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Evaluation of factors affecting early and late complications after elective splenectomy

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Abstract

We aimed to investigate the factors affecting early and late complications following splenectomy. The potential factors expected to affect postsplenectomy complications included age (≥60 vs.<60 years), gender, preoperative diagnosis (malignant vs.benign), vaccination status, surgical technique (laparoscopy vs. open surgery), and spleen size (≥15 vs.<15 cm). Postoperative complications were divided into early and late complications. In the evaluation of the factors affecting early and late complications, univariate analyses were performed using the Chi-square test. The factors found to be statistically significant in the univariate analyses were used to determine the independent factors affecting early and late complications by using multivariate logistic regression analysis. The incidence of early complications was significantly higher in the patients with hematological malignancies (p=0.001), patients aged 60 years or over (p=0.014), those who underwent open surgery (p=0.019), and patients with a spleen size of >15 cm (p=0.008), whereas the incidence of late complications was significantly higher in the patients with hematological malignancies (p=0.023) and in the patients that received no prophylactic vaccination (p=0.043). In the logistic regression analysis, the splenectomy performed for hematological malignancies was revealed as the only independent factor increasing the risk of early complications (p=0.042) as well as late complications (p=0.035). In conclusion, the splenectomy performed for hematological malignancies was revealed as the only independent factor increasing the risk of both early and late complications. However, as this factor cannot be reversed or prevented by surgeons, surgeons should instead properly administer preoperative vaccination protocols and should also inform the patients about the future doses of booster vaccination to reduce the risk of postoperative complications. For thromboembolic risks, the routine use of low-molecular-weight heparins both pre-and perioperatively should be promoted. The patients with thromboembolic complications should be closely monitored during the long term following splenectomy.

Keywords: Splenectomy, early and late period, complications

Introduction

The spleen is the largest lymphoid organ in the body, and in addition to immunological functions play important roles in erythrocyte filtration and platelet sequestration [1]. The spleen is also a major site of early ig M production, which is important in the acute clearance of pathogens from the bloodstream [2]. Since the first deliberate removal of a diseased spleen by Quittenbaum in 1826 splenectomy has become a well-established surgical procedure [3]. Splenectomy remains a successful surgical approach in the treatment of various diseases. However, splenectomy may lead to severe early or late complications. Complications after splenectomy may cause high mortality and morbidity. A significant part of the complications can be reduced with the measures to be taken. In this study, we aimed to investigate the factors affecting early or late complications in patients undergoing splenectomy. We believe that the factors to be found effective in this study could be considered both in the surgical planning and the postoperative follow-up processes of the patients indicated for splenectomy to reduce complications.

Materials and Methods

The retrospective study included 81 patients that underwent elective splenectomy between January 2007 and December 2010. To better observe late complications, we wanted a long

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postoperative follow-up period in our study. Therefore, patients who underwent surgery in this date range were included in the study. Medical records, surgical notes, and postoperative follow-up were reviewed for each patient. Postoperative complications were recorded through the interviews performed with each patient. Patients aged under 18 years, patients undergoing splenectomy due to trauma, patients with malignancies other than hematological malignancies, morbid obesity associated with an increased risk of complications (body mass index [BMI], >35), diabetes mellitus (DM), an ASA score of 3 or higher, and with thromboembolic events such as deep preoperative vein thrombosis pulmonary embolism, and patients with incomplete medical records were excluded from the study. The potential factors expected to affect post-splenectomy complications included age (≥60 vs.<60 years), gender, preoperative diagnosis (malignant vs.benign), vaccination status, surgical technique (laparoscopy vs. open surgery), and spleen size (≥15 vs.<15 cm) [4]. Early complications were defined as the complications occurring within the 30 days after splenectomy and late complications were defined as the complications occurring after the 30 days following splenectomy. Statistical analyses were separately performed for each of these two groups based on the potential factors expected to affect postoperative complications. Surgical site infections, pleural infusion, atelectasis, pancreatitis, hemorrhage, and diaphragm and adjacent organ injuries were accepted as early complications, whereas overwhelming infections and thromboembolic events (deep venous thrombosis, pulmonary embolism) were accepted as late complications. All the patients were administered low-molecular-weight heparins (LMWHs) for prophylaxis (on pre-and postoperative day 7, subcutaneously) and used anti-embolism stockings during surgery and after surgery until surgery returned to daily life activities.

