Latrogenic splenic injury: Prevention and treatment

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Accidental or iatrogenic splenic injury during other abdominal operations is neither infrequent nor inconsequential. Awareness of the hematological and immunological consequences of splenectomy has led to a significant change in surgical philosophy and has resulted in with emphasis on splenic preservation. It is well known that accidental splenectomy leads to significantly higher transfusion requirements, significantly longer mean length of hospital stay and significantly higher prevalence of infectious complications, regardless of the type of operative procedure.1-8 Even more important is the fact that accidental splenectomy is associated with the highest mortality among different indications of splenectomy (Accidental Splenectomy > external trauma > hematological).9,11 All this makes it mandatory on the part of operating surgeon to ensure that there is no iatrogenic splenic injury. This article is a brief review of etiology, technical tips on how to prevent and treat iatrogenic splenic injury.

INCIDENCE

Iatrogenic injury to the spleen is a well known complication of abdominal surgery but the extent of the problem is often under-estimated; which may be due to failure to report splenic injury on the operation note or inaccurate recording of the indication for splenectomy. Splenectomy for iatrogenic injury may be recorded as being part of a radical cancer procedure or to facilitate exposure in procedures for benign lesions.12 Not surprisingly, surgeons have been known to avoid admitting a splenectomy for iatrogenic trauma.13 Iatrogenic splenic trauma has been reported as the cause of 9-40% of all splenectomies.4,14-16 Its reported incidence during different surgical procedures is as follows: gastro-esophageal operations (vagotomy, gastrectomy, trans-hiatal oesophagectomy, anti-reflux procedures) 2-9%, splenic flexure mobilization 1.2-8%, vascular operations (abdominal aortic aneurysm repairs, thoracoabdominal aneurysm repair, left renal artery bypass, and reconstruction of the proximal abdominal aorta and its major branches) 0.5-5%, left nephrectomy 1.4-24%, and bariatric surgery 3%.2,3,5,7,8,16-26 Rarely, spleen gets damaged during drainage of subphrenic abscess, gynecological operations due to traction during omentectomy, left sided thoracocentesis, percutaneous renal biopsy, percutaneous nephrolithotomy and adrenalectomy. An excellent review of various operative procedures leading to iatrogenic splenic trauma has been recently published.12

ETIOLOGY AND MECHANISM OF INJURY TO SPLEEN

The spleen is rather firmly attached in the left upper quadrant by eight ligaments or peritoneal reflections:27

1. Gastro-splenic (containing short gastric blood vessels)
2. Spleno-renal (containing splenic blood vessels)
3. Spleno-phrenic
4. Spleno-colic
5. Pre-splenic folds
6. Pancreatico-splenic
7. Phrenico-colic
8. Pancreatico- colic

(Figure 1)

The spleen may be injured in three ways: Traction, application of retractors or directly by the surgeon’s instruments.12

Traction is the commonest mechanism of injury. Excessive manipulation or unnecessary traction on...
perisplenic peritoneal folds result in tear of splenic capsule and / or pedicle; a fact known courtesy anatomical study of numerous peritoneal attachments of the spleen.\textsuperscript{28,29} As can be expected, spleen is at a high risk for accidental injury during operations performed in the left hypochondrium and improper/ inadvertent traction during mobilization of stomach, omentum and splenic flexure are commonest surgical mistakes leading to avulsion of peritoneal attachments. The use of retractors can also cause injury to the spleen, either directly or indirectly through excessive traction on the abdominal wall.\textsuperscript{18} Direct injury to the spleen by the operating surgeon, although possible, is rarely reported.

Types of injuries
Capsular tears, lacerations, avulsions and subcapsular haematomas are the injuries most frequently encountered; capsular tears being the commonest and the lower pole of the spleen appears to bear the brunt in most cases.\textsuperscript{12} This is not surprising as most injuries are caused by traction on peritoneal attachments to the spleen, which are concentrated at the lower pole.\textsuperscript{15}

RISK FACTORS FOR IATROGENIC SPLENIC TRAUMA

Previous surgery
Understandably, risk of splenic injury is significantly higher if the patient has had previous abdominal surgery, particularly in the left upper quadrant.\textsuperscript{16,29-31} This increased risk is due to the development of dense adhesions in the left upper quadrant of the abdomen. Traction on various structures indirectly causes traction on the splenic capsule, through these adhesions, resulting in splenic injury. Difficult dissection of these adhesions to obtain exposure and to free structures may also result in direct injury to the spleen.\textsuperscript{12}

Type of surgical incision
As expected, poor exposure with a ‘inadequate’ incision is a contributing factor to splenic injury.\textsuperscript{3,13} In the case of a left nephrectomy, the risk of splenic injury is much higher with a transperitoneal compared with an extraperitoneal approach.\textsuperscript{19}

