

Indications of Splenectomy and Postoperative Mortality**Mustafa Ugur^{1*,**}, Erol Kilic^{1**}, Arif Emre², Ahmet Necati Sanli², Ozan Utku Ozturk¹, Ibrahim Yetim¹, Muhyittin Temiz¹**¹Medical School of Mustafa Kemal University, Department of General Surgery, 31100, Hatay, Turkey²Medical School of Sutcu Imam University, Department of General Surgery, 46100, Kahramanmaraş, Turkey**Original Research Article*****Corresponding author**
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Abstract: The aim of this study was to investigate the risk factors for mortality by evaluating the indications for splenectomy and postoperative mortality in patients that underwent splenectomy over a 6-year period at a general surgery department. The retrospective study included 107 patients aged over 18 years that underwent splenectomy. The patients were divided into two groups: (I) surviving and (II) no surviving. Age, gender, hospital stay, surgical procedure (elective or emergency), type of surgery (open or laparoscopic), indications for splenectomy, and the histopathological diagnosis of the splenectomy specimen were recorded for each patient. The 107 patients comprised 58 (54.2%) men and 49 (45.8%) women. Of these, 94 (87.9%) patients were in the surviving group and 13 (12.1%) were in the no surviving group. Of the 107 patients, 66 (61.7%) underwent elective surgery and 41 (38.3%) underwent emergency surgery. Mortality occurred in 4 (6%) patients that underwent elective surgery and in 9 (22%) patients that underwent emergency surgery and the risk of mortality was significantly higher in the patients that underwent emergency surgery compared to elective surgery ($p < 0.05$). The most common indication for splenectomy was trauma ($n=35$; 32.7%), followed by nondramatic hematological indications ($n=30$; 28%) including ITP ($n=15$; 14%), sickle cell anemia ($n=9$; 8.4%), beta thalassemia ($n=5$; 4.7%), and hereditary spherocytosis ($n=1$; 0.9%). In addition, splenectomy was performed as a component of the debulking of ovarian cancer ($n=28$; 26.2%). Complications occurred in 19 (12%) patients, with the most common complications including isolated abdominal bleeding ($n=7$; 6.5%) and isolated atelectasis and pneumonia ($n=6$; 5.6%). Trauma is the most common indication for splenectomy in general surgery practice and benign hematological disorders are also highly common among the indications for splenectomy. In addition, emergency splenectomy is a risk factor for mortality.

Keywords: Indication, complication, mortality, splenectomy.**INTRODUCTION**

Splenectomy is a surgical procedure commonly performed in the treatment of numerous curable diseases and in the clinical palliation of various diseases. In such diseases, splenectomy is indicated in cases that present with commonly known conditions such as blunt trauma, idiopathic thrombocytopenic purpura (ITP), beta thalassemia, and hereditary spherocytosis and also in cases with rare diseases such as epidermoid cyst, splenic tumor, and hydatid cyst [1–8]. In addition, splenectomy can also be indicated in cases in whom the treatment fails or the desired outcome is not achieved after the treatment, particularly in cases with controversial indications such as advanced-stage gastric cancer, hypersplenism, or in cases with splenic shunt that undergo liver transplantation [9–11]. However, splenectomy is a critical surgical procedure that has a high risk of serious complications and may result in mortality. To prevent

these risks, a number of measures have been proposed that are classified as preoperative [such as vaccination), perioperative [such as local bleeding control), and postoperative measures (such as monitoring of patient vitals, lung exercises)[12–18]. In addition, in patients undergoing splenectomy, pre- and post-operative vaccinations should be administered, postoperative monitoring and follow-up of the patient should be performed, and the hematological problems caused by the changes in the numerical blood parameters should be closely monitored and treated as needed [14,19]. In this study, we aimed to investigate the risk factors for mortality by evaluating the indications for splenectomy and postoperative mortality in patients that underwent splenectomy over a 6-year period at a general surgery department.

