

Splenectomy during Gastric Cancer Surgery *versus* Splenectomy during Extra-gastric Abdominal Cancer Surgery

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ABSTRACT

Objective: To evaluate the clinicopathological differences between splenectomy during gastric cancer surgery and splenectomy during extra-gastric abdominal cancer surgery.

Study Design: Observational study.

Place and Duration of Study: Erzurum Regional Education and Research Hospital, Erzurum, Turkey between January 2015 and January 2020.

Methodology: Patients who were operated due to intra-abdominal malignancies were searched retrospectively. Among those patients, concomitant splenectomy cases were filtered for the study. The patients' general clinicopathological characteristics were retrieved from their medical records. Patients were divided into two groups, according to the objectives. The clinicopathological differences between the groups were evaluated with appropriate statistical tests, assuming significant p value of less than 0.05.

Results: The study included 45 patients. The mean age of the patients was 62.84 ± 12.59 (30-86 years), and male to female ratio was 19:26. Splenectomy was performed during gastric cancer surgery in 30 patients (66.7%) and 43 patients (95.6%) were operated in elective conditions. There was a need for more erythrocyte suspension in patients, who underwent splenectomy during gastric cancer surgery ($p=0.040$). However, length of hospital stay and overall morbidity were higher at splenectomy with extra-gastric cancer group, ($p = 0.036$ and $p = 0.011$, respectively).

Conclusion: Splenectomy during gastric cancer surgery is more demanding; and requires more erythrocyte suspension. However, these patients had less morbidity tendencies. Length of stay was longer with splenectomy during extra-gastric abdominal cancer group.

Key Words: Splenectomy, Gastric cancer, Length of stay, Morbidity.

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INTRODUCTION

Splenectomy is the surgical procedure to remove spleen with several indications. Indications for splenectomy can be evaluated in two main categories: traumatic splenectomy and non-traumatic splenectomy.¹ In traumatic category, penetrating trauma, such as gunshot wounds, blunt trauma such as a direct blow to the left upper quadrant, and indirect trauma such as a tear in the splenic capsule during colonoscopy or traction on the splenocolic ligament are mechanisms of injury. However, in the non-traumatic category, hematological diseases, malignancies, hydatid cyst are important indications.²

Splenectomy is applied in malignant diseases, especially in gastric cancer located in the greater curvature. Though preoperative chemotherapy has a role in gastric cancer, it is not the substitute for radical gastrectomy with D₂ lymphadenectomy, which is still the gold standard treatment, especially in high-volume centres.³ Lymph node station 10 dissection is the routine procedure in D₂ lymphadenectomy.⁴ Because of splenic hilum or parenchyma invasion, splenectomy is required for proper D₂ lymphadenectomy. However, concurrent splenectomy is still a debatable issue in gastric cancer treatment. In the Eastern countries such as Japan, simultaneous splenectomy is performed in suitable gastric cancer cases because routine splenectomy has the potential to increase morbidity. However, in the Western countries, concurrent splenectomy is not performed as often as in the Eastern countries because of higher complication rates.⁵

On the other hand, tumors of intra-abdominal organs such as colon, pancreas and ovary can also metastasise to the spleen.⁶ Splenic metastases arise in less than 1% of all metastases.⁷ The prevalence of splenic metastases ranged between 2.3 and 7.1%.⁸ Splenectomy may also be necessary as a result of

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vascular or parenchymal injuries during any intra-abdominal dissection. The risk of splenic injury is highest during left hemicolectomy (1-8%), open anti-reflux procedures (3-20%), left nephrectomy (4-13%), and during exposure and reconstruction of the proximal abdominal aorta and its branches (21-60%).⁹ Since the subject of splenectomy has started to take an important place in cancer surgery and the main surgical indication is gastric cancer, it is aimed to compare the cases of splenectomy performed with gastric cancer and splenectomy other than gastric cancer and to emphasise what will be encountered in which cases.

The aim of this study was to evaluate the clinicopathological differences between splenectomy during gastric cancer surgery and splenectomy during extra-gastric abdominal cancer surgery.

