

Massive Splenomegaly in Children: Laparoscopic Versus Open Splenectomy

Mohamed E. Hassan, MD, PhD, FEBPS, Khalid Al Ali, MD

ABSTRACT

Background and Objectives: Laparoscopic splenectomy for massive splenomegaly is still a controversial procedure as compared with open splenectomy. We aimed to compare the feasibility of laparoscopic splenectomy versus open splenectomy for massive splenomegaly from different surgical aspects in children.

Methods: The data of children aged <12 years with massive splenomegaly who underwent splenectomy for hematologic disorders were retrospectively reviewed in 2 pediatric surgery centers from June 2004 until July 2012.

Results: The study included 32 patients, 12 who underwent laparoscopic splenectomy versus 20 who underwent open splenectomy. The mean ages were 8.5 years and 8 years in the laparoscopic splenectomy group and open splenectomy group, respectively. The mean operative time was 180 minutes for laparoscopic splenectomy and 120 minutes for open splenectomy. The conversion rate was 8%. The mean amount of intraoperative blood loss was 60 mL in the laparoscopic splenectomy group versus 110 mL in the open splenectomy group. Postoperative atelectasis developed in 2 cases in the open splenectomy group (10%) and 1 case in the laparoscopic splenectomy group (8%). Oral feeding postoperatively resumed at a mean of 7.5 hours in the laparoscopic splenectomy group versus 30 hours in the open splenectomy group. The mean hospital stay was 36 hours in the laparoscopic splenectomy group versus 96 hours in the open splenectomy group. Postoperative pain was less in the laparoscopic splenectomy group.

Conclusion: Laparoscopic splenectomy for massive splenomegaly in children is safe and feasible. Although

the operative time was significantly greater in the laparoscopic splenectomy group, laparoscopic splenectomy was associated with statistically significantly less pain, less blood loss, better recovery, and shorter hospital stay. Laparoscopic splenectomy for pediatric hematologic disorders should be the gold-standard approach regardless of the size of the spleen.

Key Words: Laparoscopy, Splenectomy, Children, Massive.

INTRODUCTION

Splenectomy is frequently required in children for various hematologic disorders.¹ The first laparoscopic splenectomy (LS) in children was published by Tulman et al² in 1993. Since that time, many articles have been published regarding this subject, in both adults and children. Despite this, the superiority of LS over open splenectomy (OS) has not been addressed from all its aspects.³

With the optimal acceptance of its clinical advantages, LS emerged as a gold-standard procedure compared with OS. However, it is still controversial and even considered a contraindication for massive splenomegaly.⁴

In the adult literature, controversy still exists regarding the role of LS in patients with massive splenomegaly.⁵ LS for massive splenomegaly has generally been found to be associated with a high conversion rate in adults and children. Despite improvements in laparoscopic techniques and the accumulation of laparoscopic experience, concerns have been raised about completing the procedure in pediatric cases with massive splenomegaly.⁶ The advantages of minimal access surgery in this subgroup of patients with massive splenomegaly are still not clear.⁷

We aimed to compare the feasibility of LS versus OS for massive splenomegaly from different surgical aspects in children.

METHODS

The data of children aged <12 years with massive splenomegaly (identified by ultrasonography as splenic size

Pediatric Surgery Unit, General Surgery Department, Zagazig University, Zagazig, Egypt (Dr. Hassan).

Pediatric Surgery Department, Al Qassimi Hospital, Sharjah, United Arab Emirates (Drs. Hassan, Al Ali).

Address correspondence to: Mohamed E. Hassan, MD, PhD, FEBPS, PO Box 441103, Dubai, United Arab Emirates. Tel: 00971065188888, Fax: 00971042515232, E-mail: dmia88@hotmail.com

DOI: 10.4293/JSLS.2014.00245

© 2014 by JSLS, Journal of the Society of Laparoendoscopic Surgeons. Published by the Society of Laparoendoscopic Surgeons, Inc.

≥ 500 mg using the formula described by Downey,⁸ $0.43 \times \text{Length} \times \text{Width} \times \text{Thickness} = \text{Splenic size [in grams]}$ who underwent splenectomy for hematologic disorders were retrospectively reviewed in 2 pediatric surgery centers from June 2004 until July 2012.

During the period from June 2004 to June 2009, splenectomy for massive splenomegaly was performed by an open technique. From July 2009 onward, all splenectomy procedures for massive splenomegaly were performed laparoscopically (the surgical steps for both procedures were the same in both institutions).

