Splenectomy Procedure

2.0 Contact Hours

California Board of Registered Nursing CEP# _16140
American Medical Education Center

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Choose the Single Best Answer for the Following Questions and Place Answers on Form:

1. The spleen is located -
   a. In the right hypochondrium
   b. beneath the 9th-11th ribs on the left side
   c. Just below the pancreas
   d. On the lesser curvature of the stomach

2. The splenic artery comes off the -
   a. Aorta
   b. Hepatic artery
   c. Celiac artery
   d. Renal artery

3. The short gastrics are found in what ligament -
   a. Gastrosplenic
   b. Gastrocolic
   c. Splenorenal
   d. Phrenicocolic

4. You are most likely going to find accessory spleen in what location?
   a. Gastrosplenic ligament
   b. Splenorenal ligament
   c. Gastrocolic ligament
   d. Gastrophrenic ligament

5. You are most likely to see splenic rupture in a patient with -
   a. Lymphoma
   b. Sickle cell anemia
   c. Pneumonia
   d. Heart failure

6. Elective splenectomy is most commonly indicated for -
   a. Idiopathic thrombocytopenic purpura
   b. Thrombotic thrombocytopenic purpura
   c. Sickle cell anemia
   d. Malaria

7. In a patient undergoing elective splenectomy, the patient should be vaccinated against -
   a. Measles and rubella
   b. Mumps
   c. Pneumococcus and H influenza
   d. Diphtheria and chicken pox

8. For open splenectomy, the patient is placed in what position?
   a. Prone
   b. Lateral decubitus
c. Supine
d. Lithotomy

9. In a patient with splenic injury from trauma with extensive bleeding, the surgery technologist should ensure that:
   a. Cell saver is available
   b. A saw is available to open the chest
   c. The patient has received heparin to prevent DVT
   d. An endoscope is available to explore the abdomen

10. For a hematological disorder, the spleen may be removed by making:
    a. A McBurney incision
    b. Left subcostal incision
    c. Median sternotomy incision
    d. Pfannenstiel incision

Title: Splenectomy Procedure

Self Study Module 2.0 CONTACT HOURS

Objectives

At the completion of this program, the learners will:

1. Describe the indications for open splenectomy.
2. List the instruments required for an open splenectomy.
3. Explain how open splenectomy is performed.
4. Discuss early and late complications of splenectomy.
5. Describe the anatomy of the spleen.

Splenectomy is a common surgical procedure. It may be done alone or in combination with other surgery procedures. The two most common reasons for performing splenectomy are 1) trauma and 2) in patients with some type of hematological disorder.¹

The spleen is one of the most frequently injured organs after blunt trauma. In the old days, almost all splenic injuries were treated with surgery. Today, there is good evidence that splenectomy or splenorrhaphy should be reserved for patients who fail conservative management. With the advent of laparoscopic surgery, the need for removal of the injured spleen is even less. The majority of spleens today are removed laparoscopically except in cases of severe splenomegaly or massive bleeding with hemodynamic instability.

Glossary
Accessory spleen is one or more additional spleens that occur in addition to the primary full sized spleen.
Asplenia is a very rare disorder which refers to absence of normal spleen. It may be congenital or acquired.

Autosplenectomy is a term used to describe splenic infarction that occurs in patients with sickle cell anemia.

Hyposplenism is used to describe decreased spleen function.

Hypersplenism is an overactive spleen. The spleen prematurely destroys the red blood cells.

Splenomegaly is used to describe an enlarged spleen, it may be seen in patients with lymphomas, malaria, leukemias and portal hypertension

Splenorrhaphy is a term used to describe surgical repair of spleen.

Splenosis is systemic seeding of splenic tissue in the abdominal cavity and typically occurs after rupture of spleen.

Relevant Anatomy
The spleen is a wedge shaped lymphoid organ located beneath the 9th and 11th ribs along the mid axillary line on the left hypochondrium (figure 1). The spleen abuts the left diaphragm superiorly and on the medial side it is attached to the greater curvature of the stomach by the gastrosplenic ligament. The splenic hilum faces the stomach and contains the splenic vessels and nerves.