METHODS

The retrospective study included 107 patients aged over 18 years that underwent splenectomy at Mustafa Kemal University Medical School General Surgery Department between January 2012 and January 2018. The patients were divided into two groups: (I) surviving and (II) no surviving. Patients that had traumatic indications and those who underwent elective surgery were also included in the study. Age, gender, hospital stay, surgical procedure (elective or emergency), type of surgery (open or laparoscopic), indications for splenectomy, histopathological diagnosis of the splenectomy specimen, and postoperative follow-up status until the end of the study period were recorded for each patient.

STATISTICAL ANALYSIS

Data were analyzed using SPSS 24.0 (IBM Corporation, Armonk, New York, United States). Normal distribution of data was analyzed using Shapiro-Wilk test and variance homogeneity was evaluated using Levine's test. The means of two independent groups were compared using Independent-Samples *t*-test with bootstrap results. Categorical variables were compared using Pearson's chi-square test and Fisher's Exact test. The effect sizes of the variables were compared using odds ratio. Mortality and survival were estimated using the Kaplan-Meier method (product limit method) and the log-rank test (Mantel-Cox method). Quantitative variables were expressed as mean standard deviation (SD), minimum, and maximum. Categorical variables were expressed as frequencies and percentages. A *p* value of <0.05 was considered significant.

RESULTS

The 107 patients included 58 (54.2%) men and 49 (45.8%) women (Table 1). Of these, 94 (87.9%) patients were in the surviving group and 13 (12.1%) were in the no surviving group. Mean age was 43.9±18.9 (range, 18-88) years in the surviving group and 48.4±23.9 (range, 20-90) years in the no surviving group and no significant difference was found between the groups in terms of mean age (*p*>0.05).

Of the 107 patients, 66 (61.7%) underwent elective surgery and 41 (38.3%) underwent emergency

surgery (Figure 1). Mortality occurred in 4 (6%) patients that underwent elective surgery and in 9 (22%) patients that underwent emergency surgery (Table 1) and the risk of mortality was significantly higher in the patients that underwent emergency surgery compared to elective surgery (*p*<0.05).

Open surgery was performed in 101 (94.4%) patients and laparoscopic surgery was performed in 6 (5.6%) patients (Table 1). Mortality occurred in 12 patients that underwent open surgery as opposed to 1 patient that underwent laparoscopic surgery; however, no significant difference was found between the patients with regards to the type of surgery (*p*>0.05).

The most common indication for splenectomy was trauma (n=35; 32.7%), followed by nondramatic hematological indications (n=30; 28%) including ITP (n=15; 14%), sickle cell anemia (n=9; 8.4%), beta thalassemia (n=5; 4.7%), and hereditary spherocytosis (n=1; 0.9%). Moreover, splenectomy was performed as a component of the debulking of ovarian cancer (n=28; 26.2%) and was performed due to rarer indications including total gastrectomy (n=3; 2.8%), Hodgkin lymphoma (n=2; 1.9%), distal pancreatectomy (n=1; 0.9%), hairy cell leukemia (n=1; 0.9%), spontaneous splenic rupture (n=1; 0.9%), myelofibrosis (n=1; 0.9%), and splenic pseudocyst (n=1; 0.9%) (Table 2).

No postoperative complication occurred in 88 (82.2%) of the patients. However, complications occurred in 19 (12%) patients, including isolated abdominal bleeding (n=7; 6.5%), isolated atelectasis and pneumonia (n=6; 5.6%), atelectasis and pneumonia plus wound site infection (n=2; 1.9%), atelectasis and pneumonia plus abdominal abscess (n=1; 0.9%), abdominal bleeding and acute pancreatitis (n=1; 0.9%), isolated wound site infection (n=1; 0.9%), and isolated abdominal abscess (n=1; 0.9%) (Table 2).

The most common histopathological diagnosis was chronic venous congestion (n=47; 43.9%), followed by capsule laceration (n=38; 35.5%), splenic invasion (malignant) (n=13; 12.1%), hydatid cyst (n=4; 3.7%), epidermoid cyst (n=1; 0.9%), granulomatous infection (n=1; 0.9%), and splenic abscess (n=1; 0.9%) (Table 2).

