Review Article

Splenectomy in trauma and complications after splenectomy

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Abstract

Splenic injury is the second most common abdominal organ injury caused by both blunt and penetrating mechanisms. In the past, all of the splenic injuries required splenectomy for treatment, but during the past 50 years, there has been increasingly interested that not all splenic injuries required splenectomy. The evolution of non-operative management for splenic injuries made us away from an aggressive operation to the spleen. Although, splenectomy still plays a significant role in life-saving for extremis injured patients. Surgeons should be familiar with this procedure and knowing complications that may occur after the procedure.

Keywords: Spleen, Splenectomy, Splenic injury, Abdominal injury, Complications

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Introduction

The spleen is the largest reticuloendothelial organ of the human body. Splenic injury is the second most common abdominal organ injury caused by both blunt and penetrating mechanisms.[1] In the past, the spleen was believed to have no vital function and splenectomy couldn't make any serious consequence. In 1783, John Ferguson, Scotland's surgeon, was victorious in the first splenectomy in trauma. After this, splenectomy was an excellent operation for treated splenic injuries even it was a minor injury.[2] Splenectomy played a significant role in pediatrics hematologic disease too, but after followed post-splenectomy patients, they found many fatal cases from a severe infection. Many investigators studied the actual function of the spleen and noticed the significant role of the spleen in the immune system and lead to a considerable conceptual changed of splenic injuries treatment including minimized splenectomy. Although, the splenectomy still plays the major role for treated life-threatening splenic injuries because this procedure is not complicated and can rapidly get rid of the bleeding. All of the general surgeons must be familiar to this procedure.

Anatomy of the spleen

The spleen is enlarged during childhood to produce red blood cells. Until the bone marrow is fully developed, the hematopoiesis function of the spleen is decreased then the spleen volume reduced to actual adult size. The splenic capsule is thicker and stronger in childhood compare to an adult, that explained why non-operative management of splenic injuries is more successful in the child.[1] The actual adult spleen weight is about 150 - 250 gm depending on the contents. The widest portion of the spleen is length from 7 - 14 cm in longitudinal plane and 11 cm circumferential plane in a healthy adult.[3] However, some conditions can increase spleen weight and volumes such as malaria, hematologic diseases or malignancies.[4]

The spleen is an intraperitoneal organ and locates on the left superoposterior aspect of the abdomen under the left dome of the diaphragm (the splenic fossa). The posterolateral aspect of the spleen is fixed to the diaphragm by the splenophrenic ligament (*ligamentum phrenicosplenicum*). The inferior border is attached to the splenic flexor of the colon by the splenocolic ligament (*plica splenoomentalis*), this ligament is the fold of fibrous tissue extending between the inferior pole of the spleen to the greater omentum. The posterior aspect of the spleen seizes to the left kidney capsule, the left adrenal gland and the left iliopsoas muscle with the splenorenal ligament (*ligamentum splenorenale*). The posteromedial aspect of the spleen adheres to the tail of the pancreas (*ligamentum splenopancreaticum*) that encircles the splenic vessels, and anteromedial aspect has the gastrosplenic ligament (*ligamentum gastrosplenicum*) that contains the short gastric arteries which direct blood supply to the spleen.[3, 4]

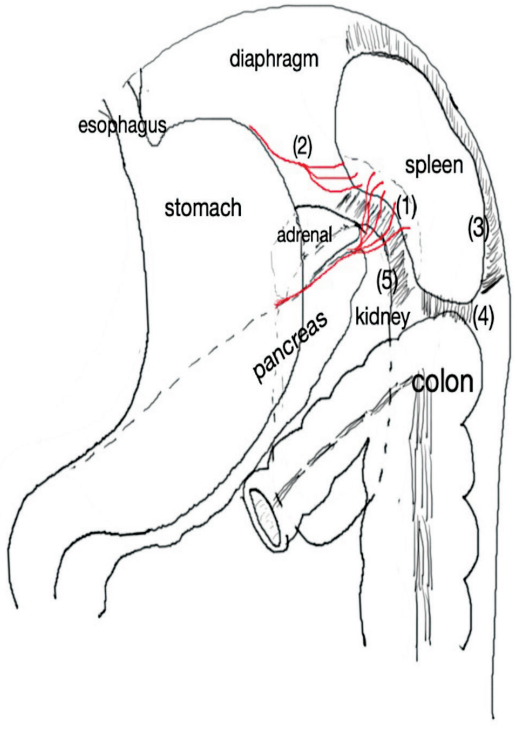

Figure 1 Location of the spleen and adjacent structures; (1) splenic hilum and splenic artery, (2) short gastric artery, (3) splenophrenic ligament, (4) splenocolic ligament, (5) splenorenal ligament