Figure 1

The hilum also provides attachments to the splenorenal and gastrosplenic ligaments. The posterior edge of the spleen sits on the upper pole of the left kidney

Blood supply to the spleen is from the splenic artery, which is the largest branch of the celiac artery. The splenic artery travels into the spleen and branches in many arterioles and capillaries. Once the branches enter the spleen, this branches divides into straight vessels called ellipsoids, penicillin, and arterial capillaries. The spleen is extremely vascular and even mild trauma can result in significant loss of blood in the peritoneal cavity.
In addition to the terminal end branches, the splenic artery also gives off tiny branches to the pancreas, several short gastric vessels and the left gastroepiploic artery. The spleen is highly vascular and appears purple-reddish; its weight (150-250 grams) and size do vary but a normal spleen is usually not palpable during a physical exam.

**Spleen Ligaments**

The spleen is surrounded by peritoneum and is stabilized by the following ligaments:

The gastroplenic ligament extends from the hilum of the spleen to the greater curvature of the stomach. This ligament contains short gastric vessels and associated lymphatics and sympathetic nerves. It is vital to ligated this ligament securely because the short gastric vessels are notorious for causing bleeding postoperatively.

The splenorenal ligament extends from the hilum of the spleen to the anterior surface of the left kidney; it contains the tail of the pancreas and splenic vessels. This ligament should be excised close to the spleen otherwise injury to the pancreas can occur. This often presents as leakage of pancreatic fluid.

The phrenicolitic ligament is a thin segment of peritoneal tissue that extends from the splenic flexure of the colon. It traverses superiorly to the diaphragm in the midaxillary line and is responsible for forming the superior end of the left paracolic gutter.

**Visceral Associations**

The visceral surface of the spleen is related to the following organs (figure 2):

- Anterior surface of the left kidney
- Fundus of the stomach
- Splenic flexure of the colon
- Tail of the pancreas

The superior aspect of spleen is related to the diaphragm, which separates the spleen from the pleura and the lung. Thus, when there is an injury to the left diaphragm, one should always suspect injury to the spleen.

**Figure 2**
Venous and Lymphatic Drainage

The splenic vein is responsible for the majority of venous drainage. The relatively large splenic vein is formed at the hilum and runs behind the pancreatic head and then combines with the superior mesenteric vein behind the neck of the pancreas to form the portal vein. It may give off branches to the short gastric, pancreatic, left gastroepiploic and inferior mesenteric veins.

Unlike the lymph nodes, the spleen has no identifiable lymphatics. In rare cases, a few lymphatics may be seen arising from the capsule and these often drain towards the lymph nodes located near the pancreas or the aorta.

Nerve Innervation

Sympathetic innervation to the spleen is from the celiac plexus.

Accessory Spleens

Accessory spleens are natural anatomic variants that develop from nodules that have failed to fuse during development. These accessory spleens may be found in various locations including the:
- Hilum (gastroplenic ligament): most common location
- Splenorenal and gastrocolic ligaments
- Greater omentum
- Mesentery
- Gastrocolic ligament
- Presacral area

In rare cases, accessory spleens have been found in the spermatic cord and broad ligament of the uterus.

**Spleen Physiology**

The chief function of the spleen is to remove defective cells, old red blood cells, and bacteria in the systemic circulation. Moreover, the spleen also helps maintain the normal morphology of red blood cells and removing their nuclei. The spleen also plays a role in the removal of denatured hemoglobin and manufactures opsonins (tuftsin and properdin) needed for phagocytosis.

**Indications for Splenectomy**

The two most common indications for performing open splenectomy in adults are hematological disorders and trauma.

Rupture of the spleen can occur after both penetrating and blunt abdominal trauma. Even though frequently mentioned in the literature, delayed spleen rupture and spontaneous spleen rupture are rare events. Spontaneous spleen rupture may occur in patients with malaria, lymphoma or when high grade spleen injuries are managed non surgically.\(^3,4\)

Trauma patients with high grade spleen injury including multiple lacerations or large subcapsular hematomas should always have blood ready for transfusion and closely observed in an ICU.\(^5\)

Emergent surgery for patients with splenic rupture is indicated when there is 1) hemodynamic compromise, 2) shock, 3) the patient has associated abdominal organ injuries and 4) in those patients who have failed medical management.

