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The risks and benefits of non-predictive splenectomy: The necessity of splenectomy and early postoperative outcomes

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Abstract

Although, most splenectomy is predictive due to preoperative tests, sometimes the decision to perform the splenectomy is made intraoperatively for non-primary splenic diseases. The aim of this study to investigate the risks, benefits and necessity of non-predictive of splenectomy and early outcomes. Splenectomy was performed as predictive splenectomy (PS) for primary splenic diseases and non-predictive splenectomy (Non-PS) for non-primary splenic diseases. Preoperative, operative, and 1-month postoperative data included to study. Between June 2012 and July 2018, 108 patients underwent splenectomy. Of these patients, 67 (62%) had PS for primary splenic disease, and 41 (38%) had non-PS due to non-primary splenic diseases. Patients with PS were statistically younger compared to Non-PS patients (52.82 ± 15.07 vs. 44.32 ± 19.23 years, p = 0.022). The most common cause of splenectomy in the PS group was immune thrombocytopenic purpura (ITP) in 16 (23.9%) and splenic trauma in 16 (23.9%), whereas in the non-PS group the major causes were gastric cancer in 16 (39%) and pancreas cancer in 10 (24.4%). Patients in the PS group had significantly lower postoperative hospital stay day (11.2 ± 7.3 vs. 6.4 ± 4.2, p = 0.001). The total complication rate was statistically higher in the non-PS patients (31.7% vs. 10.4%, p = 0.012). However, no significant differences were found in the postoperative infection rates (17% in non-PS versus 7.5% in PS, p = 0.22). Even if the preoperative investigation does not show any indication for splenectomy, but the surgeon has intraoperative concerns about sub-optimal oncological surgery without splenectomy, we recommend that the surgeon should perform the splenectomy.

Keywords: Splenectomy, post splenectomy, splenomegaly

Introduction

Splenectomy is the curative treatment for disease and is applied to patients with a spleen injury, splenic malignancy and abscesses or cysts that involve all of the spleen, tumors, and metastasis [1]. Moreover, splenectomy can be considered for some hematological diseases, such as ITP, hemolytic anemia, and hematological malignancies [1-3]. Although splenectomy is considered a safe procedure [4], it can cause fatal postoperative complications, such as infections, thrombocytosis, portal vein thrombosis [5,6]. Although, most splenectomy is predictive due to preoperative diagnostic images and laboratory values, sometimes the decision to perform the splenectomy is made intraoperatively. As reported in the literature, the suspicion of splenic hilum invasion by non-splenic intraabdominal cancer might force the surgeon to make intraoperative decision to perform splenectomy with gastric, pancreas, colon or other intraabdominal organ resection to achieve optimal cancer surgery [7]. There is controversy about whether intraoperative decisions can lead to unnecessary splenectomy and fatal complications. However, avoiding intraoperative splenectomy decisions might lead to unsatisfactory cancer surgery. The aim of this study was to investigate the risk and benefits of non-predictive splenectomy and early outcome of predictive (preoperative indication) versus non-predictive (intraoperative indication) splenectomy.

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Material and Methods

Between June 2012 and July 2018, 108 patients underwent splenectomy. Splenectomy was performed as predictive splenectomy (PS) for primary splenic diseases and non-PS for non-primary splenic diseases. Splenectomy performed for non-PS included cases of gastric cancer, pancreas cancer, colon cancers, and other intraabdominal cancers. Preoperative images and laboratory findings were used for diagnoses. The preoperative evaluation showed no pathology in non-PS patients, and the decision for splenectomy in patients with non-PS was made intraoperatively due to concerns about non-splenic malignancy invasion to the spleen

or splenic hilum lymph node metastasis. In this study, patients were divided into two groups based on the cause of splenectomy: splenectomy for PS versus non-PS. Preoperative, operative, and 1-month postoperative data included age, gender, indications for splenectomy, preoperative and postoperative platelets and WBC (white blood count), postoperative splenectomy-related complications (bleeding, infections, hematological changes), pathological diagnosis, hospital and ICU (intensive care unit) stay, and death in the first postoperative month. An early outcome was defined as 1 month after surgery.

Statistics

The NCSS (Number Cruncher Statistical System, 2007, Kaysville, Utah, USA) program was used for statistical analysis. To analyze the data we used definitive statistical methods and calculated the mean ± SD, median, frequency, minimum and maximum values. Normal distribution quantitative values were compared using the Student's t-test, whereas non-normal distribution values were compared in two groups using the Mann Whitney U test. Non-normal distributed values in the same group were compared using the Friedman test and Wilcoxon Signed Ranks test. Qualitative values were compared using the Pearson chi-squared test, Fisher's exact test, and the Fisher Freeman Halton test. A p-value of < 0.05 was used as a cut-off for significance.