The artery supply of the spleen has two pathways; the splenic artery is the primary pathway and the short gastric artery is the minor. The splenic artery is the principal branch of the celiac trunk; it runs on the upper border of the pancreas parallelly to the splenic hilum and has many terminal branches. The short gastric artery is the distribution of the left gastroepiploic artery, it runs into the gastrosplenic ligament and also has many terminal branches here. After these arteries pass through the splenic hilum to splenic parenchyma, they arrange into segmental architecture and feed to functional units of the spleen. The venous drainage of the spleen is simultaneous with the arterial supply. The splenic vein is the primary drainage pathway from the splenic hilum to the superior mesenteric vein, that drain the blood to the portohepatic circulation. The second venous drainage is the short gastric vein; it runs parallel with the short gastric artery and flows to the left gastroepiploic vein.[4]

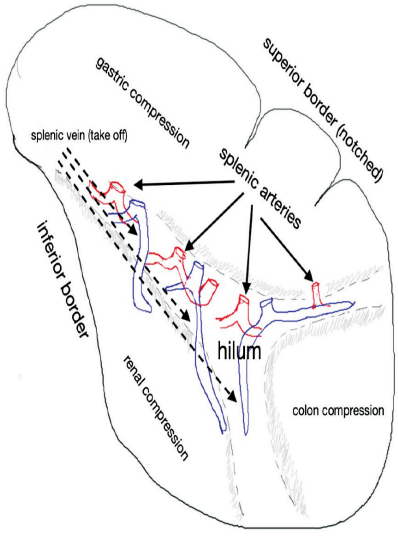

Figure 2 The splenic hilum

Function of the spleen

The spleen has three significant functions according to the histologic appearance;[4, 5]

1. Red pulp is the capillary networking structure. It has many small pores on the surface and contains macrophages, opsonins and porperdins. The primary function is the innate immunity that searching and destroying expired red blood cells and recognize foreign particle especially bacteria then send signals to lymphocyte on the white pulp for eliminating.

2. White pulp is the connection of arterioles and cumulation of lymphocytes and turns to the secondary lymphoid organ. It plays a significant role in creating immunoglobulin M (IgM) to contact with bacterial antigens and destroying them.

3. Marginal zone is the area pooled of B-lymphocytes. It has a unique function called opsonization that uses for killing encapsulated bacteria such as *Haemophilus Influenza, Streptococcal pneumoniae* or *Neisseria meningitides*.

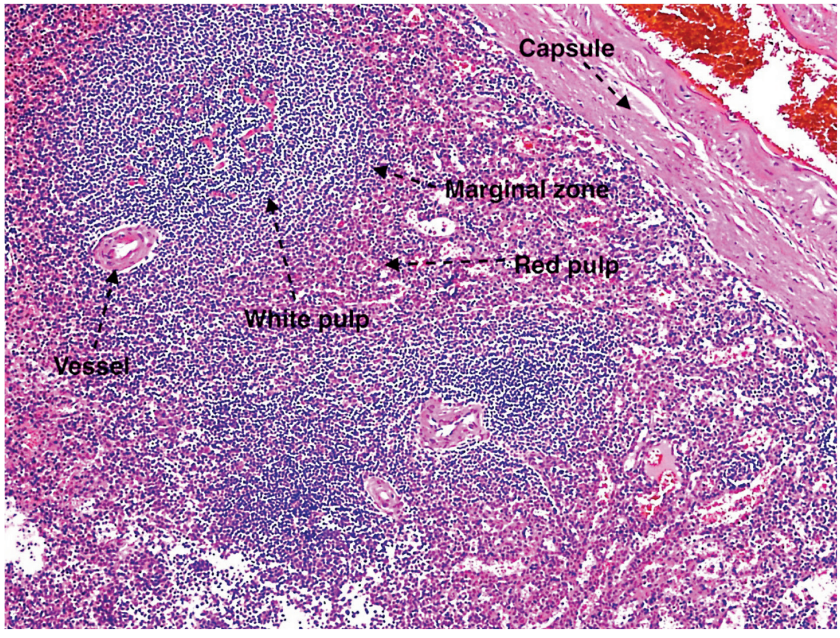

Figure 3 The histology of the spleen show white pulp, marginal zone and red pulp that correlated with trabecular vessel and splenic capsule