Nature of pathology
Splenetic injury is more likely if the indication for surgery is malignant disease of left kidney, with a large growth on the upper pole.\textsuperscript{19,20} Similarly, mobilization of a densely adhered splenic flexure may give rise to accidental splenic trauma.\textsuperscript{17}

Pathology in the spleen
Most of the spleens removed incidentally are grossly and microscopically unremarkable; and the lacerations result from excessive manipulation rather than any pathological changes predisposing to rupture but splenic pathology can increase the risk of iatrogenic trauma. A large spleen will be a predisposing factor as it will come in way of other procedures and is more likely to be damaged inadvertently. Similarly, splenomegaly as a result of portal hypertension is more likely to get injured; not only due to its size and vascularity but also due to traction/retraction trauma to its various extra-anatomical (e.g. to diaphragm, to retroperitoneum) vascular adhesions. Tendency of congestive/infective splenomegaly to rupture with even insignificant trauma is well known.

Patient characteristics
Obesity, with its attendant inadequate exposure and non-resilient parietal reflections, leads to increased risk of inadvertent splenic trauma.\textsuperscript{32} Increased friability of the spleen secondary to degenerative vascular disease, as well as lack of rib elasticity, leading to over vigorous retraction of the left costal margin, gives rise to increased incidence of iatrogenic splenic injury in elderly patients.\textsuperscript{29,30,33}

PREVENTION

Constant awareness of the problem and continued vigilance based on knowledge of anatomic relationships is the key to prevention of iatrogenic splenic trauma. Additionally, good exposure and adequate visualization are the two cornerstones of neat and clean
surgery. Nowhere are these basics more important than in avoiding inadvertent trauma to spleen.

**Good exposure by appropriate incision**
First and foremost prerequisite for good exposure is the planning of appropriate surgical incision (remember the old aphorism you can do it properly if you can see it properly). An inadequate incision is more likely to result in traction to various splenic folds leading to capsular or hilar tears. Superiority, vis-a-vis, exposure by large left subcostal and bilateral subcostal approach with a T-vertical cephalad extension (Mercedes Benz incision) has been shown over midline incision for left nephrectomy. In the case of a left nephrectomy, using an extraperitoneal approach, where possible, is the best way of reducing splenic injury. It is crucial to remember the aphorism “Pray before surgery, but remember the God will not alter a faulty incision.” (Arthur H. Keeny) and plan an appropriate incision. A ‘re-do’ anti-reflux procedure may be easier and safer via a thoracic approach. Similarly, a thoraco-abdominal incision can be planned, instead of a abdominal incision alone, for a difficult time and consuming left hypochondrium surgical procedure. “Big surgeons make big (correct) incision”, holds true even today in the era of modern surgery.

**Prophylactic division of the splenoperitoneal folds**
Early prophylactic division of the splenoperitoneal folds ensures that there is no untoward traction to various splenic folds. (Figures 2 and 3).

Avoid unnecessary traction near spleen
Traction over spleen when required should be minimized by the well-known technique of keeping a large moist pack behind the spleen. Exercising cautious traction, especially ensuring proper direction of traction in operations in the left hypochondrium is another key to avoid accidental splenic trauma. Medial traction on the lienorenal and lienogastric bands and downward traction on the lienocolic band should be avoided at all costs. The use of metal clips to secure the short gastric vessels during upper gastrointestinal surgery is a safe way of avoiding undue traction on the stomach.

**Optimize visualization**
In an attempt to optimize visualization, while mobilizing splenic flexure of colon, surgeons have positioned the patients in a modified lithotomy position and stood between the legs of the patient. Use of fiber-optic light cable can optimize illumination of the operation field. The superiority of visualization as obtained at laparoscopic surgery is confirmed by significantly lower incidence of splenic injury during laparoscopic surgery as seen in fundoplication.

**Careful use of retractors**
Use of rigid retractors must be avoided in re-operations especially in elderly people, or where there is suspicion of intrinsic splenic abnormality. Judicious and gentle use of self-retaining subcostal and manual retractors goes a long way in avoiding iatrogenic trauma to spleen.

**Splenic flexure mobilization**
Mobilization of the splenic flexure is best performed by the surgeon operating from the right side of the patient with first assistant standing between the patient’s legs, which maximizes his view and ability to assist. A second assistant on the left side of the retracts the wound and the left costal margin. It is for this part of the operation that the incision in the upper part of wound should be adequate.
The first three steps in the mobilization are:

1. Release of omental adhesions to the anterior border of spleen.
2. Release of omental adhesions to the left paracolic gutter at the level of lower pole of spleen.
3. Division of peritoneum between the colon and the lower border of spleen.