Table-1: Patient characteristics in both groups

| | Surviving | No surviving | Total | <i>p</i> |
|--------------------|------------------------|------------------------|------------------------|------------------|
| | (n=94) | (n=13) | (N=107) | |
| | Mean±SD. / Min. - Max. | Mean±SD. / Min. - Max. | Mean±SD. / Min. - Max. | |
| Age (years) | 43.9±18.9 / 18-88 | 48.4±23.9 / 20-90 | 44.4±19.6 / 18-90 | 0.521 |
| | n (%) | n (%) | n (%) | |
| Gender | | | | |
| Female | 44 (46.8) | 5 (38.5) | 49 (45.8) | 0.768 |
| Male | 50 (53.2) | 8 (61.5) | 58 (54.2) | |
| Surgical procedure | | | | |
| Elective | 62 (66.0) | 4 (30.8) | 66 (61.7) | 0.029 |
| Emergency | 32 (34.0) | 9 (69.2) | 41 (38.3) | 4.3 (1.3-22.01)* |
| Type of surgery | | | | |
| Open | 89 (94.7) | 12 (92.3) | 101 (94.4) | 0.549 |
| Laparoscopic | 5 (5.3) | 1 (7.7) | 6 (5.6) | |

Independent-samples *t*-test(Bootstrap) / Fisher's Exact Test/ Pearson's Chi-Square Test/ *Odds Ratio (95% CI)

Table-2: Indications for splenectomy, postoperative complications, and histopathological diagnosis of the patients

| | n | % | |
|--|----|-------|-----|
| Indications for Splenectomy | | | |
| Trauma | 35 | 32.7% | 28% |
| ITP | 15 | 14.0% | |
| Sickle cell anemia | 9 | 8.4% | |
| Beta thalassemia | 5 | 4.7% | |
| Hereditary spherocytosis | 1 | 0.9% | |
| Debulking of ovarian cancer | 28 | 26.2% | |
| Hydatid cyst | 4 | 3.7% | |
| Total gastrectomy | 3 | 2.8% | |
| Hodgkin lymphoma | 2 | 1.9% | |
| Distal pancreatectomy | 1 | 0.9% | |
| Hairy cell leukemia | 1 | 0.9% | |
| Spontaneous splenic rupture | 1 | 0.9% | |
| Myelofibrosis | 1 | 0.9% | |
| Splenic pseudocyst | 1 | 0.9% | |
| Complications | | | |
| No complication | 88 | 82.2% | |
| Isolated abdominal bleeding | 7 | 6.5% | |
| Isolated atelectasis and pneumonia | 6 | 5.6% | |
| Atelectasis and pneumonia + wound site infection | 2 | 1.9% | |
| Atelectasis and pneumonia + abdominal abscess | 1 | 0.9% | |
| Abdominal bleeding + acute pancreatitis | 1 | 0.9% | |
| Isolated wound site infection | 1 | 0.9% | |
| Isolated abdominal abscess | 1 | 0.9% | |
| Histopathological Diagnosis | | | |
| Chronic venous congestion | 47 | 43.9% | |
| Capsule laceration | 38 | 35.5% | |
| Splenic invasion (malignant) | 13 | 12.1% | |
| Hydatid cyst | 4 | 3.7% | |
| Epidermoid cyst | 3 | 2.8% | |
| Granulomatous infection | 1 | 0.9% | |
| Splenic abscess | 1 | 0.9% | |