Ethical Issues

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Ethics committee approval was obtained for our study from Tokat Gaziosmanpasa Medical Faculty Clinical Research Ethics Committee with the number 21-KAEK-181.

Statistical analysis

The factors for comparison were recorded on a computer using Statistical Program for Social Science (SPSS) version 15.0. The categorical data were expressed as numbers and percentages, and the continuous data were expressed as the mean±standard deviation or median (range). Comparisons of factors affecting early and late complications with categorical data were performed using chi-square tests, and comparisons with numerical data were performed using Mann-Whitney-U tests. Multivariate analysis was performed using logistic regression analysis and odds ratios (OR) for factors affecting early and late complications, and the 95% confidence intervals (CI) were calculated. A $p<0.05$ was accepted as the significance level.

Results

The study included 81 patients that underwent splenectomy, comprising 34 (42%) men and 47 (58%) women with a mean age of 45 (range, 18-78) years (Table 1). Of the 81 patients, 18 (22.2%) patients underwent splenectomy due to hematological malignancies including chronic lymphocytic leukemia (n=6), hairy cell leukemia (n=5), non-Hodgkin lymphoma (n=4), and B-cell lymphoma (n=3)and 63 (77.8%) patients underwent splenectomy due to benign diseases including idiopathic thrombocytopenic purpura (ITP) (n=37), hereditary spherocytosis (n=7), hemolytic anemia (n=7), hemangioma (n=5), hypersplenism (n=4), hydatid disease (n=2), and splenic abscess (n=1).

The mean follow-up period in all the patients was 142 (range, 1-156) months. Total mortality occurred in 5 patients, among whom one patient died of pseudomonas sepsis in the perioperative period, and the remaining four patients died in the late-term, including three patients that died of sepsis and one patient that died of pneumonia. Accordingly, the rate of perioperative mortality in our study was 1.2%. Pneumococci were detected in the sputum culture of the patient that died of pneumonia. In the three patients that died of sepsis, however, the blood culture of 2 patients was detected with pneumococci (n=1) and meningococci (n=1), whereas no pathogens were detected in the blood or sputum cultures of the remaining one patient. Moreover, 3 out of these five patients underwent splenectomy due to hematological malignancies and had received no prophylactic vaccination (Table 2). The mean preoperative platelet count was 105.70 (range, 2.00-464.00) K/μL and mean postoperative platelet count was 356.50 (range, 6.00-1286.00) K/μL, which indicates a noticeable increase between the pre-and postoperative platelet counts. Thrombocytosis was defined based on the World Health Organization (WHO) criteria: a platelet count of >450.00 K/μL [5]. Accordingly, thrombocytosis was diagnosed in 22 (27.2%) patients, including 18 patients with benign diseases and four hematological malignancies. However, no significant difference was found between the patients with benign and malignant diseases concerning the development of thrombocytosis (p=0.593).

In our study, early complications occurred in 21 (25.9%) patients, including surgical site infection (n=11), atelectasis (n=2), hemorrhage (n=1), pleural effusion (n=8), and pancreatitis (n=1). In the patients with surgical site infection, staphylococcus aureus was detected in 7, Staphylococcus epidermidis in 2, E. Coli in 1, and streptococcus pyogenesis in one patient. On the other hand, late complications occurred in 13 patients, including sepsis (n=6), pneumonia (n=3), deep vein thrombosis (n=5), pulmonary embolism (n=2), portal vein thrombosis (n=2), and superior mesenteric vein thrombosis (n=1). In the patients with sepsis, pneumococcus was detected in 2, meningococci 1, and Enterococcus 1patient, whereas no pathogens were detected in 1 patient. Moreover, 3 out of 6 patients with sepsis died after the surgery, leading to postsplenectomy sepsis mortality of 50%. In the three patients with pneumonia, pneumococci were detected in 2, and H. influenza was detected in 1 patient.