Patients with a variety of blood disorders may benefit from splenectomy. An enlarged spleen may be seen in patients with idiopathic thrombocytopenic purpura (ITP), hereditary spherocytosis and thrombotic thrombocytopenic purpura. Of these blood disorders, elective splenectomy is of most benefit in patients with ITP.\(^6\)

Patients with hereditary spherocytosis have red blood cells that get trapped and destroyed in the spleen. Other features of the disorder include jaundice, anemia and enlarged spleen.

Patients with massive splenomegaly due to a hematological disease that causes fullness of the left abdominal cavity and fail to respond to medical therapy may be candidates for splenectomy.

Splenectomy should not be done or delayed until the child is at least 6 years or older to reduce the risk of post splenectomy sepsis.
In rare cases, splenectomy may be required for the enlarged spleen in patients with sickle cell anemia and thalassemia.

Patients with Hodgkin disease who have failed to respond to chemotherapy. The removal of the spleen can help decrease the abdominal fullness, pain and hypersplenism.

Patients with Felty syndrome have a triad of rheumatoid arthritis, splenomegaly, and neutropenia. Splenectomy is sometimes performed in these patients to correct the neutropenia and abdominal fullness.

Rarely, splenectomy may be required for giant cysts, multiple splenic abscess and sarcoidosis.

Once the spleen is removed, the life span of red blood cells returns to normal. The hemolytic jaundice also disappears over the ensuing several months.

**Contraindications**

There are no absolute contraindications to splenectomy. For all elective cases, the patient should be fit for general anesthesia and all coagulopathy must be corrected. Patients with heart disease should be optimized and seen by a cardiologist prior to surgery.

**Preoperative Workup**

Routine work up requires a CBC, electrolytes, coagulation profile, ECG and a chest x-ray. Blood should be cross and typed for all splenectomy cases.

Patients being considered for splenectomy should be optimized prior to surgery. The platelet count must be within the normal range prior to surgery. In some hematological disorders, a dose of corticosteroids may boost the levels of platelets. Individuals who fail to respond to corticosteroids should be administered immunoglobulin.

Autologous donation is another method of preparing the patients for surgery without risking infections and hemorrhage. If the patient has severe splenomegaly and portal hypertension, preoperative splenic artery embolization can also be used preoperatively to reduce risk of hemorrhage.

If splenectomy is to be elective procedure, then the patient should be vaccinated with the hemophilus and pneumococcal vaccine at least 14 days prior to the surgery. This vaccine significantly reduces the risk of post splenectomy sepsis.

If the patient has been on long term steroids or has evidence of adrenal insufficiency, a stress dose of corticosteroids is required. Because splenectomy can result in bleeding, all patients must be adequately hydrated the day before surgery. Two large bore intravenous lines and a central line are placed at the time of surgery.

**Patient Preparation**

Before the incision is made, a foley catheter is inserted. To prevent deep vein thrombosis, the use of ted hose stockings and sequential compression devices is now routine. A single dose of an antibiotic is given within 60 minutes of the skin incision.
The area below the nipples, laterally to the axilla and entire abdomen are prepped.

**Anesthesia**

Splenectomy is always done with the patient under general anesthesia. Because patients who are anesthetized under emergency situations are at very high risk for aspiration, appropriate precautions are necessary. The anesthesiologist will insert a nasogastric or orogastric tube after intubation. This tube may be removed after extubation if there are no complications. If the patient is obese or has not been fasting for more than 6 hours, the anesthesiologist may utilize the rapid sequence induction technique to reduce the risk of aspiration.

**Positioning**

For a open splenectomy, the patient is usually placed supine. The arms may be tucked at the sides or they may be abducted on an arm board at right angles to the body.