Clinical presentation of splenic injury

Clinical signs and symptoms of splenic injury are mostly similar to other abdominal organ injuries such as abdominal pain, peritonism, peritonitis or instability of hemodynamics. All of these presentations are not specific to splenic injury as well, but some of clinical signs maybe specify such as left lower thoracic pain associated with left upper quadrant (LUQ) tenderness, ecchymosis and abrasion of LUQ and left flank (a seatbelt bruise), and Kehr's sign. Kehr's sign represents the left shoulder pain that not associate with shoulder movements; it causes by the irritation of the left diaphragm due to blood and fluid from the spleen. Kehr's sign may be seen in many conditions such as left diaphragmatic injury, left lower lung pneumonia, left pleural effusion, or left sub-diaphragmatic abscess. This sign can be used to differential diagnosis from other musculoskeletal conditions of the left shoulder.[1, 6]

Severity grading of splenic injury

Many grading systems are used to defines the severity of splenic injuries, but on the same scientific based. Most of them use intraoperative finding or imaging (CT scan) to grading the severity. The best-known severity grading scale is the Organ Injury Scale (OIS) which is developed by the American Association for the Surgery of Trauma (AAST). The OIS is purposed to make effective communications between the trauma surgeon and others. The OIS is used widely in the clinical practice, but the limitation is occurring due to some discordant between true clinical severity and imaging or intraoperative findings that may not predict clinical outcomes of the patient.[1, 6, 7] The spleen severity scale is in Table 1.

Table 1 The splenic injury severity scale according AAST

Grade		Injury Description
I	Hematoma	Subcapsular, <10% surface area
	Laceration	Capsular tear, <1 cm parenchymal depth
II	Hematoma	Subcapsular, 10 - 50% surface area, <5 cm in diameter
	Laceration	1 - 3 cm parenchymal depth that does not involve a trabecular vessel
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma >5 cm or expanding
	Laceration	>3 cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)
V	Laceration	Complete shattered spleen
	Vascular	Hilar vascular injury that devascularized spleen

*Advance one grade for multiple injuries up to grade III

Non-operative management for splenic injury

This method is famous for hemodynamic stable with blunt splenic injury patient in the last 50 years and expanding of indication over time. This treatment has 10 - 40% failure rate and the patient who fails to non-operative treatment usually requires immediate operation.[7] The success rate of the non-operative management is correlated to the severity of the injury; there is 75% success rate in AAST grade I injury and can be lower as 1.3% in AAST grade V.[8] The non-operative management is reasonable for the stable hemodynamic patient who absent from tachycardia and hypotension with not have diffuse peritonitis. Another critical factor rather than hemodynamic status and abdominal signs is the facility of the hospital. The non-operative management should only be used in the institute that can 24-hr monitoring of the patient and prompt to immediate operation if the patient has ongoing bleeding, unstable of hemodynamic status, or worsening of abdominal pain.[7-9] There are some studies debated for the role of the non-operative management in penetrating injury of the spleen. They concluded that the vast majority of penetrating trauma of the spleen usually required the operative management, but the non-operative management could be used in particular cases who presented without hemodynamic instability, peritonitis and radiologic evidence of the hollow organ injury and this treatment option not increased mortality.[10]

