Laparoscopic Splenectomy Following Embolization for Blunt Trauma

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ABSTRACT

Background: Grade III through V splenic injuries as defined by the American Association for the Surgery of Trauma (AAST) grading scale are associated with hemorrhage and nonoperative failure. Embolization has been reported to reduce splenic bleeding in 50% to 75% of patients with a high-grade injury. However, splenectomy following embolization may be necessary in patients who continue to bleed or develop splenic infarction with abscess formation.

Methods: We present the case of a 15-year-old female who demonstrated a Grade V splenic laceration with moderate hemoperitoneum following an all terrain vehicle crash. Central splenic artery embolization was performed. Because of signs of continued bleeding, laparoscopic splenectomy was performed.

Results: The patient had a satisfactory postoperative result and returned to normal activity in 2 weeks.

Conclusion: Our experience suggests that in cases of high-grade splenic injury or angiographic extravasation associated with moderate to large hemoperitoneum, embolization may serve as a bridge to operative therapy and make laparoscopy a safe, less-invasive option for splenectomy.

Key Words: Laparoscopy, Blunt trauma, Splenectomy, Embolization.

INTRODUCTION

Although laparoscopy has had only limited established applications in trauma surgery, improved equipment and advanced surgical skills have created greater opportunities for surgeons to apply minimally invasive techniques to the management of the injured patient. An acutely injured spleen that causes hemodynamic instability does not lend itself to minimally invasive techniques and requires an open laparotomy to control hemorrhage. However, in the hemodynamically stable patient, nonoperative management has become standard treatment. Angiographic embolization has increased the success rate of nonoperative management in patients at risk for continued or delayed splenic bleeding. But, certain patients are at risk for continued bleeding or delayed hemorrhage even following splenic embolization and may require splenectomy. This case report suggests that an spleen injured from blunt trauma can safely be removed laparoscopically following embolization, and laparoscopy represents an alternative to open laparotomy for patients at risk for continued or delayed hemorrhage.

CASE REPORT

A CT scan obtained on a hemodynamically stable 15-year-old female following an all-terrain vehicle crash demonstrated a Grade V splenic laceration with a moderate hemoperitoneum. Angiography was performed the following day because of a decrease in hemoglobin from 10.5 g/dL to 8.5 g/dL. Only the lower pole of the spleen enhanced with angiography. Vessels supplying the majority of the spleen were truncated and were thought to represent thrombosis or possibly arterial spasm. There was no free extravasation of contrast material. A decision was made to embolize the central splenic artery with a coil because of the potential risk of continued bleeding.

Over the succeeding 24 hours, the patient complained of increasing abdominal pain. Her hemoglobin decreased from 8.5 g/dL to 7.5 g/dL. The patient’s vital signs were stable except for a significant tachycardia of 120 bpm to 140 bpm. The decision was made to perform splenectomy using minimally invasive techniques because of these signs of continued bleeding. The patient was given 2 units...
of packed RBCs before surgery to increase her hemoglobin to a level of 10.5 g/dL.

After laparoscopic splenectomy, the patient’s abdominal pain was much improved and her hemoglobin remained stable. She was discharged on the third postoperative day. At 2-week follow-up, the patient had returned to normal activity.

**Technique of Laparoscopic Splenectomy for Trauma**

The patient was secured on a beanbag with the left side up 60 degrees. This positioning facilitates gravity in retracting intraabdominal organs and increases the working space in the left upper quadrant. The table was tilted to the left to begin the procedure with the patient in a supine position.

After insufflation with a transumbilical Veress needle, 5 ports were used to perform the operation. The first port was sited in the umbilicus to accommodate a 10-mm, 30-degree laparoscope. Five-mm ports were placed in the subxyphoid and left subcostal anterior axillary line positions for retraction and irrigation purposes. Finally, two 10-mm ports were inserted on each side of the umbilical port for the right and left hands of the operating surgeon. After all ports were inserted, the table was tilted to the right to place the patient into a three-quarter right lateral decubitus position. The patient was then brought into a reverse Trendelenburg position to “suspend” the spleen for optimal laparoscopic visualization.

Free blood and clot within the abdominal cavity were removed with irrigation and suction. Blood clot and coagulum on and within the spleen were left in place. To avoid additional bleeding, a subcapsular hematoma was not disturbed. Splenectomy was performed by a standard laparoscopic technique described by Katkhouda. The splenocolic ligament was first taken down from the lower pole of the spleen. The gastroplenic ligament with short gastric vessels was then divided with a Harmonic scalpel, and the splenic hilum (splenorenal ligament with hilar vessels) was secured and divided with several applications of a 35-mm linear stapling device with vascular cartridge. Following division of the hilar structures, the remaining ligamentous attachments, which suspend the spleen (splenophrenic ligament), were divided. The spleen was placed in a nonpermeable plastic bag and morcellated to facilitate its removal from the abdominal cavity.

**DISCUSSION**

The approach to management of splenic injury due to blunt trauma has undergone major changes over the past 25 years. Hemodynamically unstable patients bleeding from splenic injury must be taken immediately to the operating room for urgent laparotomy and splenectomy or splenorrhaphy. Patients whose vital signs are stable should be evaluated for nonoperative management by undergoing a CT scan with IV contrast. Table 1 lists a commonly used spleen injury scale.