These three manoeuvres release the spleen and effectively prevent traction injury to splenic capsule.

It is important not to pull down on the descending colon because this can result in splenic injury; instead the thrust of dissection is upwards towards the splenic flexure. One must remember that the spleno-colic ligament is often quite thick and may require division between clamps and transfixing suture ligation. Corman suggests putting only one clamp on the splenic side to avoid tearing the splenic capsule; and dividing the spleno-colic ligament on the flexure side. If the splenic flexure is difficult to expose, it is helpful to enter the lesser sac in the midline and approach the spleno-colic ligament from both the sides: along the left transverse colon from within the lesser sac and along the descending colon in the retroperitoneum.

Constant awareness of the continued prevalence of this operative complication and the mechanisms by which it is produced has enabled surgeons to lessen its frequency and potential sequelae.\textsuperscript{15}

**Laparoscopic surgery and iatrogenic splenic injuries**

Laparoscopic surgery, with all of its modern technology, is no panacea and has its share of iatrogenic splenic injuries during various procedures like laparoscopic nephrectomy, fundoplication, adrenalectomy etc.\textsuperscript{43-46} The reasons are same as in conventional surgery e.g. traction injuries of splenic ligaments and adhesions and very rarely direct trocar injuries. Rarely, even a simple diagnostic laparoscopy and induction of pneumoperitoneum can result in tearing away of delicate peritoneal reflections or small adhesions on the splenic capsule leading to sudden rupture and hemorrhage.\textsuperscript{47} But, by and large, superior visualization obtained at laparoscopic surgery should also result in a decrease in the incidence of iatrogenic splenic injuries. Another advantage is that an experienced laparoscopic surgeon can identify and repair the injury intra-operatively, laparoscopically, minimizing patient morbidity postoperatively.\textsuperscript{48}

**TREATMENT OF IATROGENIC SPLENIC TRAUMA**

An unexplained pool of blood in the left hypochondrium should alert the surgeon to the possibility of iatrogenic splenic trauma. Immediate dissection and delivery of the spleen from its subdiaphragmatic position is the first step, thus avoiding further iatrogenic injuries, which can readily occur in such an emergency situation.\textsuperscript{49,50} (Figures 5 and 6). The hilus is then clamped with a non-crushing vascular or intestinal clamp, which avoids blood loss during the examination of severity of trauma. Good visualization of the trauma site can be obtained by complete removal of clot by gentle irrigation. The methods used for the repair are well known and depend...
on the grade of the injury. Clearly, the more extensive the injury to the spleen the more difficult it is to preserve. Post-operatively radiocolloid spleen scan for assessment of function and healing may be done but is not required for grade I-III as there are no late failures of repair. Close to 75% of all accidentally injured spleens can be safely salvaged. If the splenic injury is promptly recognized and managed properly, then the outcome is not adversely affected by such a mishap. A careful examination of spleen at the end of operative procedure should be done to insure that an inadvertent injury is not missed on table. However, when missed on table, some cases require reoperation for control of continued bleeding from unrecognized iatrogenic splenic trauma. More than expected blood from the drain and/or unexpected hypotension in the post-operative period should alert the surgeon to this problem.

**Contraindications to salvaging accidentally injured spleen**

Contraindications to salvaging accidentally injured spleen are preexisting splenic disease, subject on anticoagulants (vascular operations), labile blood pressure, multiple intra-abdominal lesions, presence of intra-peritoneal infection, age over 70 years. Lack of post-operative monitoring facilities makes the splenic conservation difficult and possibly even dangerous. In some patients, irreparably injured organ or instability of the patient’s condition may demand prompt splenectomy rather than spending time on futile efforts for splenic conservation with its attendant risk of excessive blood loss.

**REFERENCES**


**Table 1: Grade of injury based protocol [20]**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Operation Description</th>
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<tbody>
<tr>
<td>I</td>
<td>Haemostatic agents alone (Fibrin glue, resorbable collagen platelets, resorbable gauze)</td>
</tr>
<tr>
<td>II</td>
<td>Haemostatic agents, or splenorrhaphy/omentoplasty or mesh enclosure</td>
</tr>
<tr>
<td>III</td>
<td>Splenorrhaphy/mesh enclosure</td>
</tr>
<tr>
<td>IV</td>
<td>Anatomic splenic resection, ligation of main/polar segmental arteries, subtotal splenectomy</td>
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<tr>
<td>V</td>
<td>Intra-omental auto transplantation/Splenectomy</td>
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**Figure 6: Dissection and delivery of the spleen from its subdiaphragmatic position by blunt finger dissection posterior to pancreas allowing the spleen to be rotated in to operative wound for inspection**

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