If the patient meets all criteria, CT scan of the abdomen with contrast study must be performed to identify the severity of the splenic injury and searching for associate intraabdominal injuries that may change the treatment modality or be the contraindication of non-operative management such as hollow viscus injury and active contrast brushing. The active bleeding spleen on CT imaging is indicated for adjunct contrast angiography with embolization or operative management.[7, 11] The systematic review from Olthof et al. in 2013 suggested indications for adjunct angiography with embolization in splenic injury were CT evidence of active extravasation or pseudoaneurysm, AAST grade IV-V injury, massive hemoperitoneum, and multiple injuries patient.[12] Some investigators against this statement, S. Bansai

et al. studied on 270 isolate splenic injury pediatric patients in 2015, who received non-operative management, they found 47 patients (17.4%) had contrast brushing on CT imaging and no one received angiography. They followed these patients and found there had no significant difference in blood transfusion, length of hospital stays and needed to splenectomy between active contrast blushing group and no active group. They concluded that might not adjunct angiography with embolization in every case with contrast brushing on CT scan.[13] The meta-analysis and systematic review from Crichton et al. in 2017 suggested the splenic angioembolization was strongly considered as adjunct to the non-operative management of the blunt splenic injury with AAST grade IV or grade V and not routinely used in the patient with low grade AAST. However, morbidity was higher in the splenic angioembolization group compared to the patient who treated with the non-operative management alone (38.1% vs. 18.6%, $p < 0.01$).[14]

The non-operative management for splenic injury patient is following;

- The patient should not allow to eat or drink (NPO) at least 24 hours after injury to make sure there is no another associated injury that may need to operate especially hollow organ injuries.

- The patient should limit productive activity, but not absolutely bed rest.[15]

- The care provider should close monitor of vital signs and urine output, serial hematocrit, and serial abdominal examinations with the same operator if possible.

- The patient should receive vaccines for *H. influenza*, Streptococcal and Meningococcal to prevent of post-splenectomy overwhelming sepsis because the patient has a risk to fails conservative treatment.

- The patient should stay in ICU at least 24-72 hours, and if stable the patient can move to the regular floor.

- The patient needs deep venous thrombosis prevention such as gradual pneumatic stocking or medical prophylaxis. Some investigators suggested to giving medical prophylaxis after 24 hours of injury without evidence increased of bleeding complication or failure rate of the non-operative management.[16]

- The patient may need to follow up CT imaging for evaluating the possibility of complications if the patient has progression of abdominal signs, persistent abdominal pain more than seven days, or high AAST grading but there is no consensus about this topic.[17]

There still no consensus about which is the best duration to close observation for non-operative treatment of splenic injury in the hospital. Some studies showed most of failure non-operative cases must be in 6 - 8 days after admission. They found that 90% failure occurs within the first four days after injury and 8% failure was happen in the 9th day or later.[7, 18] We prefer to close observation in the hospital at least seven days after the injury. The patient still needs to limit the productive activity after discharge at least four weeks in AAST grade I-II, at least 4 - 8 weeks in grade III and more than eight weeks in high AAST grade (IV-V).[9]

The success rate of non-operative management for splenic injury varies; there will be high as 95% in a pediatric patient, and 80 - 94% in an adult. E. Jeremitsky et al. studied in 2013; the success rate was about 95%, they concluded some factors that associate with the failure of non-operative management for splenic injury were high AAST grading of injury and the patient age more than 55 years.[19]

Operative management for splenic injury

If the patient does not meet to non-operative management or fails to conservative treatment, the patient needs to be operated. There have many choices of operation but in the same principle. The main concept of the operation to the spleen in the traumatic patient is to stop the bleeding and maintain the function of the spleen as much as possible. Before starting the operation, the patient should be prepared; the prophylaxis antibiotic should give, the nasogastric tube should be inserted to decompress of the stomach for proper exposure of the spleen, the patient should be placed in the supine position with the left arm extend, and skin over lower chest and abdomen should be prepared in sterile fashion.

The surgeon must stand on the right side of the patient. The incision made on the midline or the left subcostal. We suggest to build on the midline if you want to explore of the abdomen and to find other associated injuries, but you can use the left subcostal incision in the patient who has isolated splenic injury or obese. After entering the abdomen, the clot should be removed, and the whole abdomen should be inspected. The four-quadrant packing procedure should be done as the standard abdominal exploration in blunt trauma. This procedure can be skipped in the patient with penetrating injury or which confirm the isolated splenic injury. The spleen and associated structure such as the left diaphragm, the stomach, the splenic flexor of colon and the tail of pancreas should be inspected carefully then the spleen should be fully mobilized before choosing the appropriated procedure. The spleen mobilization is following;

- Cutting the splenophenic ligament with sharp scissor or cauterization until catching the esophageal hiatus.