METHODOLOGY

Patients who were operated due to abdominal malignancies between January 2015 and January 2020 at Erzurum Regional Education and Research Hospital, Erzurum, Turkey, were searched retrospectively. Among those patients, concomitant splenectomy cases were filtered for the study. The study excluded patients in the pediatric age group (0-18 years) and those who were diagnosed and treated at external centres and then admitted to this centre. A total of 45 patients were enrolled in the study after fulfilling the desired inclusion criteria *via* purposive sampling technique. The patients' general characteristics were retrieved from the hospital's computer system and the archives of patients' medical records. Patients included in the study were divided into two groups of splenectomy during gastric cancer surgery and splenectomy during extra-gastric abdominal cancer surgery as per objective.

Age, gender, primary focus of abdominal malignancy, surgical emergency, the amount of erythrocyte suspension, fresh frozen plasma replacement usage during the hospital stay, hematologic parameters on admission (leucocyte count, hemoglobin level and platelet count), and length of hospital stay were searched. Postoperative morbidity, mortality, tumor invasion at splenectomy specimen and pathological stage of the main resection material were also evaluated. Patients who developed complications in 30 days after surgery were considered as the morbidity-positive group, and patients who died within 30 days after surgery were considered as the mortality-positive group.

Statistical evaluation was made with SPSS version 22.0 (IBM, Armonk, NY, USA). The data were presented as median (interquartile range), mean, and frequency (percentage). The normality distribution of quantitative variables were checked with Shapiro-Wilk test, histograms, Q-Q plot, and box plot charts. Independent t-test or Mann-Whitney U-test was used according to the results of the normality distribution tests. In addition, Chi-square test was used to compare qualitative variables. A p-value below 0.05 was considered statistically significant.

This retrospective study was conducted after approval from the local Ethics Committee (Decision No. 2021/09-170, dated: 03.05.2021).

RESULTS

Forty-five patients met the criteria for the study. The mean age of the patients was 62.84 ± 12.59 (30-86 years), and male to female ratio was 19:26. Forty-three patients (95.6%) were operated in elective conditions. Splenectomy was performed during gastric cancer surgery in 30 patients (66.7%), while splenectomy was performed during extra-gastric abdominal cancer surgery in 15 patients (33.3%). Extra-gastric tumor locations were: distal pancreas in five patients (11.1%), splenic flexure in five patients (11.1%), esophagus in three patients (6.7%), and ovarian in two patients (4.4%). Clinicopathological features of the patients are shown in Table I.

Both the groups were similar in terms of age, gender, and basic hematological parameters. All splenectomies were performed by open surgery. Except for two, all other cases were carried out under elective conditions. These emergency surgeries were performed due to obstruction. Splenectomy was required in 40 patients (88.9%) due to splenic invasion or hilum invasion. On the other hand, splenectomy was required in five patients (11.1%) due to bleeding. Splenectomy cases secondary to bleeding were performed during gastric cancer surgery. In pathological evaluation, only 13 patients had splenic invasion.

Mean hospital stay was 18.22 ± 7.52 days (1-40 days). The morbidity and mortality rate of this study was 46.7% and 13.3%, respectively. The most common postoperative complications were pulmonary complications. Postoperative complications are shown in Table II.

There was a need for more erythrocyte suspension in patients who underwent splenectomy concurrently with gastric cancer surgery ($p = 0.040$), and morbidity was higher in non-gastric abdominal malignancy cases ($p = 0.011$). However, in non-gastric abdominal cancers, there was no prolongation in the duration of intensive care stay, but the total hospital stay was longer than the group with gastric cancer ($p = 0.036$). The comparison of both the groups is shown in Table I.

DISCUSSION

The spleen is a highly vascularised organ from both splenic artery and arteriae gastricae breves; and an injury to this organ can result in significant blood loss either from the parenchyma or the arteries and veins that supply the spleen. The most common splenectomy indications are as follows: blood and reticuloendothelial disorders, infective complications, inflammatory disorders, neoplastic, congestive disorders, metabolic storage disorders, and splenic trauma. In this study, situations in which splenectomy is unavoidable during malignancy surgery (invasion and bleeding due to trauma) were examined and compared.