Results

Between June 2012 and July 2018, 108 patients underwent splenectomy. Of these patients, 67 (62%) had PS, and 41 (38%) had non-PS.Of the 67 patients who underwent total splenectomy in the PS group, 9 (13.4%) had a laparoscopic splenectomy. There were no statistical differences in group regarding male gender (35% in PS vs 45% in non-PS p = 0.314). Among these patients, 55.6% (60) were female, and 44.4% (48) were male. The mean age of the patients was 47.70 ± 18.1 years (range: 18-86 years. Patients with PS were statistically younger compared to Non-PS patients (52.82 ± 15.07 vs. 44.32 ± 19.23 years, p = 0.022). Indications for splenectomy are outlined in Table 1. The most common cause of splenectomy in the PS group was immune thrombocytopenic purpura (ITP) in 16 (23.9%) and splenic trauma in 16 (23.9%), whereas in the non-PS group the major causes were gastric cancer in 16 (39%) and pancreas cancer in 10 (24.4%). The preoperative splenomegaly rate was statistically higher in the PS group than the non-PS group [44 (65.7 %) versus 12 (29.3 %), p = 0.001].

The most common pathological diagnosis that was statistically higher in the PS group was hamartoma, whereas the most common diagnosis was a tumoral invasion in the non-PS group ($p < 0.01$). Of the 41 patients that underwent splenectomy due to concern about cancer invasion, only 8 (19.5%) had pathologically confirmed cancer invasion to the spleen from non-splenic intraabdominal cancers. The deseases pathological diagnosis in in non-PS was found to be statistically higher compared to PS (77.5% vs 45.3% p = 0.001, Table 2).

No significant differences were found in platelet number between the two groups at 1 week postoperation (464.80 ± 281.99/μL in PS vs. 482.67 ± 283.12/μL in non-PS, p = 0.76) and 1 month postoperation (483.61 ± 570.58/μL vs. 475.60 ± 247.16/μL, p = 0.23). The preoperative platelets rate was statistically lower in the PS group (250.4 ± 279/μL vs. 323.9 ± 129/μL, p = 0.001). To identify differences, further statistical analysis showed significant increases at 1 week postoperation (211.4 ± 354.8/μL) and 1 month postoperation (245.8 ± 385/μL) (p = 0.001 and 0.001 respectively, Figure 1). However, the increase in platelet number from 1 week postoperation to 1 month postoperation was not statistically significant in the PS group ((464,80±281,9/μL vs 483,61±570,5/μL, $p > 0.05$).

Table 1. Indications for splenectomy

	Group	
	Non-PS (n=41)	**PS (n=67)**
Amenia	-	3 (4.5 %)
Hamartom	-	1 (1.5 %)
Hemangiom	-	2 (2.9 %)
Hemolytic Anemia	-	5 (7.5 %)
Hypersplenism	-	2 (2.9 %)
ITP	-	16 (23.9 %)
Lymphoma	-	1 (1.5 %)
Spleen Abcess	-	4 (6 %)
Spleen Cyst	-	2 (2.9 %)
Spleen Hydatic Cyst	-	2 (2.9 %)
Spleen Infarction	-	9 (13.4 %)
Spleen Malignancy	-	2(2.9 %)
Splenomegaly	-	2 (2.9 %)
Trauma	-	16 (23.9 %)
Colon cancer	3 (7.3 %)	-
Endometrium cancer	1 (2.4 %)	-
Gastric cancer	16 (39 %)	-
Lung cancer	2 (4.9 %)	-
Over cancer	8 (19.5 %)	-
Pancreas Cyst	1 (2.4 %)	-
Pancreas cancer	10 (24.4 %)	-
Pancreas Trauma	3 (7.3 %)	-

Table 2. Pathological Diagnosis in Groups

	Groups		
	Non-PS (n=41)	**PS (n=67)**	**p**
Abcess	-	5 (7.5%)	χ2:40,417
Congestion	33 (80.5%)	29 (43.3%)	d0,001**
Cyst	-	1 (1.5%)	
Cystic Malignancy	-	3 (4.5%)	
Hamartom	-	16 (23.9%)	
Hydatic Cyst	-	1 (1.5%)	
Hypersplenism	-	4 (6%)	
Inflamation	-	3 (4.5%)	
Infarction	-	3 (4.5%)	
Lymphoma	-	1 (1.5%)	
Nodular Lesion	-	1 (1.5%)	
Tumoral Invasion	8 (19.5%)	0 (0)	

