



Laparoscopic splenectomy advantages over open surgery

Majid Safarpanah (MD)^{1*}, Mehran Hiradfar (MD)²

¹Department of General Surgery, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

²Department of Pediatric Surgery, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

ARTICLE INFO

Article type

Review article

Article history

Received: 13 Mar 2014

Revised: 18 Apr 2014

Accepted: 30 Apr 2014

Keywords

Laparoscopy

Spleen

Splenectomy

Surgery

ABSTRACT

In recent years, laparoscopy has become a popular surgical method. Laparoscopy is a minimally invasive surgery, which results in minor traumas in comparison with conventional open surgeries. There are several risk factors associated with laparoscopy based on the involved organ and the patient's general situations. Due to the improvements of clinical approaches, laparoscopic splenectomy has been known as a gold standard method for spleen removal as a result of various diseases, such as ITP. The human spleen plays a key immunologic role in defense against a number of organisms, particularly encapsulated bacteria. The spleen can cause significant morbidity and/or hematologic disturbance if it becomes hyperfunction (hypersplenism) or hypertrophied (splenomegaly). Laparoscopic surgery for cancer is also an appropriate procedure if good tissue handling techniques are maintained. In this study, we attempted to review the results obtained from recent articles about the beneficial features of the laparoscopic splenectomy in comparison with conventional open surgery.

Please cite this paper as:

Safarpanah M, Hiradfar M. Laparoscopic splenectomy advantages over open surgery. Rev Clin Med. 2015;2 (1):19-23.

Introduction

Laparoscopic surgery

Laparoscopic surgery is a noteworthy diagnostic and therapeutic surgical procedure, which is proposed as the gold standard method since the first successful laparoscopic cholecystectomy in 1987. Laparoscopy is among minimal access techniques, reduces the traumas resulted from the surgical interventions and reveals considerable therapeutic outcomes. Various advantages of this method over the conventional open surgeries have led to the worldwide popularity of this procedure for treating numerous organs. Small incision is the major benefit of laparoscopy, which results in lower pain and recovery time, and small post-operative scars. Reduced hemorrhage, early mobilization of the patients, lower hospital

staying, and minimal exposure of internal organ which reduce the risk of various infections, are other considerable features of laparoscopy (1).

These days, due to significant improvements in performance of laparoscopy, it is used for different indications including cholecystectomy, appendectomy, vagotomy, nephrectomy, herniorrhaphy, hysterectomy, ovarian cystectomy, pancreaticoduodenectomy, rectopexy, and etc (2).

Different risk factors might adversely affect the laparoscopic operation and outcomes based on the type of laparoscopy and the involved organ.

Major complications of each laparoscopic operation can be studied in different groups including peritoneum access complexity, complications following pneumoperitoneum, and the complications of the procedure.

***Corresponding author:** Majid Safarpanah.

Department of General Surgery, Imam Reza Hospital, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

E-mail: majestic_1257@yahoo.com

Tel: 09355283328

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Pneumoperitoneum

Because of the requirement for adequate visualization to increase the possibility of enhanced performance and organ manipulating during the surgery, pneumoperitoneum is necessary in every laparoscopic surgery. Creation of pneumoperitoneum using carbon dioxide (CO₂) is one of the major aspects of the surgery that might lead to the various physiological complications. The creation of pneumoperitoneum results in increased pressure of the intra-abdominal, raised diaphragm, downturned functional residual capacity (FRC), and the induced hypoxemia which might lead to pulmonary changes and should be managed during the surgery (3). Reported cardiovascular changes include elevated the systemic vascular resistance, arterial and central venous pressures, decreasing the venous return, and cardiac index (4).

Based on studies, various cardiovascular and cardiopulmonary changes occur during the laparoscopy which might be the consequences of patient position, CO₂ absorption, ventilation, and operation times and method (5).

It has been recommended that additional pre-operative considerations should be undertaken in patients who are pregnant, obese, or those with previous operations or cardiopulmonary problems.

Splenomegaly

Splenomegaly is a disease condition resulted from different factors and disorders including infections (infectious mononucleosis, viral hepatitis, septicemia, typhoid, cytomegalovirus, toxoplasmosis, tuberculosis, HIV, leishmaniasis, malaria), hematological conditions (myelofibrosis, chronic myeloid leukemia, lymphoma, leukemia, congenital causes), inflammations and malignancies and etc. The etiology of splenomegaly is different between developing and developed countries. The definitions of the splenomegaly varies according to every article but majorly, spleens more than 1.5kg weight or 10 times larger than normal size are proposed as splenomegaly, however, the exact size of the spleen is hard to be assessed (6). Before deciding for splenectomy, the occurrence of splenomegaly should be accurately diagnosed based on the patients' clinical features, different experiments, and splenic biopsy.

