

**ORIGINAL RESEARCH**

# A new technique to control bleeding from splenic injuries while splenic flexure mobilization during abdominal surgeries

Dr. Vaishali Jain<sup>1</sup>, Dr. Charmi Patidar<sup>2</sup>, Dr. Akshay Jain<sup>3</sup>, Dr. Mayank Pancholi<sup>4</sup><sup>1</sup>Assistant Professor, Department of General Surgery, Amaltas Institute of Medical Science Ujjain, Madhya Pradesh, India<sup>2</sup>Assistant Professor, Department of General Surgery, R.D. Gardi Medical College, Ujjain, Madhya Pradesh, India<sup>3</sup>Assistant Professor, Department of Orthopedics, R.D. Gardi Medical College, Ujjain, Madhya Pradesh, India<sup>4</sup>HOD & Professor, Department of General Surgery, Sri Aurbindo Institute of Medical Sciences, Ujjain, Madhya Pradesh, India**Correspondent Author**

Dr. Charmi Patidar

Assistant Professor, Department of General Surgery, R.D. Gardi Medical College, Ujjain, Madhya Pradesh, India

Received: 20 March, 2024

Accepted: 24 April, 2024

**ABSTRACT****Aim:** The aim of this study is to achieve haemostasis in splenic injury caused during abdominal surgeries secondary to misplaced traction and tension on the spleen while splenic flexure mobilization through this technique in order to avoid splenectomy and direct splenic suturing (due to friability of spleen).**Materials And Methods:** This is a retrospective study undertaken on the patients undergoing abdominal surgeries where bleeding from lacerations (splenic capsule and parenchymal tears) in the spleen during colonic mobilization was near totally stopped using this technique. The final outcome was then analysed in detail.**Results:** Using this technique, near total haemostasis was achieved in all the patients having splenic capsular and parenchymal tears while mobilisation of splenic flexure during abdominal surgeries.**Conclusion:** This technique was easy to perform and done in very short time. It gives us mean observation time of 45 minutes (while the primary procedure is been performed and completed) to check the achievement of haemostasis. In every case it has proved to be successful in achieving near total haemostasis immediately.

---

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution- Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

---

**INTRODUCTION****INCIDENCE**

Iatrogenic injury to the spleen is a common 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.<sup>12</sup> Iatrogenic splenic trauma has been reported as the cause of 9-40% of all splenectomies.<sup>4,14-16</sup>

**Incidence of iatrogenic splenic injury during different surgical procedures are as follows**

- Gastro-oesophageal operations (vagotomy, gastrectomy, trans-hiatal oesophagectomy, anti-reflux procedures) 2-9%,

- Splenic flexure mobilization 2-8%<sup>1</sup>,
- 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%<sup>2,3,5,7,8,16-26</sup>

Rarely, spleen gets damaged during drainage of subphrenic abscess, gynaecological operations due to traction during omentectomy, left sided thoracocentesis, percutaneous renal biopsy, percutaneous nephrolithotomy and adrenalectomy.

**SPLEENIC FLEXURE MOBILISATION**

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.<sup>34</sup> 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.

**TECHNIQUE OF ACHIEVING HAEMOSTASIS IN SPLEENIC INJURY**

While mobilising the splenic flexure of the colon during abdominal surgeries, spleen may get injured in the form of lacerations which may range from splenic capsular tear on the tip to up to variable degree of parenchymal transaction from which continuous oozing occurs. In order to achieve haemostasis due to such injuries this easy technique can be applied immediately in which, two similar adjacent sutures, using silk round bodied, are applied, of which one bite is taken on to the diaphragmatic peritoneum lying just above the splenic injury and another bite is taken on to the peripancreatic tissue. A hygroscopic material such as Abgel is placed over the splenic wound. The two ends of the suture are then tied and tightened in a manner such that the diaphragmatic peritoneum gets approximated to the

peripancreatic tissue causing pressure over the bleeding wound of the spleen, against the chest wall resulting in haemostasis, called the splenic tamponade. This procedure is done immediately as the injury occurs, in between the primary procedure, so that by the time the primary surgery gets completed, we can assess the achievement of haemostasis from the splenic wound by splenic tamponade. We get the mean observation time of about 45 minutes.

**MATERIALS AND METHODS**

It is a retrospective study of cases of abdominal surgeries operated by a single surgeon in the years from 2013 to 2018 where the bleeding from splenic injuries occurring while mobilization of the splenic flexure of the colon during abdominal surgeries was controlled near totally with this new technique.

Total four patients had splenic injury, all of them occurred during left colonic flexure mobilisation while performing abdominal surgeries.