[d]Fisher Freeman Halton Test **p<0,01

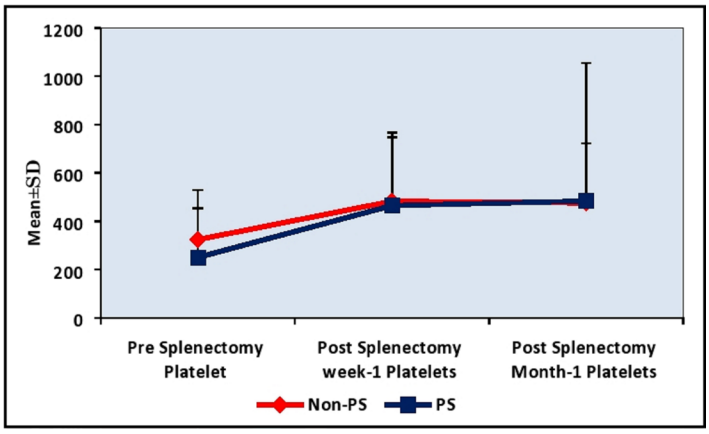

Figure 1. Changes in platelet number following splenectomy

No differences were found in preoperative WBC in the two groups (9.13 ± 3.69x109/L in PS vs. 11.05 ± 43.17 x109/L, p = 0.212). The increase of WBC from the day of splenectomy to 1 week postoperation was found to be significant in the non-PS group (9.13 ± 3.69 x109/L vs. 12.55 ± 4.67 x109/L, p = 0.001), and the decrease of WBC from 1 week postoperation to 1 month postoperation was statistically significant (12.55 ± 4.67 x109/L vs. 10.30 ± 3.86 x109/L, p = 0.001). The increase in WBC from the day of splenectomy to 1-week postoperation was significant in the non-PS group (11.05 ± 43.17 x109/L vs. 16.93 ± 20.93 x109/L, p = 0.001), and the decrease of WBC from 1-week postoperation to 1-month postoperation was statistically significant (16.93 ± 20.93 x109/L vs. 11.77 ± 3.47 x109/L, p = 0.001).

Patients in the PS group had significantly lower postoperative hospital stay day compared to the non-PS group (11.2 ± 7.3 vs. 6.4 ± 4.2 day, p = 0.001). The mean stay in the ICU period was statistically longer in patients with non-PS (1.8 ± 1.2 vs. 0.6 ± 0.8 day, p = 0.014, Table 3). The total complication rate was statistically higher in the non-PS patients (31.7% vs. 10.4%, p = 0.012, Table 3). However, no significant differences were found in the postoperative infection rates of the two groups (17% in non-PS versus 7.5% in PS, p = 0.22, Table 3). The complications in PS were Clavien-Dindo classification class-1 [5 of 7 (71.4%)] and class-2 [2 of 7, 28.6%]. In the non-PS groups, the complications were Clavien-Dindo classification class-1 [6 of 13 (46.1%)], class-2 [5 of 13(38.5%)], and class-3 [2 of 13 (15.4%)].

Table 3. The complications rate and hospital and ICU stay times

		Non- PS (n=41)	PS (n=67)	p
Postoperative Hospital Stay (day)	Min-max (Median)	3-34 (8)	1-30 (5)	Z:-4,128
	Mean±SD	11,22±7,28	6,37±4,20	ᶜ0,001**
Postoperative ICU Stay (day)	Min-Max (Median)	0-4 (2)	0-2 (0)	Z:-2,448
	Mean±SD	1,79±1,19	0,64±0,81	ᶜ0,014*
Total Complications (rate)		13 (31.7%)	7 (10.4%)	ᶜ0,012
Infections (rate)				
ᶜFisher's Exact Test	ᶜMann Whitney U Test	*p<0,05	**p<0,01	

The rate of patients that received a post-splenectomy vaccine was not statistically different between the two groups (62.5% in PS vs. 45.5% in non-PS, p = 0.08). Post-splenectomy vaccination did not affect the infection rate in either of the two groups (10% in vaccinated patients vs. 4.2% in non-vaccinated patients, p = 0.30). Post-splenectomy vaccination did not affect the total complications rate in the two groups (11.6% in vaccinated patients vs. 10.4 % in non-vaccinated patients, p = 0.83). No differences were detected in the total complications rate in patients with splenectomy and pancreatectomy versus splenectomy and gastrectomy (8.2% vs. 6.3%, p = 0.655). Two (4.9%) patients died in the non-PS group due to cardiopulmonary causes, whereas no deaths were reported in the PS group during the 1 month follow-up period.

The variables that were significant in the univariant analysis were analyzed using backward stepwise logistic regression analysis. In the logistic regression analysis, we detected increased risk for a longer hospital stay [OR: 1.148 (%95 CI: 1.028-1.283), p = 0.014] and higher chance to have congestion (OR: 5.111 (%95 CI: 1.329-19.646), p = 0.018) in spleen pathological reports in the non-PS group. However, having preoperative splenomegaly is most likely in the patients in the PS group [OR: 6.870 (%95 CI: 2.025-23.30), p = 0.002].