- Hold the spleen with your left hand and pull up to separate the embryonal plane between the spleen and the left kidney then divide of the splenorenal ligament. At this point, the spleen and the tail of pancreas will place in the center of the abdominal cavity.

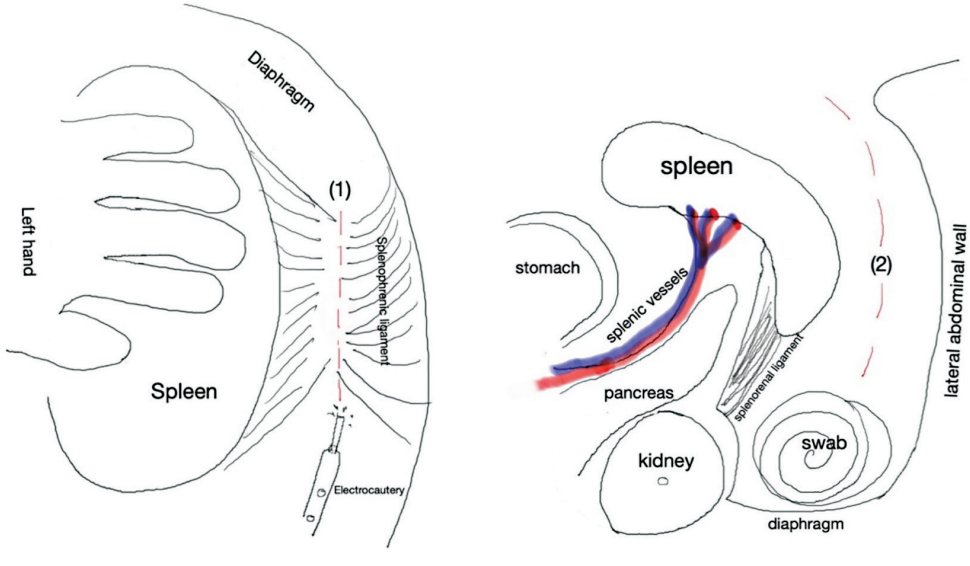

Figure 4 Spleen mobilization; (1) lateral mobilization of spleen; start with cutting the splenophrenic ligament (top view), (2) lateral mobilization of spleen; plane of dissection along the splenophenic ligament downward to the splenorenal ligament (cross-sectional view)

- The assistant brings the spleen and pulls to well expose of the gastro-splenic ligament. You must divide short gastric vessels. Be careful at this point; you should separate the vessel close to the spleen to prevent injury to the greater curvature of the stomach.

- Cutting the lower pole of the spleen and divide the splenocolic ligament.

- During these procedures, you can compress the splenic hilum with your finger or non-crushing clamp to control of bleeding parenchyma, and we advise to avoid blind clamping in this area to prevent injury of the tail of pancreas.

The surgeon should be careful to inspected and decide to repair (splenorrhaphy) or remove (splenectomy) after fully mobilization of the spleen. The surgeon can do nothing and place the spleen back to the splenic fossa if the spleen has no active bleeding or bleeding is stopped. If the spleen has minimal bleeding or AAST grade I, you can use hemostatic agents such as microfibrillar collagen (Fibrillar™), gelatin sponge (Gelfoam®) or fibrin glue. In AAST grade II or III injury with stability of hemodynamics, you can choose splenorrhaphy procedure.[1, 4] The splenorrraphy procedure has many choices such as;

- **Argon beam coagulation:** This method is better for bleeding from the spleen capsular tear and non-active bleeding.

- **Suture repair:** This method is used in capsular intact splenic injury. We prefer using the monofilament suture material with pledged buttress to decrease capsular cut through.

- **Partial splenectomy:** Due to the arterial feeder of the spleen is in segmental architecture as described above, if the injured site is well demarcation you can use this method to control bleeding and save the remnant spleen for preserving function. We recommend cutting the spleen along demarcation border then ligate of the arterial feeder and close the raw surface with mattress suture or synthetic mesh wrapping. The study about partial splenectomy usually done in pediatrics group due to concerning of splenic function after splenectomy and the result suggested the partial splenectomy had low morbidity and mortality, but severe complications were also reported. The total splenectomy should not be minimized. The laparoscopic surgery could be used with a good result and low conversion rate.[20]

- **Mesh wrapping:** This method is performed in multiple injuries of the spleen with hemodynamics stability. This technique needs experience of the surgeon and increase the operative time. A serious complication is an erosion of the mesh to an adjacent hollow organ such as the stomach, small bowel and splenic flexor of the colon.[21] We suggest using the biologic mesh wrapping around the whole spleen and fix with monofilament suture around the spleen.