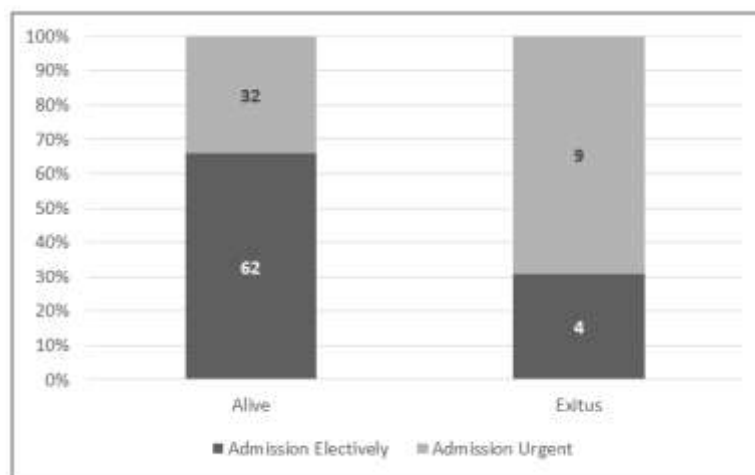


Fig-1: Type of surgical procedure in surviving and no surviving patients

DISCUSSION

Splenectomy is a common surgical procedure primarily used for the treatment of cystic, tumoral, and infectious diseases of the spleen and also used for the treatment of thrombocytopenia and traumatic splenic injuries caused by benign diseases such as erythrocyte, hemoglobin, and platelet abnormalities and by malignant diseases such as myeloproliferative disorders, Agno genic myeloid metaplasia (AMM), and leukemia [20–23].

Literature reviews indicate that traumatic splenic injury is the most common indication for splenectomy [24,25] and immune thrombocytopenic purpura (ITP) is the most common nontraumatic indication [26,27]. Similarly, in our patients, trauma was also the most common indication for splenectomy (32.7%). In addition, since our hospital is located in the Mediterranean Region in Turkey, hereditary hematological disorders were also highly common among the indications for splenectomy, which accounted for 28% (n=30) of the cases and included ITP (n=15; 14%), sickle cell anemia (n=9; 8.4%), beta thalassemia (n=5; 4.7%), and hereditary spherocytosis (n=1; 0.9%). Moreover, splenectomy was also performed as a component of the surgical debulking of ovarian cancer (n=28; 26.2%).

Agnogenic myeloid metaplasia (AMM), which is a condition arising from bone marrow fibrosis as a result of various benign and malignant disorders, has emerged as a frequent indication for splenectomy [28,29]. However, splenectomy cannot be performed with the indication of AMM in most patients due to a lack of communication between the physicians and the surgeons performing primary treatment and follow-up care of these patients. Meaningfully, in our patients, AMM was the indication for splenectomy in only 1 patient and thus AMM seems to be an indication that is mostly overlooked in clinical practice.

Splenectomy has been shown to cause pulmonary, hemorrhagic, infection, pancreatic, and thromboembolic complications [30–32]. Of these, left lower lobe pneumonia and atelectasis are the most commonly reported complications [33–35]. In our study, these two complications occurred in 9 patients, of whom 6 patients had isolated atelectasis and pneumonia. In addition, the second most common complication was abdominal bleeding.

Splenic capsule laceration is a common condition detected in gross and histopathological examinations of the spleen after external traumatic splenic injuries and iatrogenic splenic injuries [36–38]. On the other hand, chronic venous splenic congestion, which is caused by numerous disorders that lead to increased portal vein pressure or increased venous outflow resistance, is a condition that can be detected on histopathological examination and leads to congestion and/or expansion in the spleen [39–42]. In line with the literature, in our study, chronic venous congestion and capsule laceration accounted for 43.9% and 35.5% of the indications for splenectomy, respectively.

The indication of splenectomy is the most predictive risk factor for the development of post-splenectomy mortality [43–45]. However, isolated splenic injury rarely leads to mortality [46]. Moreover, although the patients undergoing splenectomy with traumatic indications often have a good prognosis, the patients undergoing emergency splenectomy due to the presence of other organ injuries have a higher mortality risk compared to patients undergoing elective splenectomy [47,48]. In our study, we did not investigate the presence of other organ injuries in the patients that died after emergency splenectomy, which could be accepted as a limitation of our study. However, we compared the patients that underwent emergency and elective splenectomy and found that the mortality rate was significantly higher in the patients that underwent emergency splenectomy ($p < 0.05$). This

finding indicates that emergency splenectomy is a risk factor for mortality. However, we also found that age, gender, and the type of surgery (open or laparoscopic) did not constitute a risk factor for mortality ($p>0.05$).