**Equipment**

Splenectomy is always done in a dedicated general surgery operating room. Open splenectomy requires a laparotomy set with abdominal retractors and good lighting. The basic equipment needed include:

- Artery forceps
- Abdomen retractor
- Army and navy retractor
- Bowel clamps (atraumatic clamps)
- Drapes, gowns, mask, gloves.
- Electrocautery
- Fibrin glue
- Foley catheter
- High shoe covers are recommended because most of these cases are associated with bleeding and contamination of the peritoneal cavity. Copious irrigation is often done and spillage on the floor is common.
- Kelly clamps
- Lap pads
- Needle holder
- Richardson retractor
- Saline for irrigation
- Scalpel with handle
- Staples
- Sterile specimen containers
- Suction with tubing
- Surgical blade
- Surgicel, fibrin glue
- Sutures- prolene, nylon, vicryl
- Tissue forceps

If there is any suspicion of a vascular injury, than a vascular instrument tray should be available in the room. Similarly, if there is suspicion for rectal, urological or gynecological involvement,
appropriate instruments trays have to be ready, but not opened. If the case involves abdominal trauma with bleeding, a cell saver should be on stand by.

**Technique**

Once the patient is asleep, the surgery is started. The surgeon stands on the patient's right side with the assistant on the opposite side.

The incision to remove a spleen depends on the reason for the surgery and surgeon preference. If the patient has had trauma to the abdomen or is in shock, an upper midline incision provides the ideal exposure for exploration of other abdominal organs. In patients with hematological disorders, some surgeons may elect to make a left subcostal incision, which begins a few centimeters below the xiphoid and extends from the midline to the mid axillary line.

The left subcostal incision allows excellent exposure to the left hypochondrium, diaphragm, pancreas, spleen and stomach. The disadvantage of this incision is that it does not allow for good exposure to the right side and lower pelvic structures.

**Mobilization of Spleen**

Once the abdominal cavity is entered, the abdomen is always manually explored. Following this, attention is paid to the spleen. The spleen is a fragile organ and should be handled with care. The first step is to excise all the avascular ligaments and peritoneal attachments with either metzenbaum scissors or electrocautery.

The gastrosplenic ligaments are vascular and need to be ligated and clipped.

This is then followed by dissection in the hilum where the splenic artery and vein are identified. These vessels are dissected and doubly ligated with a non absorbable suture. Most surgeons also use a suture ligature for safety.

To avoid injury to the pancreas, dissection is usually carried close to the spleen.

Once these maneuvers are completed, the spleen is mobile and the posterior attachments are excised.

After the spleen is removed, hemostasis is obtained in a systemic manner. The greater curvature of the stomach should be evaluated and each short gastric vessel must be looked to ensure that the clip or ligature has not fallen off. The stomach should then be retracted to look at the posterior aspect of the abdomen. All active bleeding must be secured with clips or suture. It is important to ensure that the patient is not hypotensive during this phase. Because low blood pressure may obscure any bleeding vessels.

Whenever splenectomy is being done for a blood disorder, it is important that the surgeon thoroughly explore the abdomen to look for accessory spleens. Accessory spleens need to be removed to prevent recurrence of the idiopathic thrombocytopenic purpura. If the surgeon decides to transfuse the patient with platelets, they should be administered after the splenic artery is ligated.
Partial Splenectomy and Splenorrhaphy

There are some disorders where the surgeon may only perform a partial splenectomy. To prevent bleeding from the excised segment, an omental patch, use of hemostatic device or an argon beam laser device may be used to minimize bleeding.

The technique of splenorrhaphy is frequently used to treat lacerations localized to the edge of the spleen. A common approach to tamponade the bleeding is to use deep horizontal mattress sutures with pledgets. The use of omentum or fibrin glue is commonly used to prevent bleeding from the raw edge of spleen.6

Autotransplantation of the spleen was once done but is no longer recommended. Even though the splenic tissue can survive after reimplantation, the remaining tissue no longer has any immune or phagocytic functions because the architecture and vascularity is often disrupted.