The splenectomy procedure is currently used in high-grade splenic injury (AAST grade IV-V), low-grade splenic injury with instability of hemodynamic, the patient who fails the non-operative management, or multiple injuries patient who need other procedure to save the life.[1, 22] The splenic hilum should be careful identified then individual ligations of splenic artery and vein to prevent late formation of an arteriovenous fistula. The surgeon should beware the tail of pancreas in this step, and we suggest to cut the vessel at least 1 cm away from the visible pancreas. Currently, many hemostasis devices are introduced and have benefit to short operative time and decrease intraoperative blood loss such as Ligasure™ or Harmonic scalpel. V.S. Amirkazem et al. studied compare between conventional splenectomy and Ligasure™ assisted splenectomy, they found Ligasure™ had scientific significantly shorter the operative time and decreased intraoperative blood loses compare to the traditional method.[23] The laparoscopic splenectomy in trauma is increasing use at many centers throughout the US and around the world. The result of this surgery is good and might be safe in the selective patient with a high-experienced surgeon.[24]

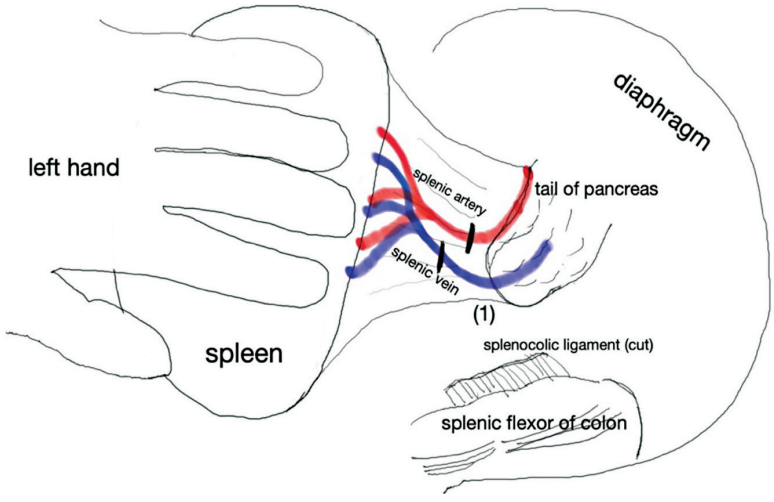

Figure 5 Splenic hilum control; (1) individual ligation of splenic vessels at least 1 cm from the tail of pancreas to prevent pancreatic injury

Many experts suggested to perform the splenic autotransplantation after splenectomy for maintain the splenic function and prevent of post-splenectomy overwhelming infection. Small pieces (usually 2 X 2 cm per piece) of the spleen prepared after splenectomy then wrapping these pieces of spleen with the greater omentum. The neovascular from the omentum will feed the remnant spleen and they will have function lately. There is no current scientific evidence supports this procedure can substitute previous splenic function or prevent of post-splenectomy overwhelming infection.[1, 2, 25]

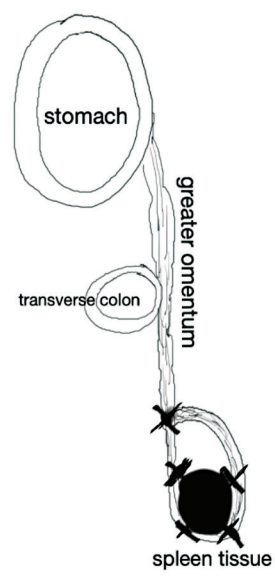

Figure 6 Splenic autotransplantation

The routinely drain placement is not recommended. The surgical drain should place to splenic fossa after splenectomy if the patient has coagulopathy, or concomitant pancreatic or kidney injury and the surgical drain might play an essential role in early detection of the post-operative bleeding and pancreatic injury.[26]