CONCLUSION

In conclusion, trauma is the most common indication for splenectomy in general surgery practice and benign hematological disorders are also highly common among the indications for splenectomy in the region where our study was conducted, the Mediterranean Region in Turkey. In addition, although emergency splenectomy is a risk factor for mortality, age, gender, and the type of surgery (open or laparoscopic) do not constitute a risk factor for mortality.

REFERENCES

1. Pugliese R, Maggioni D, Scandroglio I, Sansonna F, Grilloa G, Di SL, Ferrari GC, Boniardi M, Costanzi A, Magistro C. Splenectomy in haematologic diseases. Clinical indications and surgical technique. *Chirurgia italiana*. 2005;57(3):283-91.
2. Patel N, Nicola A, Bennett P, Mapunda E, and Loveland J, Grieve A. PAEDIATRIC SPLENECTOMY: THE JOHANNESBURG EXPERIENCE. *South African journal of surgery. Suid-Afrikaanse tydskrif vir chirurgie*. 2017 Jun;55(2):74-5.
3. Bonnet S, Guédon A, Ribeil JA, Suarez F, Tamburini J, Gaujoux S. Indications and outcome of splenectomy in hematologic disease. *Journal of visceral surgery*. 2017 Jul 27.
4. Meshikhes AW, Mubarek MA, Abu-Alrahi AI, Al-Saif OH. The pattern of indications and complications of splenectomy in Eastern Saudi Arabia. *Saudi medical journal*. 2004;25(12):1892-5.
5. Khamechian T, Alizargar J, Farzanegan M. Pattern of Splenectomy Indications in Kashan Shahid-Beheshti Hospital: A 5-Year Study. *Archives of trauma research*. 2013;1(4):180.
6. Subbannan K, Ustun C, Natarajan K, Clair B, Daitch L, Fields S, Kutlar F, Kutlar A. Acute splenic complications and implications of splenectomy in hemoglobin SC disease. *European journal of haematology*. 2009 Sep 1;83(3):258-60.
7. Héry G, Becmeur F, Méfat L, Kalfa D, Lutz P, Lutz L, Guys JM, de Lagausie P. Laparoscopic partial splenectomy: indications and results of a multicenter retrospective study. *Surgical endoscopy*. 2008 Jan 1;22(1):45-9.
8. Bermas H, Fenoglio ME, Haun W, Moore JT. Hand-assisted laparoscopic splenectomy: indications and technique. *JSL: Journal of the Society of Laparoendoscopic Surgeons*. 2004 Jan;8(1):69.
9. Usui S, Tashiro M, Haruki S, Arita K, Ito K, Matsumoto A, Takiguchi N. Spleen preservation versus splenectomy in laparoscopic total gastrectomy with D2 lymphadenectomy for gastric cancer: A comparison of short-term outcomes. *Asian journal of endoscopic surgery*. 2016 Feb 1;9(1):5-13.
10. Özer İ, Bostancı EB, Ulaş M, Özoğul Y, Akoğlu M. Changing Trends in Gastric Cancer Surgery. *Balkan medical journal*. 2017 Jan;34(1):10.
11. Golse N, Mohkam K, Rode A, Pradat P, Ducerf C, Mabrut JY. Splenectomy during whole liver transplantation: a morbid procedure which does not adversely impact long-term survival. *HPB*. 2017 Jun 1;19(6):498-507.
12. Gao K, Yu PM, Su JH, He CQ, Liu LX, Zhou YB, Pu Q, Che GW. Cardiopulmonary exercise testing screening and pre-operative pulmonary rehabilitation reduce postoperative complications and improve fast-track recovery after lung cancer surgery: A study for 342 cases. *Thoracic cancer*. 2015 Jul 1;6(4):443-9.
13. Hirschhorn AD, Richards DA, Mungovan SF, Morris NR, Adams L. Does the mode of exercise influence recovery of functional capacity in the early postoperative period after coronary artery bypass graft surgery? A randomized controlled trial. *Interactive cardiovascular and thoracic surgery*. 2012 Sep 12;15(6):995-1003.
14. Qu Y, Ren S, Li C, Qian S, Liu P. Management of postoperative complications following splenectomy. *International surgery*. 2013 Feb;98(1):55-60.
15. Chan G, Taqi A, Drage M, Quan D. A case report of massive vaginal variceal hemorrhage in a patient with cirrhosis secondary to nonalcoholic steatohepatitis unresolved even after successful liver transplantation. In *Transplantation proceedings* 2013 Mar 1 (Vol. 45, No. 2, pp. 835-837). Elsevier.
16. Eigenberger K, Sillaber C, Greitbauer M, Herkner H, Wolf H, Graninger W, Gattringer R, Burgmann H. Antibody responses to pneumococcal and hemophilus vaccinations in splenectomized patients with hematological malignancies or trauma. *Wiener klinische Wochenschrift*. 2007 May 1;119(7-8):228-34.
17. Schreiber MA, Pusateri AE, Veit BC, Smiley RA, Morrison CA, Harris RA. Timing of vaccination does not affect antibody response or survival after pneumococcal challenge in splenectomized rats. *Journal of Trauma and Acute Care Surgery*. 1998 Oct 1;45(4):692-7.
18. Papadatou I, Piperi C, Alexandraki K, Kattamis A, Theodoridou M, Spoulou V. Antigen-specific B-cell response to 13-valent pneumococcal conjugate vaccine in asplenic individuals with β -thalassemia previously immunized with 23-valent pneumococcal polysaccharide vaccine. *Clinical infectious diseases*. 2014 May 30;59(6):862-5.
19. Böttcher D, Blümel J, Staib I. Changes in Blood Coagulation after Splenectomy. In *Diagnosis and Therapy of Malignant Lymphoma 1974* (pp. 113-