Computed tomography scans and ultrasound procedures are helpful in providing the more accurate evaluation of the spleen size for massive splenomegaly.

Splenectomy

Splenectomy is a diagnostic and therapeutic method, which can be used for removing the defected spleen. The occurrence of spleen failures

might be resulted conditions such as refractory, relapse, or chronic diseases, which have failed pharmacotherapy responses or other treatments. Hemolytic anemias, hemolytic purpuras, secondary hypersplenism, and other primary hematologic disorders might lead to the spleen damages and eventually complete splenectomy (7).

Splenectomy in patients with hematologic disorders has been previously reported as a procedure with post-operative morbidity and mortality risk of almost 52% and 9%, respectively. Septic complications were proposed as the major causes of post-splenectomy mortality. The frequency of post-operative complications had been suggested to be higher in patients with spleen larger than 2000 gr (8). Due to the lower prevalence of spleen disorders which need splenectomy surgery it is not easy to perform clinical trials. In various studies, the properties and benefits of open splenectomy have been compared with laparoscopic method. The extraction of the spleen is a complex issue, which led to various controversies about the suitability of laparoscopy for this purpose. According to studies, splenectomy might reveal some major therapeutic efficacies (reversing the cytopenia associated with hypersplenism) in addition to diagnostic benefits (9).

Laparoscopic splenectomy

The first laparoscopic splenectomy was achieved successfully in 1991 by Delaitre et al. which increased the prevalence of using this method in comparison with conventional open surgeries (10). Previously, splenomegaly was known as the contraindication of laparoscopic splenectomy. In recent years, due to significant improvements of the clinical procedures, laparoscopy has shown outstanding achievements in splenectomy of patients with splenomegaly (11,12).

Idiopathic thrombocytopenic purpura (ITP) not assisted with splenomegaly and patients who are young with normal spleen size are the major indications of laparoscopic splenectomy. Based on some studies about the methods used for the treatment of idiopathic thrombocytopenic purpura (ITP), the laparoscopic splenectomy has been proposed as the gold standard method compared to the open splenectomy. In one study on the ITP, the preference of laparoscopy was independent from parameters including patient's age, sex, comorbidity, and the size of the spleen. Short hospitalization after the laparoscopy and more quick mobilization of the patients were reported as the major advantages of laparoscopy in ITP patients. In another study, patients' age and spleen size were considered as the prognostic parameters of the laparo-

scopic results (9,13,14).

Enlarged spleens or massive splenomegaly need more sophisticated methods for splenectomy. Targarona et al. evaluated the effect of spleen size on post-operative outcomes of laparoscopy and open surgery. In this regard, the preoperative pneumococcal vaccine and antibiotic prophylaxis reduced the risk of different possible infections. It is proposed by Targarona et al. that spleens close to anterior iliac spine or those which surpass the midline, are suitable cases for open surgery, but patients with mobile inferior splenic pole and a distensible abdomen are acceptable cases for the laparoscopic method (15).

Results obtained by another study suggested that laparoscopic splenectomy reveals similar results regarding the post-operative morbidity, hospitalization, and the transfusion requirement rate in patients with larger spleens compared with those with normal size spleen (16).

Although laparoscopy revealed higher efficacy over the open surgery regarding the splenectomy of patients with hematological diseases with normal or relatively large spleens, controversial and inconsistent results have been obtained based on different studies about the efficacy of laparoscopy in massive splenomegaly (over than 1000 grams in weight) (17). One study revealed almost 33% morbidity rate during massive laparoscopic splenectomy and proposed the spleen

size as the significant prognostic variable of morbidity and conversion rate to open surgery. Due to the reduced abdominal size in patients with massive splenomegaly during the surgery and lower possibility for manipulating the organ, the conversion of laparoscopy method to open surgery might happen. Bleeding was proposed as one of the major complications of the laparoscopy of massive splenomegaly cases (18). Almost 10-fold increase in post-surgical morbidity rate with longer hospitalization has been reported in 2004 as results of the laparoscopy of patients with massive splenomegaly (19). In contrast to the mentioned study, others have indicated no limitation for performing laparoscopy in patients with significantly massive splenomegaly. It is also indicated that laparoscopy appears to be associated with less blood loss, transfusion necessity, hospitalization, revision, and death (20). Hand-assisted laparoscopic approach is another type of laparoscopy that might be applied for the supra-massive splenomegaly (19,21).

In Table 1, information of recent trials, which have compared the efficacy of laparoscopy and open surgery for splenectomy of patients with massive splenomegaly secondary to various hematological diseases, ITP, and other disorders are summarized.