Complications after splenectomy

Delayed post-operative bleeding is a common complication after splenectomy. This complication occurs about 2% after the operation. Common points of bleeding are a short gastric stump, splenic artery and vein stump, splenic fossa, and splenic remnant. This complication may need reoperation if bleeding is massive. Prevention is the best way to decrease this complication. The surgeon must be careful inspection, and use the meticulous hemostasis technique. Some institutes suggest to retain the NG tube at least 48 - 72 hours post-operation to prevent gastric distention that may cause dislodge of the short gastric stump.[1, 4, 27]

The pancreatic injury may occur during splenic mobilization or ligation of splenic hilum vessels.[4] Clinical presentations are abdominal distention, feeding intolerance, abdominal pain, ileus, and ascites. Clinical diagnosis may be delayed due to most injury is involving the tail of the pancreas, that usually less severity. Abdominal fluid or drain fluid amylase level is the diagnostic tool. This type of pancreatic injury mostly spontaneous healed but if persistent leakage, endoscopic treatment is suggested. This condition is less likely need reoperation.[1]

An Arterio-venous fistula is a rare complication but may cause morbidity. This complication occurs during ligation of splenic hilum vessels and happens when the surgeon doesn't perform individual ligation of splenic vessels. Clinical manifestations are abdominal pain, anemia, the left side abdominal bruit, or the right-side heart failure in a severe case. CT angiography or celiac angiography is a diagnostic tool. Embolization with the coil is the treatment of choice.[1, 5, 28]

Thromboembolic complications meant to the portosystemic thrombosis, the caval thrombosis, and the pulmonary embolism. Many studies suggested the mechanism of thrombosis came from the hypercoagulable state, thrombocytosis, or endothelial alteration following asplenic state, and might from ligation of the splenic vein which decrease blood flow of portal system (venous stasis) and leading to thrombosis of the portal vein. Clinical manifestations are persistent abdominal pain following splenectomy, or persistent back pain with fever. The patient may have clinical signs of pulmonary embolism if the thrombus is throwing to the pulmonary artery. Doppler ultrasonography of portal vein and vena cava or CT venography are diagnostic tools, and an anticoagulant drug is the treatment of choice. The complete resolution rate is about 68%, and the partial resolution rate is 13%.[5, 6, 29] We prefer to start unfractionated heparin as soon as possible and bridging to vitamin K antagonist at least 3 - 6 months. Some expert's opinion suggests giving the antiplatelet drug with hydroxyurea in case of thrombocytosis after splenectomy which platelet count more than 1 - 1.5 million/mm^3, but there is no consensus about this treatment option.[6, 28, 29]

Overwhelming post-splenectomy infection (OPSI) is a severe infectious complication following splenectomy. The asplenic patient couldn't combat to encapsulated bacteria such as *Haemophilus Influenza, Streptococcal pneumoniae* and *Neisseria meningitides*, and other pathogens such as *Capnocytophaga canimorsus*, Malaria, and *Bebesia microti*. The post-splenectomy patient has 3 - 5% incidence of OPSI per year with high mortality rate approximate 50 - 70% in some studies. Early given appropriated antibiotics can reduce the mortality rate to 10 - 40%. Effective prevention is early immunization, prophylactic antibiotics, and appropriate patient education.[6, 28, 30]

- **Immunization:** US Centers for Disease Control and Prevention (CDC) recommend giving the vaccine for prevention of OPSI in asplenic patients as soon as possible after splenectomy or within two weeks. The effect of immunization is not good but still better than not being given. The appropriate vaccine should include *S. pneumoniae, H. influenza*, and *N.meningitides* vaccines. After the first dose of vaccine, asplenic patients should be re-vaccinate as in Table 2.

Table 2 CDC vaccine recommendations for asplenic patients[30]

Vaccine	Recommendation
Haemophilus Influenza type b (Hib)	1 dose perioperative splenectomy
Influenza	1 dose annually
Meningococcal 4-valent conjugate (MenACWY) or polysaccharide (MPSV4)	1 dose perioperative splenectomy, re-vaccinate after 5 years with MenACWY
Meningococcal B (MenB)	Series given according to manufacturer recommendation*
Pneumococcal 13-valent conjugate (PCV13)**	1 dose perioperative splenectomy***
Pneumococcal polysaccharide (PPSV23)**	1 dose perioperative splenectomy***, re-vaccinate after 5 years****

* MenB is given as 2-dose series of MenB-4C given at least one month apart or 3-dose series of MenB-FHbp at 0, 2 and 6 months; 2 vaccines are unchangeable; the same preparation given for the complete series.