Malignancies involving the spleen can be grouped into lymphoproliferative diseases, myeloproliferative diseases, metastatic diseases, and primary (non-lymphoma) malignancies.

Table I: Clinicopathological parameters of all patients who underwent splenectomy during malignancy surgery.

Characteristics	All splenectomy cases (n=45)	Splenectomy during gastric cancer surgery (n=30)	Splenectomy during extra-gastric cancer surgery (n=15)	p-value
Age (mean±sd)	62.84±12.59	64.57±12.67	59.40±12.13	0.198*
Gender (n,%)				0.135**
Female	26 (57.8%)	15 (57.7%)	11 (42.3%)	
Male	19 (42.2%)	15 (78.9%)	4 (21.1%)	
WBC count (mean±sd)	10.08±2.17	9.88±2.20	10.47±2.13	0.399*
Hb (mean±sd)	11.9±2.2	12.02±2.54	11.66±1.64	0.619*
Platelet count [median, (IQR)]	262.00 IQR=144.50	292.00 IQR=151.25	237.00 IQR=100	0.060***
Surgical emergency				0.609**
Elective	43 (95.6%)	29 (67.4%)	14 (32.6%)	
Urgent	2 (4.4%)	1 (50%)	1 (50%)	
Splenectomy indication				0.094**
Bleeding	5 (11.1%)	5 (100%)	0 (0%)	
Invasion	40 (88.9%)	25 (62.5%)	15 (37.5%)	
ES replacement [median, (IQR)]	6 IQR=6	8 IQR=6.25	5 IQR=5.0	0.040***
FFP replacement (mean±sd)	32.04±14.66	34.8±11.75	26.53±18.47	0.130*
Overall morbidity				0.011**
Yes	21 (46.7%)	10 (47.6%)	11 (52.4%)	
No	24 (53.3%)	20 (83.3%)	4 (16.7%)	
Overall mortality				>0.999**
Yes	6 (13.3%)	4 (66.7%)	2 (33.3%)	
No	39 (86.7%)	26 (66.7%)	13 (33.3%)	
Invasion at spleen specimen				0.732**
Yes	13 (28.9%)	8 (61.5%)	5 (38.5%)	
No	32 (71.1%)	22 (68.8%)	10 (31.3%)	
LOS [Median, (IQR)]	16.00 IQR=7.5	15 IQR=5.25	21 IQR=14	0.036***
ICU stay [Median, (IQR)]	7.00 IQR=5.50	7.5 IQR=6	6 IQR=2	0.174***

SD: Standard deviation, IQR: Interquartile range, WBC: White blood cell, Hb: Hemoglobin, ES: Erythrocyte suspension, FFP: Fresh frozen plasma, LOS: Length of stay, ICU: Intensive care unit. *Independent t-test, **Chi-square test, ***Mann-Whitney U-test.

Table II: Postoperative complications.

Complications	n (%)
Pulmonary complications	
Atelectasis	5 (11.1%)
Pleural effusion	2 (4.4%)
Pneumonia	2 (4.4%)
Cardiac complications	
Atrial fibrillation	1 (2.2%)
Cardiac tamponade	1 (2.2%)
Wound complications	
Surgical site infection	2 (4.4%)
Evisceration	1 (2.2%)
Others	
Cerebrovascular disease	2 (4.4%)
Ileus	1 (2.2%)
Deep vein thrombosis	1 (2.2%)
Enterocutaneous fistula	1 (2.2%)
Gastrointestinal hemorrhage	1 (2.2%)
Intra-abdominal hematoma	1 (2.2%)
Total	21 (46.7%)

Hematological malignant diseases are the leading indications for splenectomy among the malignancy cases. Primary cancers that metastasise to the spleen include colonic, gastric, ovarian, endometrial, lung, breast, prostatic, melanoma, and esophageal.¹⁰ In this study, it was aimed to find the differences between cases with gastric cancer plus splenectomy, and cases with non-gastric intra-abdominal cancer plus splenectomy. It is also the first comparative study to compare such two groups to the best of the authors' knowledge.