Discussion

As reported in the literature, prophylactic splenectomy does not provide survival advantages in proximal gastric cancer surgeries but can cause unnecessary postoperative complications [8,9]. However, not doing splenectomy in non-splenic intraabdominal cancer surgery can cause insufficient oncological surgery due to missing metastatic splenic hilar lymph nodes or invasions of neighboring organs, such as in gastric, pancreas or colon cancers. It remains unclear whether the intraoperative decision to perform splenectomy is sufficiently safe. In this study, we analyzed our records to determine how many splenectomies were unnecessary, as well as the rate of splenectomy-related early complications in non-predictive splenectomy. We also compared early results of patients with predictive and non-predictive splenectomy.

Previously, in patients with proximal gastric cancer, splenectomy was performed routinely to clear metastatic lymph node or tumoral invasion in splenic hilum. However, it was reported that this does not have a survival benefit but increases postoperative complications [10]. Nevertheless, splenectomy must be done if there is tumor invasion in spleen hilum [10]. However, other studies have recommended spleen hilar lymph nodes dissection even if

laparoscopically can be safely done without doing splenectomy [11,12].

Some studies have reported that, for neuroendocrine pancreas tumor in the left side of the pancreas, it is not necessary to perform splenectomy because it does not affect the outcome and no tumor invaded the lymph node retrieved in their series [13]. A meta-analysis comparing distal pancreatectomy spleen preservation (SPDP) to distal pancreatectomy with splenectomy (DPS) showed that SDPS has more benefits in borderline pancreas malignants [14,15]. However, a study reported and claimed that spleen preservation is time-consuming and causes more blood transfusion, which increases the risk of postoperative complications [16]. Another study detected no difference in long-term complication rate when comparing performing colectomy with or without splenectomy in patients with colon cancer and inadvertent splenectomy [17]. This study related complications in colectomy and splenectomy to non-splenectomy causes [17]. Splenectomy is recommended for cytoreductive surgery for stage-4 ovarian cancers, and it is reported that splenectomy improves survival rate [18].

Of the 41 patients who underwent non-predictive splenectomy based on the surgeon's intraoperative decision, 19.5% had a malignant invasion in splenic hilum. However, in this study, about 80% of splenectomies was unnecessary. It is noteworthy that some of the splenectomies were performed due to the previously accepted protocol, which recommended a splenectomy in case of proximal gastric cancer. Therefore, this might account for why the unnecessary splenectomy rate might is higher than expected. Although we cannot provide the information in this study, how many metastasis or tumoral invasion were missed by not doing splenectomy in gastric and other intraabdominal cancers is unknown . Unfortunately, the information about the risk of missing metastatic lymph nodes by not doing splenectomy is scarce in the literature. Therefore, more studies are needed to determine the risks and benefits of performing (or not performing) splenectomy in non-splenic intraabdominal cancers. We also accept that some of the tumor invasion to the spleen might have occurred preoperatively, but been missed in the operative evaluation.

In this study, the complications were higher in non-predictive splenectomy, most likely due to concurrent organ surgery-related complications, such as a pancreatic leak from pancreas resection or anastomosis complications in gastric and colon surgeries. We also did not determine the differences in infections rate in patients who underwent predictive versus non-predictive splenectomy. Since we only included early complications in the first month after splenectomy, the long-term follow-up findings might differ. Postsplenectomy hematologic changes in platelets and WBC were similar in the two groups. In this study, platelets increased after splenectomy, which is consistent with the literature. The increase of WBC after splenectomy was consistent with the findings of a previous study, and this is most likely a physiological reaction to splenectomy [19]. Although we did not include long-term complications of splenectomy in this study, the fatal long-term complication of splenectomy is an overwhelming post-splenectomy infection (OPSI) which has a high mortality rate [20]. Even if the early morbidity and mortality have decreased in recent years, the long-term complications rate remains high [21]. Although a study reported that non-vaccinated patients have more complications compared to the unvaccinated [22], in this study, the vaccinated rate did not affect the infection rate in patients, and this might be due to the shorter follow-up period.

Conclusions

Overall, although splenectomy can increase the risk of postoperative complications (some of which are fatal), not performing these splenectomies might result in non-optimal oncological surgery and thus affect patient survival. We recommend thorough preoperative investigations to determine whether lymph node metastasis or invasion to spleen have occurred, thus increasing the accuracy of the surgical plan. However, even if the preoperative investigation does not show any indication for splenectomy, but the surgeon has intraoperative concerns about sub-optimal oncological surgery without splenectomy, we recommend that the surgeon should perform the splenectomy. More randomized studies are needed to address long-term complications in patients with predictive and non-predictive splenectomy and the necessity of splenectomy in non-splenic intraabdominal centers surgery.

Competing interests
The authors declare that they have no competing interest.

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Ethical approval
Consent of ethics was approved by the local ethics committee.

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