The univariate analyses of the potential factors expected to affect early post-splenectomy complications indicated that gender (p=0.924) and the status of prophylactic vaccination (p=0.942) had no effects on early post-splenectomy complications. However, the incidence of early complications was significantly higher in the patients with hematological malignancies (p=0.001), patients aged 60 years or over (p=0.014), those who underwent open surgery (p=0.019), and patients with a spleen size of >15 cm (p=0.008). The logistic regression analysis revealed the splenectomy performed

for hematological malignancies as the only independent factor increasing the risk of early complications (p=0.042, OR=1.4, 95.0% CI =0.079-0.952) (Table 3).

On the other hand, the univariate analyses of the potential factors expected to affect late postsplenectomy complications indicated that gender (p=0.344), age (p=0.666), spleen size (p=0.069), and surgical technique (laparoscopy vs. open surgery) (p=0.572) had no effects on late post-splenectomy complications. However, the incidence of late complications was significantly higher in the patients with hematological malignancies (p=0.023) and in the patients that received no prophylactic vaccination (p=0.043). Similarly, the logistic regression analysis indicated that the splenectomy performed for hematological malignancies was revealed as the only independent factor increasing the risk of late complications (p=0.035, OR=1.72, 95.0% CI=0.068-0.909) (Table 3).

In all the 24 patients that underwent laparoscopic splenectomy, the spleen size was smaller than 15 cm. Moreover, a significant difference was found between the patients who underwent laparoscopy and those who underwent open surgery regarding spleen size (p=0.001). Of the 24 patients that underwent laparoscopy, 23 patients had benign diseases, and one patient had hematological malignancies. Additionally, a significant difference was found between the patients who underwent laparoscopy and those who underwent open surgery regarding preoperative diagnosis (malignant vs. benign) (p=0.011).

Table 1. Demographic and Clinical Characteristics of the Patients and Result of Univariate Analysis

Characteristics	n	Patients with early complications (n)	Patients with late complications (n)	Early Comp. p	Late Comp. p
Age (years)					
≥ 60	16	8	2	0.014	0.666
< 60	65	13	11		
Gender					
Male	34	9	7	0.924	0.344
Female	47	12	6		
Diagnosis					
Malignant	18	10	6	0.001	0.023
Benign	63	11	7		
Vaccination					
Yes	66	17	8	0.942	0.043
No	15	4	5		
Surgical Technique					
Open surgery	57	19	10	0.019	0.572
Laparoscopic	24	2	3		
Spleen size					
≥15 cm	21	10	6	0.008	0.069
<15 cm	60	11	7		

Table 2. Clinical characteristics of nonsurviving patients

Diagnosis	Time from splenectomy to death (months)	Cause of death	Pathogens isolated	Vaccination
Hypersplenism	67	Sepsis	Meningococci	No
Splenic abscess	66	Sepsis	Pneumococci	Yes
Hairy cell leukemia	19	Sepsis	None	Yes
Hairy cell leukemia	8	Pneumonia	Pneumococci	No
Non-Hodgkin lymphoma	1	Sepsis	Pseudomonas	No

Table 3. Results of Logistic Regression Analysis

	Odds ratio (OR)	95.0% CI for Exp(B)	p
Early complicationsvs. Malignancies	1.4	0.079 – 0.952	0.042
Late complicationsvs. Malignancies	1.72	0.068 – 0.909	0.035

Discussion

Splenectomy is an effective technique used in the treatment of numerous malignant and benign hematological disorders and primary diseases of the spleen. Splenectomy is a widely performed technique, and its complications remain a serious problem and can lead to serious morbidity and mortality.

Early post-splenectomy complications include hemorrhage, surgical site infections, pleural effusion, atelectasis, pancreatitis, pancreatic fistula diaphragm, and adjacent organ injuries [6]. On the other hand, late complications following splenectomy often include infections and thromboembolic events [7]. In our study, early and late complications occurred in 26% and 16% of the patients, respectively. The reported splenectomy mortality rates range between 0-4 % [9-11]. Similarly, the mortality rate in our patients was 1.2%.