The size of splenic injury was in the form of lacerations ranging from simple splenic capsular tear to up to variable degree of parenchymal transaction.

The mean observation time after applying this technique was 45 minutes which was the time required to perform and complete the primary abdominal procedure.

**INCLUSION CRITERIA**

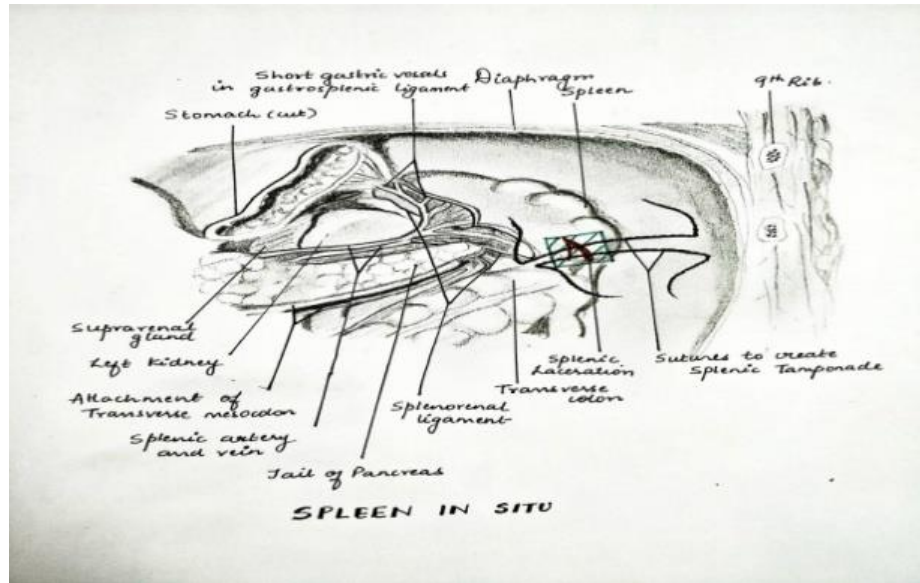
- Partial splenic polar lacerations and tears.
- Hemodynamic stability of the patient.
- Absence of intraperitoneal infection.

**EXCLUSION CRITERIA**

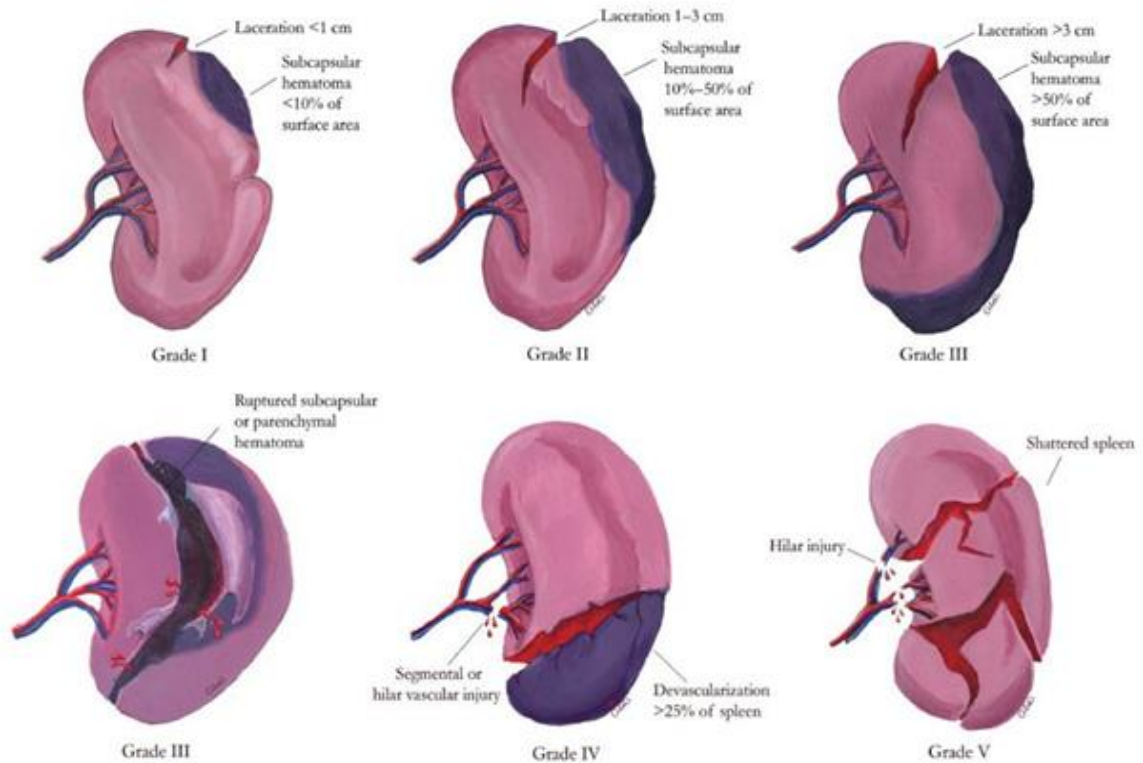
- Major splenic injury i.e. Hilar injury/complete transaction.
- Pre-existing splenic disease.
- Hemodynamic instability of the patient.
- Presence of intraperitoneal infection.
- Multiple intra-abdominal lesions.