According to the study of Vecchio, spleen size

Table1. Information of the trials compared the efficacy of the laparoscopy with open surgery

Author Year Reference	Included patients disease	Complication events	Laparoscopy (LP) Events/total number	Open surgery (OS) Events/total number	LS vs. OS Risk difference%
Vecchio 2011 (22)	Splenomegaly secondary to various hematological diseases	Portal vein thrombosis	3/102	1/60	2%
Mohamed 2010 (23)	Idiopathic thrombocytopenic purpura	Portal vein thrombosis	6/21	8/28	0%
Alwabari 2009 (24)	Children with sickle cell disease	LP*: Chest syndrome, fever, OS**: Chest syndrome, infection, bleeding, fever	2/30	13/120	-4%
Maurus 2008 (25)	Splenomegaly secondary to various hematological diseases	LP: Infection, Pneumonia, bleeding OS: Pancreatic fistula and Thromboembolic events	10/25	13/27	-8%
Goers 2008 (26)	Children with sickle cell disease	Chest syndrome and pain	13/98	22/42	-39%
Feldman 2008 (27)	Splenomegaly secondary to various hematological diseases	—	7/18	6/11	-16%
Sampath 2007 (28)	Idiopathic thrombocytopenic purpura	Recurrence of idiopathic thrombocytopenic purpura	17/51	8/54	19%

*LP: Laparoscopy; **OS: Open surgery

and splenectomy surgery can be suggested as risk factors for portal vein thrombosis as a post-splenectomy complication. Although the occurrence of this complication is rare, it should be diagnosed and managed carefully by accurate follow-up. In the study of Vecchio et al., no significant difference was observed in the frequency of portal vein thrombosis between laparoscopy and open surgery and heparin was suggested to apply for all the patients who have been under the splenectomy (22,23).

Sickle cell disease (SCD) is another disorder that usually represents with spleen involvement and finally the patients' splenomegaly with severe adhesion. Laparoscopy has been proposed as a preferred method, which can be performed concomitantly with cholecystectomy in SCD patients. Laparoscopic splenectomy in SCD patients has revealed reduced transfusion requirement rate and other post-operative complications including acute chest syndrome (24). Articles studied the efficacy of different methods in splenectomy, all have suggested laparoscopy as the preferred method to open surgery (24, 26). According to Maurus et al, spleen size should not be the only considered parameter while choosing the proper splenectomy method; the possibility of conducting laparoscopy splenectomy should be evaluated as an important priority regarding to the patients' conditions and history (25). In various studies on splenomegaly secondary to different hematological disorders, laparoscopy have been proposed as a technically demanding procedure due to reduced peritoneal cavity, decreased ability for organ moving, and increased adhesion of the organ as a result of spleen enlargement (27). In these studies, laparoscopy can be associated with higher rate of conversion to open surgery, bleeding, operation duration, and major post-operative complications if not be managed via skilled experienced surgeon (27,29,30).

Conclusion

According to articles and different conducted trials, it is not easy to propose an evidence-based management strategy for the splenectomy of patients with splenomegaly. Based on various studies, laparoscopy would be recommended as the preferred procedure even for patients with massive splenomegaly, due to several advantages over other methods of the splenectomy. No significant differences have been observed between methods regarding the patients' bleeding and mortality rate. Further reliable trials are needed for obtaining more comprehensive evaluations of splenectomy method benefits.

Acknowledgement

We would like to thank Clinical Research Development Center of Ghaem Hospital for their assistant in this manuscript. This study was supported by a grant from the Vice Chancellor for Research of the Mashhad University of Medical Sciences for the research project as a medical student thesis with approval number of

Conflict of Interest

The authors declare no conflict of interest.