** At any time, PCV13 should be spaced at least 1 year from last dose of PPSV23; PPSV23 should be spaced 8 weeks from last PCV13 dose.

*** If PCV13 given, PPSV23 should be spaced 8 weeks from last PCV13 dose; if PPSV23 given, PCV13 should be spaced at least 1 year from PPSV23 administration.

**** If most recent PPSV23 was administrate at age <65 years, administer another dose at age > 65 years, given at least 5 years from last dose.

- **Prophylactic antibiotics:** Recommended prophylaxis antibiotics in asplenic patients at age <5 years, Amoxycillin 10 mg/kg twice a day at least two years postoperative or until the age of 5. If the patient had a history of OPSI, HIV infection, immunosuppressant, or advanced liver disease recommended prophylaxis antibiotics until the age of 18 or life long. [1, 5, 30]

Clinical manifestations of OPSI are similarly to flu and flu-like symptoms such as fever, malaise, loss of appetite, nausea and vomiting, abdominal cramp, diarrhea, weight loss and headache. In a severe case, acute pneumonitis, meningitis, and sepsis can occurs. Most of OPSI has rapid progression and can cause mortality within 24 - 48 hours after the onset. The care provider should have a high index of suspicious in the asplenic patient who presents with flu and flu-like symptoms. Intravenous antibiotics, fluid, and in-hospital care should be given immediately. The recommended antibiotics are Vancomycin plus Ceftriaxone or Cefotaxime, or Vancomycin plus Moxifloxacin in the patient with allergy to beta-lactam. In a severe case, ICU administration with inotropic drug and mechanical ventilation may need. Also, IVIG and dexamethasone may be helpful.[30]

Discussion

Splenectomy still plays a significant role in the treatment of splenic injuries. The surgeon should understand to the spleen anatomy and the operation before performing a splenectomy. Also, knowing of complications may help the surgeon to proper care of asplenic patients and reduce the mortality after the surgery.

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บทคัดย่อ

การตัดม้ามสำหรับผู้ป่วยอุบัติเหตุ และภาวะแทรกซ้อนจากการตัดม้าม

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การบาดเจ็บของม้ามพบได้บ่อยเป็นอันดับที่สองของการบาดเจ็บต่ออวัยวะภายในช่องท้องทั้งหมดไม่ว่าจะเกิดจากกลไกใดก็ตาม ในอดีตการตัดม้ามถือว่าเป็นการรักษาหลักของการบาดเจ็บต่อม้ามไม่ว่าจะมีระดับความรุนแรงของการบาดเจ็บมากน้อยเพียงใด ต่อมามีการศึกษาพบอุบัติการณ์การเสียชีวิตของผู้ป่วยที่ได้รับการตัดม้ามจากการติดเชื้อรุนแรงในกระแสโลหิตเพิ่มสูงขึ้น ร่วมกับอัตราความสำเร็จในการรักษาการบาดเจ็บต่อม้ามด้วยวิธีการไม่ผ่าตัดเพิ่มสูงขึ้นเช่นกัน ทำให้ความจำเป็นของการตัดม้ามในผู้ป่วยอุบัติเหตุลดลง อย่างไรก็ดีการตัดม้ามยังคงถือเป็นการรักษาที่สำคัญในกรณีที่ผู้ป่วยไม่เหมาะกับการรักษาด้วยวิธีการไม่ผ่าตัด หรือในกรณีที่ผู้ป่วยมีสัญญาณชีพไม่คงที่จากการเสียเลือดมาก ดังนั้นศัลยแพทย์จึงควรให้ความสำคัญต่อการศึกษาเกี่ยวกับวิธีการตัดม้ามที่ถูกต้องและทราบถึงภาวะแทรกซ้อนที่อาจเกิดขึ้นจากการตัดม้าม เพื่อเตรียมความพร้อมในการดูแลผู้ป่วยอุบัติเหตุช่องท้องได้อย่างเหมาะสมต่อไป

คำสำคัญ: ม้าม, การตัดม้าม, การบาดเจ็บของม้าม, การบาดเจ็บของช่องท้อง, ภาวะแทรกซ้อน