**RESULTS**

Using this technique, near total haemostasis was achieved in all the patients omitting the need of suturing (due to friability of spleen) and splenectomy having splenic capsular and parenchymal tears while mobilisation of splenic flexure during abdominal surgeries.



I	Haematoma Laceration	Subcapsular, <10% surface area Capsular, <1cm parenchymal depth
II	Haematoma Laceration	Subcapsular, 10%-50% surface area; intraparenchymal, <5cm in diameter Capsular tear, 1-3cm parenchymal depth that does not involve a trabecular vessel
III	Haematoma Laceration	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal haematoma; intraparenchymal haematoma ≥5cm or expanding >3cm parenchymal depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularisation (>25% of spleen)
V	Hematoma Laceration	Completely shattered spleen Hilar vascular injury devascularizes spleen



**ASST Spleen Injury Scale**

- **PROTOCOL BASED ON TYPE OF INJURY [20]**

Grade II	Haemostatic agents, or splenorrhaphy/ omentoplasty or mesh enclosure
Grade III	Splenorrhaphy/mesh enclosure
Grade IV	Anatomic splenic resection, ligation of main/ polar segmental arteries, subtotal splenectomy
Grade V	Intra-omental auto transplantation/Splenectomy

**DISCUSSION****MECHANISM OF INJURY TO SPLEEN**

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

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

Splenic injury may occur in following ways: Traction, application of retractors or directly by the surgeon's instruments.<sup>12</sup> Traction is the commonest mechanism of injury. Excessive manipulation of perisplenic peritoneal folds result in tear of splenic capsule and / or pedicle. Spleen is at a high risk for accidental injury during operations performed in the left hypochondrium and 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.<sup>18</sup> 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 at the lower pole of spleen while mobilising splenic flexure of colon. Most injuries are caused by traction on peritoneal attachments at the lower pole.

- **ASST SPLEEN INJURY SCALE**
- **SPLENIC INJURIES AND THEIR MANagements**

Of 13 897 colectomies, we identified 59 splenic injuries (0.42%). Of these, 33 (56%) were in men; there was a median age of 68 years (range, 30-93 years) and a median body mass index of 25.5 (range, 15-54). Most splenic injuries had splenic flexure mobilization (90%) and 6 (10%) occurred without splenic flexure mobilization. Thirty seven injuries (63%) occurred during elective surgery, and 5 (8.4%) occurred during minimally invasive surgery.<sup>3</sup>

Injury was successfully managed by primary repair in 10 (17%), splenorrhaphy in 4 (7%), and splenectomy in 45 cases (76%). Four injuries (7%) were unrecognized and resulted in reoperation and splenectomy. Multiple attempts at splenic salvage were performed in 30 (51%); of these, 21 (70%) required splenectomy. More than 2 attempts at salvage was associated with splenectomy (P=.03). The 30-day major morbidity and mortality rates were 34% and 17%, respectively.<sup>36</sup> The need for managing splenic injuries should never be underestimated. As neglecting splenic injuries may lead to the need of re-operations and eventually may lead to the need of partial or total splenectomies. This technique of achieving haemostasis by splenic tamponade is a very easy, less time consuming, less resourceful and reversible technique doing the necessary job of controlling bleeding from splenic wounds near totally. Above all this minor procedure gives us the time for observation by which we can check the haemostasis before closing the abdomen after completing the primary procedure (mean observation time of 45 minutes).