The files of 69 patients who were subjected to splenectomy during the study period were reviewed. Of these patients, 32 were defined as having massive splenomegaly by preoperative ultrasonography: 12 underwent LS and 20 underwent OS.

Using SPSS software, version 17 (IBM, Armonk, New York), we collected and statistically analyzed the following: demographic data, size of the spleen, indications for splenectomy, type of surgical procedure, operative time, intraoperative complications, intraoperative blood loss, conversion to OS, postoperative pain management (pain was evaluated according to the word-graphic rating scale of Tesler et al⁹), postoperative complications, postoperative time required to start oral feeding, and length of hospital stay.

The χ^2 test was used to test statistically significant differences in qualitative data, and the *t* test was used to test statistically significant differences in quantitative data. $P < .05$ was considered to indicate a statistically significant difference.

Surgical Technique for OS

OS was performed through a left subcostal incision. Control of the splenic hilum was achieved with ligation of the splenic artery above the pancreas and then ligation of the splenic vein.

Surgical Technique for LS

For LS, the patient was positioned in the right lateral decubitus position on a neutrally positioned table with the umbilicus at or near the break in the table. The surgeon and the camera operator stood on the patient’s right side, with the video monitors above and lateral to the patient’s left shoulder.

The camera port was inserted into the infraumbilical fold, and a 10-mm 30° telescope was used. In cases in which

the spleen was extending beyond the midline, the camera port was inserted in the right lumbar area. Three 5-mm trocars were inserted, two in the midline above the umbilicus and one under the lower edge of the spleen in the left iliac fossa.

The splenocolic ligament and the short gastric vessels were divided with a tissue sealing device (Ultracision Harmonic Scalpel; Ethicon Endo-Surgery, Cincinnati, Ohio). The lateral attachments of the spleen were divided completely. The splenic hilum was divided by use of a linear endoscopic vascular stapler device with an articulating end (Endopath ETS Articulating Endocutters; Ethicon Endo-Surgery), and the staple line length was 45 mm in all cases in the study. The device was inserted into the umbilical incision after removal of the 10-mm port and shifting of the 10-mm telescope to a 5-mm 30° telescope in the left lateral port.

An Endobag (Endo Catch II 15 mm Specimen Pouch; Covidien, Mansfield, Massachusetts) was inserted through the umbilicus, and the spleen was moved inside, underwent morcellation, and was extracted. A size 18 Nelaton tube (B. Braun, Melsungen, Germany) was inserted into the bed of the spleen and exited through the left lateral trocar, which was removed within 24 hours. (We insert a drain only in cases of massive splenomegaly.)

RESULTS

There were 22 female and 10 male patients. The age range was 6 to 12 years for the LS group versus 5 to 11 years for the OS group (**Table 1**). The indications for splenectomy were hematologic disorders in all cases (sickle cell anemia in 15, chronic idiopathic thrombocytopenic purpura in 6, hereditary spherocytosis in 5, thalassemia major in 4, and autoimmune hemolytic anemia in 2).

The size of the spleen by ultrasonography ranged from 500 to 1000 g. The operative time ranged from 150 to 210

	LS Group (12 Cases)	OS Group (20 Cases)	Statistical Data
Mean age (\pm SD) (y)	8.5 \pm 1.9	8 \pm 1.7	<i>t</i> =0.73, <i>P</i> >.05
Sex			χ^2 =0.01, <i>P</i> >.05
Male	5	8	
Female	7	12	

minutes in the LS group and from 110 to 180 minutes in the OS group.

There was 1 case (8%) of an intraoperative complication in the LS group. It was due to incomplete closure of the staples that resulted in incomplete hemostasis, which was controlled with a tissue sealing device. The conversion rate from LS to OS was 8% (1 case).

The mean amount of intraoperative blood loss was 60 mL in the LS group versus 110 mL in the OS group. Postoperative left lung lower lobe atelectasis developed in 2 cases in the OS group (10%) and 1 case in the LS group (8%), which was managed by chest physiotherapy.

Postoperatively, oral feeding was resumed within 6 to 8 hours in the LS group (mean, 7.5 hours) and 24 to 36 hours (mean, 30 hours) in the OS group. The mean hospital stay was 36 hours in the LS group versus 96 hours in the OS group.

Both groups of splenectomy patients were given intravenous acetaminophen/6h and a diclofenac sodium suppository/8h for the first 24 hours postoperatively as routine medications. Opioid injection was required in the first 24 hours in 2 cases in the LS group (17%) and all cases in the OS group (100%) (**Table 2**).