Literature indicates that the incidence of thrombocytosis and thromboembolic events is increased in the patients with malignancies and the patients aged 60 years or over [7,12]. In line with the literature, in our study, the patients with malignancies aged 60 years had a higher incidence of complications and lower survival. However, no significant difference was found between the patients with benign and malignant diseases about the development of thrombocytosis [7,8].

Literature reviews indicate that although laparoscopic splenectomy is a commonly performed treatment method, the hemorrhage rates following laparoscopic splenectomy remain controversial, particularly when compared to other surgical techniques [13]. Of note, although laparoscopic splenectomy leads to increased patient comfort and shorter postoperative hospital stays, bleeding control becomes difficult as a result of increased hemorrhage volume, and the risk of early postoperative hemorrhage is relatively higher, particularly in patients with splenomegaly [11,14,15]. Nevertheless, some studies are suggesting that there is no

significant difference between laparoscopic splenectomy and other treatment methods for the development of hemorrhage and deep vein thrombosis [16,17].

In our study, we also found no significant difference between laparoscopic splenectomy and open surgery about late complications, whereas the incidence of early complications was lower in the patients that underwent laparoscopic splenectomy compared to those who underwent open surgery. These findings could be attributed to the smaller spleen sizes in the patients who underwent laparoscopic splenectomy and that most of the patients with malignant diseases underwent open surgery.

Overwhelming infections are common complications occurring following splenectomy. The most common pathogens isolated in these infections include pneumococci, H.influenza B, and meningococci [18]. Similarly, these pathogens were isolated in our patients with sepsis, and the rate of long-term mortality after sepsis was 50%. On the other hand, the rate of prophylactic vaccination in our patients was 81%, whereas it was 40% in the patients that died of sepsis. Overwhelminginfections mostly occur within the two years after splenectomy [19]. Accordingly, considering that the mean follow-up period in our patients was 142 (range, 1-156) months, we believe that the follow-up periods in our patients were adequate. On the other hand, the literature suggests that prophylactic antibiotic therapy has little or no effect in preventing overwhelming infections. Thus, prophylactic vaccination could be preferred instead. The optimal timing for vaccination is 15 days before surgery [20,21]. However, in emergency patients or in patients that are not vaccinated preoperatively, a single dose of booster vaccination should be performed within postoperative 15 days and should be repeated every five years [22]. In our study, the findings related to vaccination were consistent with those reported in the literature. Nevertheless, although vaccination is commonly known as the most effective method for preventing post-splenectomy complications, the national vaccination rates are remarkably low in the world. Moreover, the rates are remarkably low even in developed countries, which has been shown to be 53% in the UK for the year2005 [23].

Thromboembolic complications after splenectomy can be life-threatening in the long term and account for 10% of post-splenectomy complications [24]. In our patients, the rate of thromboembolic complications was 12%. Literature suggests that, in the patients scheduled for splenectomy, LMWHs should be initiated preoperatively and should be continued until the third week after surgery [25]. Moreover, in the patients detected with a risk of thromboembolic complications at a 3-week follow-up, antiaggregant drugs can be prescribed as needed.

Conclusion

In conclusion, the splenectomy performed for hematological malignancies was revealed as the only independent factor increasing the risk of both early and late complications. However, as this factor cannot be reversed or prevented by surgeons, surgeons should instead properly administer preoperative vaccination protocols and should also inform the patients about the future doses of booster vaccination to reduce the risk of postoperative complications. For thromboembolic risks, however, the routine use of LMWHs both pre-and peri-operatively should be promoted. The patients with thromboembolic complications should be closely monitored during the long term following splenectomy.

Highlight Key Points

1. The only factor affecting the complications in the early and late stages after splenectomy is malignancy.
2. Preoperative vaccination is important.
3. Attention should be paid to the risk of thromboembolism in the perioperative and postoperative periods.

Note: This study was presented orally at the 19th National Surgery Congress in Turkey.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Ethics committee approval was obtained for our study from Tokat Gaziosmanpasa Medical Faculty Clinical Research Ethics Committee with the number 21-KAEK-181.

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