Preservation of splenic tissue has become a major objective in the management of splenic trauma to avoid over-

| Grade | Type of Injury | Type of Injury |
|-------|----------------|----------------|
| I     | Hematoma       | Subcapsular, <10% surface area |
|       | Laceration     | Capsular tear, <1-cm parenchymal depth |
| II    | Hematoma       | Subcapsular, 10% to 15% surface area, intraparenchymal, <5 cm |
|       | Laceration     | Capsular tear, 1-cm to 3-cm 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     | Completely shattered spleen |
|       | Vascular       | Hilar vascular injury that devascularizes spleen |
whose vital signs remain stable. Bleeding will subside in closely monitor and observe patients with splenic injury competence is not known. It is possible in many cases to amount of splenic tissue necessary to maintain immune accomplished in certain types of injuries, but the exact preserves splenic tissue and function but also avoids the morbidity attendant with major operative intervention.

Improved CT imaging capability has made it possible to identify certain findings that are associated with a greater risk for continued or delayed splenic hemorrhage. The presence of these markers increases the likelihood that a patient will fail observation and require surgery. CT findings that are associated with splenic hemorrhage include Grade III through V injuries as defined by the American Association for the Surgery of Trauma (AAST) grading scale for splenic injuries. Other findings on CT scan associated with an increased risk of continued bleeding include contrast blush, vascular truncation, aneurysm, or arteriovenous fistula formation. The presence of moderate to large hemoperitoneum (defined as blood around the liver as well as spleen, peri-colic gutters, and pelvis) is also associated with nonoperative failure.

Angiography has been demonstrated to be a useful diagnostic adjunct to further define vascular aberrations associated with splenic bleeding and failed nonoperative management. In addition, interventional angiography provides an opportunity for therapeutic splenic embolization. Embolization has been reported to be effective in controlling splenic bleeding in 50% to 75% of high-risk patients. Consequently, embolization increases the likelihood for success of nonoperative management to greater than 80% for all grades of splenic injury.

Even though embolization significantly decreases the need for splenectomy, 5% to 20% of patients have been reported to continue bleeding following embolization. Smith reported that nonoperative failure following embolization was associated with a high Grade of injury (III at 40%, IV at 38%, and V at 40%), moderate to large associated hemoperitoneum (36%), and extravasation at the time of angiography (59%). When extravasation was associated with a moderate to large hemoperitoneum, the failure rate was 71%. In our experience, 4 of 22 embolized spleens (18%) continued to bleed, requiring a splenorrhaphy in 1 patient and splenectomy in 3. All were Grade IV or V splenic injuries with associated moderate to large hemoperitoneum.

Surgery following embolization has traditionally been performed through open laparotomy as was done in 3 of 4 of our cases. The current case presentation represents our first laparoscopic removal of a bleeding spleen injured from blunt trauma.

Not many case reports exist in the literature of laparoscopic splenectomy following blunt trauma. A few isolated case reports have been published of athletes with stable Grade III injuries undergoing “prophylactic splenectomy” to return to physical activity more quickly. The largest experience of laparoscopic treatment of blunt splenic injuries was reported by Huscher et al. They reported 11 cases, including 6 spleenectomies and 1 partial splenectomy. Of the 11 laparoscopic explorations for splenic injury, only 7 patients had all or part of the spleen removed. The remaining 4 patients had cautery or topical coagulants applied to the injured spleen; no splenic tissue was actually removed. None of the patients in Huscher's series had preoperative embolization. We identified 2 case reports in which embolization was performed before splenectomy for blunt trauma. The earliest case was reported by Poulin et al. A partial splenectomy was performed for an infarcted upper pole following embolization for bleeding from a Grade IV injury. The other embolized patient was 1 of 4 laparoscopic splenectomies reported by Nasr et al. This was a Grade IV injury that underwent initial embolization for vigorous bleeding. Similar to our case report, the patient continued to bleed following embolization and underwent successful laparoscopic splenectomy.

Importantly, concerns for nonoperative management of spleens that demonstrate signs of continued bleeding or for those at risk of re-bleeding are appearing in the trauma literature. These concerns may be particularly relevant in the physically active patient who is susceptible to reinjury of a damaged spleen. The risk of serious morbidity or death from hemorrhage from injured spleens may become greater than that for OPSI. Embolization is a less-invasive alternative to laparotomy and is effective in stopping or retarding splenic bleeding in most cases. Hagiwara et al recently reported successful control of hemorrhage from injured spleens with embolization in patients who demonstrated episodes of hypotension during the initial resuscitation, but responded to fluids. Indeed in cases of high-grade injury or angiographic extravasation associated with moderate to large hemoperitoneum, embolization may serve as a bridge to stabilize patients and allow prepara-
tion for surgical intervention. Our experience suggests that in those patients who continue to bleed following embolization or are at risk for delayed bleed or re-injury, laparoscopic splenectomy may represent a viable alternative to open laparotomy for removal of the injured spleen. The practice of preoperative embolization as an aid to reduce intraoperative bleeding during elective laparoscopic removal of large spleens has been reported to be successful for hematologic/oncologic disease.21,22

CONCLUSION

This case, along with limited reports in the literature, suggests that minimally invasive surgical techniques to remove a spleen for blunt traumatic injury can be performed safely in the hemodynamically stable patient who continues to bleed following embolization. In addition, patients who are at risk for spontaneous rebleed or bleed from re-injury may benefit from preoperative embolization as a bridge to operative therapy, and laparoscopy may be a safe, less invasive option for splenectomy.

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