limitations of our study; Since it is a retrospective study and a single center experience, the number of cases is low.

Conclusion

Our study has shown that the development of postoperative complications, the development of complications of three or more according to the Clavian- Dindo classification, and the high number of injured organs in addition to spleen injury are poor prognostic factors in determining the prognosis after splenectomy due to trauma and are factors that increase mortality. Since the risk of mortality will increase in patients with these factors, more care should be taken in their management.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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