Completion and Closure

Once the splenectomy is performed, the abdominal cavity is thoroughly irrigated with warm water. Complete hemostasis is obtained. The decision to place drains in the peritoneal cavity is a matter of debate. There are no good data to indicate that drains are of benefit. However, people with massive peritoneal contamination or pancreas injury may benefit from a drain. The drain may be placed under the diaphragm to prevent subphrenic abscess, subhepatic space to prevent bile collection or in the pelvic cavity.

After the sponge and instrument counts are correct, the abdominal wound is closed. It is important to have a double count of all instruments and lap pads. In cases where an open splenectomy is done as an emergency, small instruments and gauze have a good chance of being lost. The surgeon should also make an effort to double check the peritoneal cavity for any gauze, pads or instruments and not just rely on the scrub nurse or the surgery technologist.

Time should be spent to ensure that there is complete hemostasis in the area. Once the wound is clean and dry, the abdominal incision is closed by approximating the linea alba with a running 1-0 prolene suture. If a subcostal incision was used, it may be closed with an absorbable 1-0 suture or nylon. The subcutaneous layer may be approximated with a 3-0-vicryl suture. The closure of the skin depends on surgeon preference. Some use staples and others use a 4-0 monocryl suture.

There are times when the abdominal closure may be difficult due to edema or distended bowel loops. In such scenarios, closure of the abdomen can result in excess abdominal pressure, impaired ventilation, dehiscence and pain. There is also a concern for abdominal compartment syndrome. Thus, a delayed closure may be a better alternative. The surgeon may use a mesh to close the abdomen superficially, keep the patient intubated and paralyzed. The patient can then be brought back to the operating room in 24-48 hours. In the ICU, the patient is kept on the dry side to limit the edema.

Post Procedure
In general, patients who undergo splenectomy are ill and having undergone emergent surgery are best monitored in the ICU or a step-down unit at least for the next 12-24 hours. Patients who are critically ill are monitored in the ICU until they are extubated.

**Monitoring**

Trauma patients should be vaccinated in the postoperative period during the hospital stay because they may have unreliable follow-up once discharged. Patients are usually discharged when they can ambulate, tolerate diet and have minimal pain. Splenectomy is often associated with atelectasis and patients should be urged to ambulate and use the incentive spirometer frequently. Ted stockings for prevention of deep vein thrombosis should be continued until the patient is discharged.

**Complications of Procedure**

Splenectomy is a not a benign procedure and injuries to the adjacent organs like the colon, stomach, pancreas and diaphragm can occur.

The early complications after open splenectomy include the following:

- Subphrenic abscess is also a known complication of splenectomy and often difficult to diagnose. A CT scan can be used and large fluid collections require drainage.
- Ileus
- Deep vein thrombosis
- Wound complications
- Seromas
- Bleeding is a very common complication of splenectomy. At least 2-5% of patients have some degree of bleeding in the postoperative period. This has been attributed to poor exposure of the spleen and loose ligatures. These patients often present within the first 12 hours with a distended abdomen and falling hematocrit. A return to the operating room is recommended. To reduce bleeding, preoperative embolization of the splenic artery has been utilized in patients with large spleen. Successful devascularization can occur in the periphery of the spleen and reduces bleeding in the post op period. However, interventional angiography also is expensive, predisposes the patient to inadvertent thrombosis of other vessels, pancreatitis, contrast reactions and groin puncture site complications.
- Respiratory complications of splenectomy include atelectasis, pneumonia and left sided pleural effusions. To avoid these complication, early ambulation and use of the incentive spirometer is encouraged.
- Rare complications of splenectomy include pancreatic injury and pancreatitis.
Late compilations include:

- Splenosis

- Failure to explore the abdomen thoroughly can also result in accessory spleens. If this occurs, ITP remains untreated.

- Overwhelming postsplenectomy infection (OPSI) is the most serious complication of splenectomy. This complication can occur at anytime in the postoperative period and carries a very high mortality. Patients should be advised to seek prompt medical care at the first sign of any fever or respiratory symptoms.⁹

References


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