**FACTORS PREDISPOSING TO IATROGENIC SPLENIC TRAUMA****1. INADEQUATE INCISION LEADING TO POOR EXPOSURE**

Poor exposure with a 'inadequate' incision is a contributing factor to splenic injury.<sup>3,13</sup> In the case of a left nephrectomy, the risk of splenic injury is much higher with a transperitoneal compared with an extraperitoneal approach.<sup>19</sup>

**2. INDICATION FOR SURGERY**

Splenic injury is more likely if the indication for surgery is malignant disease of left kidney, with a large growth on the upper pole.<sup>19,20</sup> Similarly, mobilization of a densely adhered splenic flexure may give rise to accidental splenic trauma.<sup>17</sup>

**3. ADHESIONS**

Risk of splenic injury is significantly higher if the patient has had previous abdominal surgery, particularly in the left upper quadrant.<sup>16,29-31</sup> 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.<sup>12</sup>

#### 4. SPLENOMEGALY DUE TO ANY CAUSE

Excessive manipulation causes splenic lacerations rather than splenic pathology but, splenic pathology does contribute in iatrogenic splenic injury. For example a large spleen will be a contributing factor as it will come in way of other procedures and is more likely to be damaged. 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 (e.g. to diaphragm, to retroperitoneum) vascular adhesions. Tendency of congestive/infective splenomegaly to rupture with even insignificant trauma is well known.

#### 5. MORBID OBESITY AND DISEASES

Obesity, with its attendant inadequate exposure and non-resilient parietal reflections, leads to increased risk of inadvertent splenic trauma.<sup>32</sup> 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.<sup>29,30,33</sup>

#### PREVENTION

##### APPROPRIATE INCISION

An inadequate incision is more likely to result in traction to various splenic folds leading to capsular or hilar tears.<sup>3</sup> 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.

##### OPTIMUM VISULISATION

Surgeons have positioned the patients in a modified lithotomy position and stood between the legs of the patient in an attempt to optimize visualization, while mobilizing splenic flexure of colon.<sup>17</sup> Use of fiber-optic light cable can optimize illumination of the operation field

##### AVOID UNNECCESARY TRACTION

By ensuring proper direction of traction in operations in the left hypochondrium accidental splenic trauma can be avoided.

By keeping a large moist pack behind the spleen, traction over spleen when required should be minimized.<sup>32</sup>

Medial traction on the spleno-omental and spleno-gastric bands and downward traction on the spleno-colic band should be avoided.<sup>37</sup>

#### CONTROLLED USE OF CORRECT RETRACTORS

Judicious and gentle use of self-retaining subcostal and manual retractors should be done to avoid iatrogenic trauma to spleen.<sup>5,8</sup>

Use of rigid retractors must be avoided in re-operations especially in elderly people, or where there is suspicion of intrinsic splenic abnormality.<sup>18,33</sup>

#### CONCLUSION

This technique was easy to perform and done in very short time. It gives us mean observation time of 45 minutes (while the primary procedure is been performed and completed) to check the achievement of haemostasis. In every case it has proved to be successful in achieving near total haemostasis immediately. Benefit of this technique is that it omits the need of splenic suturing which is difficult and often unsuccessful due to friability of the splenic tissue. Also haemostasis is achieved at once so splenectomy is not required which itself turns out to be major procedure. Besides being easy this procedure is less time consuming, less resourceful and reversible without causing any damage to the vital tissues, as removing the sutures at any desired point would undo the procedure.

#### REFERENCES

- Roy M, Geller JS. Increased morbidity of iatrogenic splenectomy. *Surg Gynecol Obstet* 1974;139:392-4.
- Walstad PM. Operative trauma to the spleen: Incidence, morbidity and mortality. *Am Surg* 1974;40:586-90.
- Danforth DN Jr, Thorbjarnarson B. Incidental splenectomy: A review of the literature and the New York Hospital experience. *Ann Surg* 1976;183:124-9.
- Morgenstern L. The avoidable complications of splenectomy. *Surg Gynecol Obstet* 1977;145:525-8.
- Rogers DM, Herrington JL Jr, Morton C. Incidental splenectomy associated with Nissen fundoplication. *Ann Surg* 1980;191:153-6
- Pate JW, Peters TG, Andrews CR. Postsplenectomy complications. *Am Surg* 1985;51:437-41.
- Konstadoulakis MM, Kymionis GD, Leandros E, Ricaniadis N, Manouras A, Krespis E, et al. Long term effect of splenectomy on patients operated on for cancer of the left colon: A retrospective study. *Eur J Surg* 1999;165:583-7.
- Eaton MA, Valentine J, Jackson MR, Modrall G, Clagett P. Incidental splenic injury during abdominal vascular surgery: A case-controlled analysis. *J Am Coll Surg* 2000;190:58-64.
- Colheart G, Little JM. Splenectomy: A review of morbidity. *Aust N Z J Surg* 1976;46:32-6.
- Fabri PJ, Metz EN, Nick WV, Zollinger RM. A quarter century with splenectomy. Changing concepts. *Arch Surg* 1974;108:569-75
- Fujita T, Matai K, Kohno S, Itsubo K. Impact of splenectomy on circulating immunoglobulin levels and the development of postoperative infection following total gastrectomy for gastric cancer. *Br J Surg* 1996;83:1776-8.
- Cassar K, Munro A. Iatrogenic splenic injury. *J R Coll Surg Edinb.* 2002;47:731-41.