- 117). Springer, Berlin, Heidelberg.
20. Rice HE, Englum BR, Rothman J, Leonard S, Reiter A, Thornburg C, Brindle M, Wright N, Heeney MM, Smithers C, Brown RL. Clinical outcomes of splenectomy in children: report of the splenectomy in congenital hemolytic anemia registry. *American journal of hematology*. 2015 Mar 1;90(3):187-92.
 21. Banerjee JK, Bharathi RS, Venkatesan S, Singh G. Epithelial cyst of spleen presenting as hypersplenism. *Medical Journal Armed Forces India*. 2018 Jan 1;74(1):85-8.
 22. Arslan S, Guzel M, Turan C, Doğanay S, Kopru M. Management and treatment of splenic trauma in children. *Annali italiani di chirurgia*. 2015;86(1):30-4.
 23. Kucuk C, Sozuer E, Ok E, Altuntas F, Yilmaz Z. Laparoscopic versus open splenectomy in the management of benign and malign hematologic diseases: a ten-year single-center experience. *Journal of laparoendoscopic & advanced surgical techniques*. 2005 Apr 1;15(2):135-9.
 24. Cadeddu M, Garnett A, Al-Anezi K, Farrokhyar F. Management of spleen injuries in the adult trauma population: a ten-year experience. *Canadian journal of surgery*. 2006 Dec;49(6):386.
 25. Beuran M, Gheju I, Venter MD, Marian RC, Smarandache R. Non-operative management of splenic trauma. *Journal of medicine and life*. 2012 Feb 22;5(1):47.
 26. Tsiotos G, Schlinkert RT. Laparoscopic splenectomy for immune thrombocytopenic purpura. *Archives of Surgery*. 1997 Jun 1;132(6):642-6.
 27. Cameron JL, Cameron AM. *Current Surgical Therapy E-Book*. Elsevier Health Sciences; 2013 Nov 20.
 28. Rialon KL, Speicher PJ, Ceppa EP, Rendell VR, Vaslef SN, Beaven A, Tyler DS, Blazer DG. Outcomes following splenectomy in patients with myeloid neoplasms. *Journal of surgical oncology*. 2015 Apr 1;111(4):389-95.
 29. Tefferi A. *Clinical manifestations and diagnosis of primary myelofibrosis*. UpToDate, Waltham, MA: Walters Kluwer Health. 2016.
 30. Santos FP, Tam CS, Kantarjian H, Cortes J, Thomas D, Pollock R, Verstovsek S. Splenectomy in patients with myeloproliferative neoplasms: efficacy, complications and impact on survival and transformation. *Leukemia & lymphoma*. 2014 Jan 1;55(1):121-7.
 31. Winslow ER, Brunt LM. Perioperative outcomes of laparoscopic versus open splenectomy: a meta-analysis with an emphasis on complications. *Surgery*. 2003 Oct 1;134(4):647-53.
 32. Wang X, Li Y, Crook N, Peng B, Niu T. Laparoscopic splenectomy: a surgeon's experience of 302 patients with analysis of postoperative complications. *Surgical endoscopy*. 2013 Oct 1;27(10):3564-71.
 33. Bhandarkar DS, Katara AN, Mittal G, Shah R, Udwardia TE. Prevention and management of complications of laparoscopic splenectomy. *Indian Journal of Surgery*. 2011 Oct 1;73(5):324-30.