With the passage of time, the subject of gastric cancer treatment has gained new dimensions and the addition of splenectomy to the surgical modality has been a subject of discussion, especially in tumors located in the greater curvature. Despite the continuous comparison between spleen-preserving surgeries and spleen-resecting surgeries in the literature, concurrent splenectomy is still a debatable issue in gastric cancer treatment. Concurrent splenectomy is especially recommended in cases of gastric cancer with greater curvature involvement. In the prospective study of the Japan Clinical Oncology Group, concurrent splenectomy has been shown to have no advantage over oncological outcomes in cases without greater curvature involvement, but rather to increase morbidity. In the Eastern countries such as Japan, concurrent splenectomies are performed in suitable gastric cancer cases.¹¹ However, in the Western countries, concurrent splenectomy is not performed as often as Eastern countries because of higher complication rates.⁵ In the study of Ohkura *et al.*, there was a significant increase in blood loss and pancreatectomy-related complications in cases with splenectomy.¹² However, in some retrospective studies, splenectomy had a negative effect on overall survival.¹³ Another important issue is station 10 lymph node dissection. Up to 10% of patients with advanced proximal gastric cancer have station 10 lymph node metastasis.¹² In the literature, the efficacy of station 10 lymph node dissection with splenectomy is under investigation. In those studies, splenectomy showed either a negative impact or no impact on survival.¹⁴

Surgery procedure of choice for splenic flexure cancers is a debatable issue. Some surgeons recommend extensive surgery, such as an extended right hemicolectomy or combined splenectomy.¹⁵ In the study by Kim *et al.*, combined splenectomies were added to main surgery because of the tumor proximity to the spleen (≤ 2 cm) in 68.6% of all cases, and because of bleeding in 9.8% of all cases.¹⁶ Some authors recommend routine splenectomy and distal pancreatectomy,¹⁷ while others found that such procedures did not improve 5-year survival of splenic flexure cancer patients.¹⁶ In this study, splenectomy was performed in 40 (88.9%) of all patients due to invasion, and the remaining patients due to bleeding. At the pathological evaluation, only 13 patients had splenic invasion.

Literature show post-splenectomy complications rate ranging from 12% to 52%, while mortality rates ranging from 1% to 9%.^{2,18} The morbidity rate and mortality rate of the present study were 46.7% and 13.3%, respectively. While the morbidity rate was consistent with the available literature, the mortality rate was higher than the literature average. The authors attributed the high mortality rate of the study to the fact that splenectomy cases were performed due to malignancy.

In the guidelines for ovarian cancer, it is considered the removal of relevant abdominal organs such as spleen.¹⁹ However, the clinical practice of splenectomy in ovarian cancer is rare.²⁰ Main reasons for splenectomy in ovarian cancer include splenic metastasis, perisplenic tumor infiltration, and intraoperative bleeding.²¹ Metastatic splenic lesions are always more than 1 cm; and it is difficult to achieve optimal cytoreductive surgery for those patients without splenectomy, which may influence prognosis.²² In the present study, all splenectomies during ovarian cancer surgery were performed due to invasion.

In literature, the rate of splenectomy during gastric cancer was higher than splenectomy during non-gastric cancer intra-abdominal malignancy surgeries. In this study, there were more cases of splenectomy performed during gastric cancer surgery than patients who underwent splenectomy during extra-gastric intra-abdominal cancer operation.

CONCLUSION

Splenectomy during gastric cancer surgery is more demanding; and requires more erythrocyte suspension. In addition, these patients had less morbidity tendencies. However, hospital stay is longer in the splenectomy during non-gastric intra-abdominal cancer group than in the splenectomy during gastric cancer surgery group.

ETHICAL APPROVAL:

This study was started after receiving Ethics Committee approval from Clinical Research Ethics Committee of Van Yuzuncu Yil University (Decision No. 2021/09-170, dated:

03.05.2021).

PATIENTS' CONSENT:

As the study was a retrospective study, patients' consent was waived.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

MY: Conception and study design, literature review, data collection, image analysis, statistical analysis, results, writing the manuscript, and critical review of the manuscript. TK: Study design, data collection, image analysis, and critical review of the manuscript.

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