13. Rich NM, Lindner HH, Mathewson C Jr. Splenectomy incidental to iatrogenic trauma. *Am J Surg* 1965;110:209-15.
14. Rose AT, Newman MI, Debelak J, Pinson CW, Morris JA Jr, Harley DD, et al. The incidence of splenectomy is decreasing: Lessons learned from trauma experience. *Am Surg* 2000;66:481-6.
15. Hugh TB, Coleman MJ, Cohen A. Splenic protection in left upper quadrant operations. *Aust N Z J Surg* 1986;56:925-8
16. Coon WW. Iatrogenic splenic injury. *Am J Surg* 1990;159:585-8.
17. Langevin JM, Rothenberger DA, Goldberg SM. Accidental splenic injury during surgical treatment of the colon and rectum. *Surg Gynecol Obstet* 1984;159:139-44.
18. Peters TG, Steinmetz SR, Cowan GS Jr. Splenic injury and repair during bariatric surgical procedures. *South Med J* 1990;83:166-9.
19. Cooper CS, Cohen MB, Donovan JF Jr. Splenectomy complicating left nephrectomy. *J Urol* 1996;155:30-6.
20. Mejean A, Vogt B, Quazza JE, Chretien Y, Dufour B. Mortality and morbidity after nephrectomy for renal cell carcinoma using a transperitoneal anterior subcostal incision. *Eur Urol* 1999;36:298-302.
21. Klaupe P, Eckert P, Kern E. Incidental splenectomy: Early and late postoperative complications. *Am J Surg* 1979;138:296-300.
22. Peck DA, Jackson FC. Splenectomy after surgical trauma. *Arch Surg* 1964; 89:54-64.
23. Orringer MB, Marshall B, Iannettoni MD. Transhiatal esophagectomy: Clinical experience and refinements. *Ann Surg* 1999;230:392-403.
24. Katariya K, Harvey JC, Pina E, Beattie EJ. Complications of transhiatal esophagectomy. *J Surg Oncol* 1994;57:157-63.
25. Polk HC. Fundoplication for reflux esophagitis: Misadventures with the operation of choice. *Ann Surg* 1976;183:645-52
26. Reilly LM, Ramos TK, Murray SP, Cheng SWK, Stoney RJ. Optimal exposure of the proximal abdominal aorta: A critical appraisal of transabdominal medial visceral rotation. *J Vasc Surg* 1994;19:375-90.
27. Skandalakis PN, Colborn GL, Skandalakis LJ, Richardson DD, Mitchell WE, Skandalakis JE. The surgical anatomy of the spleen. *Surg Clin North Am* 1993;73:747-68.
28. Lord MD, Gourevitch A. The peritoneal anatomy of the spleen with special reference to the operation of partial gastrectomy. *Br J Surg* 1965;52:202-4.
29. Tocchi A, Fornasari V, Puma F, Di Giorgio A. Embryologic and anatomic-surgical presuppositions in intraoperative injuries of the spleen. A clinical study. *Minerva Chir.* 1989;44:937-42. [Article in Italian]
30. Devlin HB, Evans DS, Birkhead JS. The incidence and morbidity of accidental injury to the spleen occurring during abdominal surgery. *Br J Surg* 1969;56:446-8
31. Ferraris VA, Sube J. Retrospective study of the surgical management of reflux esophagitis. *Surg Gynecol Obstet* 1981;152:17-21.
32. Lieberman RC, Welch C. A study of 248 instances of traumatic rupture of the spleen. *Surg Gynecol Obstet* 1968;127:961-5.
33. Cioffiro W, Schein CJ, Gliedman ML. Splenic injury during abdominal surgery. *Arch Surg* 1976;111:167-71.
34. Corman ML. Carcinoma of colon. In *Colon and Rectal Surgery*. Philadelphia: JB Lippincott Company 1993;3:487-595.
35. Gill IS, Kavoussi LR, Clayman RV, Ehrlich R, Evans R, Fuchs G, et al. Complications of laparoscopic nephrectomy in 185 patients: A multi-institutional review. *J Urol* 1995;154:479-83.
36. [archsurj.jamanetwork.com/pdfaccess.ashx?url=/data/journals/surg/9772/ on 06/18/2017](https://archsurj.jamanetwork.com/pdfaccess.ashx?url=/data/journals/surg/9772/ on 06/18/2017)