 34. Lee SH, Lee JS, Yoon YC, Hong TH. Role of laparoscopic partial splenectomy for tumorous lesions of the spleen. *Journal of Gastrointestinal Surgery*. 2015 Jun 1;19(6):1052-8.
 35. Misiakos EP, Bagias G, Liakakos T, Machairas A. Laparoscopic splenectomy: Current concepts. *World journal of gastrointestinal endoscopy*. 2017 Sep 16;9(9):428.
 36. Farhi DC, Ashfaq R. Splenic pathology after traumatic injury. *American journal of clinical pathology*. 1996 Apr 1;105(4):474-8.
 37. Al-Kindi H, Devi L, George M. Splenic pathology in traumatic rupture of the spleen: a five year study. *Oman medical journal*. 2009 Apr;24(2):81.
 38. Feola A, Niola M, Conti A, Delbon P, Graziano V, Paternoster M, Della Pietra B. Iatrogenic splenic injury: review of the literature and medico-legal issues. *Open Medicine*. 2016 Jan 1;11(1):307-15.
 39. Bolognesi M, Merkel C, Sacerdoti D, Nava V, Gatta A. Role of spleen enlargement in cirrhosis with portal hypertension. *Digestive and Liver Disease*. 2002 Feb 1;34(2):144-50.
 40. Uy PP, Francisco DM, Trivedi A, O'Loughlin M, Wu GY. *Vascular Diseases of the Spleen: A Review*. *Journal of clinical and translational hepatology*. 2017 Jun 28;5(2):152.
 41. Buob S, Johnston AN, Webster CR. Portal hypertension: pathophysiology, diagnosis, and treatment. *Journal of veterinary internal medicine*. 2011 Mar 1;25(2):169-86.
 42. Procopet B, Berzigotti A. Diagnosis of cirrhosis and portal hypertension: imaging, non-invasive markers of fibrosis and liver biopsy. *Gastroenterology report*. 2017 Apr 17;5(2):79-89.
 43. Newland A, Provan D, Myint S. Preventing severe infection after splenectomy: Patients should know the risks, be immunised, and take prophylactic antibiotics. *BMJ: British Medical Journal*. 2005 Aug 20;331(7514):417.
 44. Leone G, Pizzigallo E. Bacterial infections following splenectomy for malignant and nonmalignant hematologic diseases. *Mediterranean journal of hematology and infectious diseases*. 2015;7(1).
 45. Weledji EP. Benefits and risks of splenectomy. *International Journal of Surgery*. 2014 Feb 1;12(2):113-9.
 46. Coccolini F, Montori G, Catena F, Kluger Y, Biffi W, Moore EE, Reva V, Bing C, Bala M, Fugazzola P, Bahouth H. Splenic trauma: WSES classification and guidelines for adult and pediatric patients. *World Journal of Emergency Surgery*. 2017 Dec;12(1):40.
 47. Liu S. Management of upper gastrointestinal bleeding from portal hypertension: Elective or emergency operation?. *Pakistan journal of medical*

sciences. 2014 May;30(3):574.

48. Davies I, Cho J, Lewis MH. Splenectomy results from an 18-year single centre experience. The Annals of The Royal College of Surgeons of England. 2014 Mar;96(2):147-50.