DISCUSSION

The advantages of LS become less obvious in patients with large spleens. A spleen weight ≥ 1000 g has been associated with a longer operative time, higher conversion rate, and higher morbidity rate compared with LS for smaller spleens.^{7,10} On the other hand, Targarona et al^{11,12} and Grahn et al¹³ argued that their data on LS versus OS for massive splenomegaly favored the former

approach, with a lower morbidity rate, reduced need for blood transfusion, and shorter postoperative hospital stay.

Currently, there is no consensus on the definition of massive splenomegaly. The lower weight limit applied in the adult literature to define massive splenomegaly has ranged between 500 g¹⁴ and 1000 g.^{15,16} O'Reilly¹⁷ defined splenomegaly as a spleen length of >12 cm as estimated by 2 clinicians or spleen weight >250 g in an excised spleen or on autopsy. In children, Zhu et al⁶ defined massive splenomegaly as a splenic margin below the umbilicus or anteriorly extending over the midline.

We used a splenic size of 500 g, by preoperative ultrasonography, as our lower limit to define massive splenomegaly in children in our study. All the patients in this study showed the same clinical characteristics described by Zhu et al⁶ for massive splenomegaly, but we preferred to rely on a more accurate definition for massive splenomegaly as described by Downey.⁸

In the first period of the study (June 2004 to June 2009), massive splenomegaly was performed with OS whereas LS was only performed for splenomegaly patients with a spleen weight <500 g to build our experience.

The recent literature contains very few comparative studies between OS and LS for massive splenomegaly in children. Deng et al⁴ and Zhu et al⁶ recently published their retrospective studies of 57 children and 145 children, respectively, who required splenectomy for massive splenomegaly. Our study included 12 LS cases and 20 OS cases. There was no sex difference between the 2 groups. Age was nearly similar in both groups.

Table 2.
Variables Between Groups

Variable	LS Group (12 Cases)	OS Group (20 Cases)	Statistical Data
Mean size of spleen (\pm SD) (g)	800 \pm 157	850 \pm 185	$t=1.9, P>.05$
Mean operative time (\pm SD) (min)	180 \pm 10	120 \pm 8	$t=9.7, P<.001^a$
Intraoperative complications	1 case (8%)	0 cases (0%)	
Mean intraoperative blood loss (\pm SD) (mL)	60 \pm 6	110 \pm 9	$t=8.1, P<.001^a$
Postoperative complications	1 case (8%)	2 cases (10%)	
Mean time to start oral feeding (\pm SD) (h)	7.5 \pm 1	30 \pm 2	$t=7.5, P<.001^a$
Use of opioids for pain management postoperatively	2 cases (17%)	20 cases (100%)	$\chi^2=20.5, P<.01^a$
Mean length of hospital stay (\pm SD) (h)	36 \pm 7	96 \pm 20	$t=8.04, P<.05^a$

^aStatistically significant difference.

The difference in the size of the spleen in both groups was not statistically significant. The study of Deng et al,⁴ as well as our study, showed a statistically significantly longer operative time in the LS group, which is in concordance with the published literature in the adult population.^{7,10,16}

Although there was only 1 case of an intraoperative complication in the LS group (8%), no intraoperative complications were encountered in the OS group. The complication rates for LS versus OS were 13.6% and 41.2%, respectively, in the study by Zhu et al.⁶ The single intraoperative complication encountered in our LS group was due to device failure and was not related to the size of the spleen itself. The device failure was possibly caused by increased thickness of the hilar vessels.

In concordance with our study, there was statistically significantly less intraoperative blood loss in the study of Deng et al⁴ in the LS group.

Deng et al⁴ reported a conversion rate of 13.33% in their study. Reports in the adult literature showed conversion rates ranging from 18.5% to 60% in cases of LS for massive splenectomy. There was 1 case of conversion (8%) in our study. (This case was occurred in the LS group.) The reason for conversion was severe adhesions around the spleen and the hilum (this was the third case of LS in our study); we believed that it was unsafe to proceed with the laparoscopy in this case.

There were statistically insignificantly fewer postoperative complications in the LS group versus the OS group (8% vs 10%), which concurs with the study by Deng et al.⁴ The postoperative time to resume oral feeding and postoperative hospital stay were statistically significantly less in the LS group. Deng et al and Owera et al⁵ showed the same results in their studies.