References

- O'Malley C, Cunningham AJ. Physiologic changes during laparoscopy. *Anesthesiol Clin North America*. 2001;19:1-19.
- Loffer FD, Pent D. Indications, contraindications and complications of laparoscopy. *Obstet Gynecol Surv*. 1975;30:407-427.
- Kim JY, Shin CS, Kim HS, et al. Positive end-expiratory pressure in pressure-controlled ventilation improves ventilatory and oxygenation parameters during laparoscopic cholecystectomy. *Surg Endosc*. 2010;24:1099-1103.
- Branche PE, Duperret SL, Sagnard PE, et al. Left ventricular loading modifications induced by pneumoperitoneum: a time course echocardiographic study. *Anesth Analg*. 1998;86:482-487.
- Srivastava A, Niranjana A. Secrets of safe laparoscopic surgery: Anaesthetic and surgical considerations. *J Minim Access Surg*. 2010;6:91-94.
- Goldstone J. Splenectomy for massive splenomegaly. *Am J Surg*. 1978;135:385-388.
- Casaccia M, Torelli P, Squarcia S, et al. Laparoscopic splenectomy for hematologic diseases: a preliminary analysis performed on the Italian Registry of Laparoscopic Surgery of the Spleen (IRLSS). *Surg Endosc*. 2006;20:1214-1220.
- Horowitz J, Smith JL, Weber TK, et al. Postoperative complications after splenectomy for hematologic malignancies. *Ann Surg*. 1996;223:290-296.
- Donini A, Baccarani U, Terrosu G, et al. Laparoscopic vs open splenectomy in the management of hematologic diseases. *Surg Endosc*. 1999;13:1220-1225.
- Delaitre B, Maignien B. Splenectomy by the laparoscopic approach. Report of a case. *Presse Med*. 1991;20:2263.
- Nicholson IA, Falk GL, Mulligan SC. Laparoscopically assisted massive splenectomy. A preliminary report of the technique of early hilar devascularization. *Surg Endosc*. 1998;12:73-75.
- Iwase K, Higaki J, Mikata S, et al. Laparoscopically assisted splenectomy following preoperative splenic artery embolization using contour emboli for myelofibrosis with massive splenomegaly. *Surg Laparosc Endosc Percutan Tech*. 1999;9:197-202.
- Friedman RL, Fallas MJ, Carroll BJ, et al. Laparoscopic splenectomy for ITP. The gold standard. *Surg Endosc*. 1996;10:991-995.
- Kucuk C, Sozuer E, Ok E, et al. Laparoscopic versus open splenectomy in the management of benign and malignant hematologic diseases: a ten-year single-center experience. *J Laparoendosc Adv Surg Tech A*. 2005;15:135-139.
- Targarona EM, Espert JJ, Cerdan G, et al. Effect of spleen size on splenectomy outcome. A comparison of open and laparoscopic surgery. *Surg Endosc*. 1999;13:559-562.
- Targarona EM, Espert JJ, Balagué C, et al. Splenomegaly should not be considered a contraindication for laparoscopic splenectomy. *Ann Surg*. 1998;228:35-39.
- Baccarani U, Donini A, Terrosu G, et al. Laparoscopic splenectomy for haematological diseases: review of current concepts and opinions. *Eur J Surg*. 1999;165:917-923.
- Patel AG, Parker JE, Wallwork B, et al. Massive splenomegaly is associated with significant morbidity after

- laparoscopic splenectomy. *Ann Surg.* 2003;238:235-240.
19. Kercher KW, Matthews BD, Walsh RM, et al. Laparoscopic splenectomy for massive splenomegaly. *Am J Surg.* 2002;183:192-196.
 20. Grahn SW, Alvarez J, Kirkwood K. Trends in laparoscopic splenectomy for massive splenomegaly. *Arch Surg.* 2006;141:755-761.
 21. Bo W, He-Shui W, Guo-Bin W, et al. Laparoscopy Splenectomy for Massive Splenomegaly. *J Invest Surg.* 2013;26:154-157.
 22. Vecchio R, Cacciola E, Cacciola RR, et al. Portal vein thrombosis after laparoscopic and open splenectomy. *J Laparoendosc Adv Surg Tech A.* 2011;21:71-75.
 23. Mohamed SY, Abdel-Nabi I, Inam A, et al. Systemic thromboembolic complications after laparoscopic splenectomy for idiopathic thrombocytopenic purpura in comparison to open surgery in the absence of anti-coagulant prophylaxis. *Hematol Oncol Stem Cell Ther.* 2010;3:71-77.
 24. Alwabari A, Parida L, Al-Salem AH. Laparoscopic splenectomy and/or cholecystectomy for children with sickle cell disease. *Pediatr Surg Int.* 2009;25:417-421.
 25. Maurus CF, Schafer M, Muller MK, et al. Laparoscopic versus open splenectomy for nontraumatic diseases. *World J Surg.* 2008;32:2444-2449.
 26. Goers T, Panepinto J, Debaun M, et al. Laparoscopic versus open abdominal surgery in children with sickle cell disease is associated with a shorter hospital stay. *Pediatr Blood Cancer.* 2008;50:603-606.
 27. Feldman LS, Demyttenaere SV, Polyhronopoulos GN, et al. Refining the selection criteria for laparoscopic versus open splenectomy for splenomegaly. *J Laparoendosc Adv Surg Tech A.* 2008;18:13-19.
 28. Sampath S, Meneghetti AT, MacFarlane JK, et al. An 18-year review of open and laparoscopic splenectomy for idiopathic thrombocytopenic purpura. *Am J Surg.* 2007;193:580-583.
 29. Habermalz B, Sauerland S, Decker G, et al. Laparoscopic splenectomy: the clinical practice guidelines of the European Association for Endoscopic Surgery (EAES). *Surg Endosc.* 2008;22:821-848.
 30. Mahon D, Rhodes M. Laparoscopic splenectomy: size matters. *Ann R Coll Surg Engl.* 2003;85:248-251.