Patel et al⁷ reported, in their adult population, a 23% conversion rate, a 10-fold increase in morbidity rate, and prolongation of the hospital stay with the laparoscopic approach in 27 patients with massive splenomegaly.

The need for postoperative medications for pain management was statistically significantly less in the LS group than in the OS group in our study, concurring with the results of Owera et al.⁵ We used the word-graphic rating scale of Tesler et al⁹ for evaluation of pain severity; patients with a rating for large pain or worst possible pain on the scale were given opioid analgesics.

In an elegant study in adults, Grahn et al¹³ concluded that “the laparoscopic approach should be considered for pa-

tients requiring elective splenectomy regardless of spleen size,” and we support this statement. Our study emphasizes that all cases of elective splenectomy for hematologic disorders in children could be better managed laparoscopically.

CONCLUSION

LS for massive splenomegaly in the pediatric age group is safe and feasible to perform under some precautions to prevent conversion to the open technique. Although there was a significantly greater operative time in the LS group, LS was associated with statistically significantly less pain, less intraoperative blood loss, better recovery, shorter postoperative hospital stay, and better cosmesis.

LS for pediatric hematologic disorders should be the gold-standard approach regardless of the size of the spleen.

References:

1. Guaglio M, Romano F, Garancini M, et al. Is expertise in pediatric surgery necessary to perform laparoscopic splenectomy in children? An experience from a department of general surgery. *Updates Surg.* 2012;64(2):119–123.
2. Tulman S, Holcomb GW III, Karamanoukian HL, Reynhout J. Pediatric laparoscopic splenectomy. *J Pediatr Surg.* 1993;28:689–692.
3. Bax NMA, van der Zee DC. Laparoscopic splenectomy: is this the way to do it? *Pediatr Endosurg Innov Tech.* 2001;5(3):281–286.
4. Deng XG, Maharjan A, Tang J, et al. A modified laparoscopic splenectomy for massive splenomegaly in children with hematological disorder: a single institute retrospective clinical research. *Pediatr Surg Int.* 2012;28(12):1201–1209.
5. Owera A, Hamade AM, Bani Hani OI, Ammori BJ. Laparoscopic versus open splenectomy for massive splenomegaly: a comparative study. *J Laparoendosc Adv Surg Tech A.* 2006;16(3):241–246.
6. Zhu J, Ye H, Wang Y, et al. Laparoscopic versus open pediatric splenectomy for massive splenomegaly. *Surg Innov.* 2011;18(4):349–353.
7. Patel AG, Parker JE, Wallwork B, et al. Massive splenomegaly is associated with significant morbidity after laparoscopic splenectomy. *Ann Surg.* 2003;238(2):235–240.
8. Downey MT. Estimation of splenic weight from ultrasonographic measurements. *Can Assoc Radiol J.* 1992;43(4):273–277.
9. Tesler MD, Savedra MC, Holzemer WL, Wilkie DJ, Ward JA, Paul SM. The word-graphic rating scale as a measure of chil-

dren's and adolescents' pain intensity. *Res Nurs Health*. 1991;14:361–371.

10. Friedman RL, Hiatt JR, Korman JL, Facklis K, Cymerman J, Phillips EH. Laparoscopic or open splenectomy for hematologic disease: which approach is superior? *J Am Coll Surg*. 1997;185:49–54.

11. Targarona EM, Espert JJ, Balague C, Piulachs J, Artigas V, Trias M. Splenomegaly should not be considered a contraindication for laparoscopic splenectomy. *Ann Surg*. 1998;228:35–39.

12. 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.

13. Grahn SW, Alvarez J III, Kirkwood K. Trends in laparoscopic splenectomy for massive splenomegaly. *Arch Surg*. 2006;141(8):755–762.

14. Heniford BT, Park A, Walsh RM, et al. Laparoscopic splenectomy in patients with normal-sized spleens versus splenomegaly: does size matter? *Am Surg*. 2001;67:854–857.

15. Greene AK, Hodin RA. Laparoscopic splenectomy for massive splenomegaly using a Lahey bag. *Am J Surg*. 2001;181:543–546.

16. Mahon D, Rhodes M. Laparoscopic splenectomy: size matters. *Ann R Coll Surg Engl*. 2003;85:248–251.

17. O'Reilly RA. Splenomegaly in 2,505 patients at a large university medical center from 1913 to 1995. 1963 to 1995: 449 patients. *West J Med*. 1998;169:88–97.