

Hand-assisted laparoscopic splenectomy versus open splenectomy for massive splenomegaly: 20-year experience at a Canadian centre

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Background: Multiple techniques for splenectomy are now employed and include open, laparoscopic and hand-assisted laparoscopic splenectomy (HALS). Concerns regarding a purely laparoscopic splenectomy for massive splenomegaly (> 20 cm) arise from potentially longer operative times, higher conversion rates and increased blood loss. The HALS technique offers the potential advantages of laparoscopy, with the added safety of having the surgeon's hand in the abdomen during the operation. In this study, we compared the HALS technique to standard open splenectomy for the management of massive splenomegaly.

Methods: We reviewed all splenectomies performed at 5 hospitals in the greater Vancouver area between 1988 and 2007 for multiple demographic and outcome measures. Open splenectomies were compared with HALS procedures for spleens larger than 20 cm. Splenectomy reports without data on spleen size were excluded from the analysis. We performed Student *t* tests and Pearson χ^2 statistical analyses.

Results: A total of 217 splenectomies were analyzed. Of these, 39 splenectomies were performed for spleens larger than 20 cm. We compared the open splenectomy group (19 patients) with the HALS group (20 patients). There was a 5% conversion rate in the HALS group. Estimated blood loss (375 mL v. 935 mL, $p = 0.08$) and the mean (and standard deviation [SD]) transfusion rates (0.0 [SD 0.0] units v. 0.8 [SD 1.7] units, $p = 0.06$) were lower in the HALS group. Length of stay in hospital was significantly shorter in the HALS group (4.2 v. 8.9 d, $p = 0.001$). Complication rates were similar in both groups.

Conclusion: Hand-assisted laparoscopic splenectomy is a safe and effective technique for the management of spleens larger than 20 cm. The technique results in shorter hospital stays, and it is a good alternative to open splenectomy when treating patients with massive splenomegaly.

Contexte : Les multiples techniques de splénectomie actuellement utilisées comprennent la splénectomie ouverte, la splénectomie laparoscopique et la splénectomie laparoscopique avec assistance manuelle (SLAM). Les préoccupations soulevées par la splénectomie entièrement laparoscopique dans les cas de splénomégalie massive (> 20 cm) sont notamment la durée de l'intervention qui peut être plus longue, les taux de conversion plus élevés et les pertes de sang plus importantes. La technique SLAM peut conjuguer les avantages de la laparoscopie à une sécurité accrue, du fait que le chirurgien a la main à l'intérieur de l'abdomen au cours de l'intervention. Durant cette étude, nous avons comparé la technique SLAM à la splénectomie ouverte ordinaire pour la prise en charge d'une splénomégalie massive.

Méthodes : Nous avons passé en revue toutes les splénectomies pratiquées à 5 hôpitaux de la région métropolitaine de Vancouver entre 1988 et 2007 afin d'effectuer de multiples mesures démographiques et analyses des résultats. Nous avons comparé la splénectomie ouverte aux interventions pratiquées par la technique SLAM pour les rates de plus de 20 cm. Nous avons exclu de l'analyse les rapports de splénectomie ne comportant pas de données sur les dimensions de la rate. Nous avons effectué un test Student *t* et une analyse statistique du χ^2 de Pearson.

Résultats : Nous avons analysé au total 217 splénectomies, dont 39 ont été pratiquées sur des rates de plus de 20 cm. Nous avons comparé les patients qui ont subi une splénectomie ouverte (19 patients) à ceux qui ont subi une intervention par la technique SLAM (20 patients). Il y a eu un taux de conversion de 5 % chez les patients traités par la technique SLAM. La perte de sang estimée (375 ml c. 935 ml, $p = 0,08$) et les taux moyens (et l'écart-type [ET]) de transfusion (0,0 [ET 0,0] unité c. 0,8 [ET 1,7] unité, $p = 0,06$) ont

été moins élevés chez les patients traités par la technique SLAM, dont l'hospitalisation a été beaucoup plus courte (4,2 c. 8,9 j, $p = 0,001$). Les taux de complications étaient semblables dans les 2 groupes.

Conclusion : La splénectomie laparoscopique avec assistance manuelle est une technique sans danger et efficace à utiliser pour la prise en charge des rates de plus de 20 cm. L'utilisation de cette technique permet de raccourcir la durée de l'hospitalisation et constitue une bonne solution de rechange à la splénectomie ouverte dans les cas des patients qui ont une splénomégalie massive.

Laparoscopic splenectomy was first reported by Delaitre and Maignien in 1991.¹ This technique was quickly adopted as it resulted in reduced hospital stays and lower complication rates.² Despite these findings, there were concerns regarding the role of laparoscopy in the management of massive spleens (> 20 cm). Investigators raised concern regarding the increased morbidity and high conversion rates associated with laparoscopic splenectomy when it was used for massive splenomegaly.³⁻⁵ Boddy and colleagues⁶ found that patients with splenomegaly who were treated with open splenectomy had shorter operative times and less blood loss than patients who received a laparoscopic operation. They found no significant difference in hospital stay (6 v. 7 d), and they recommended open splenectomy for patients with spleens greater than 1 kg.

To deal with the issues encountered during laparoscopic splenectomy, the hand-assisted laparoscopic technique (HALS) was developed. Through the work of Targarona and colleagues,⁷ it was recognized that HALS dramatically reduced the number of problems that were often encountered during the non-hand assisted laparoscopic approach when dealing with larger spleens. They found that the HALS technique in patients with spleens greater than 700 g was associated with less morbidity (10% v. 36%), shorter hospital stays (4 d v. 6.3 d) and shorter operative times (135 min v. 177 min) when compared with the standard laparoscopic technique. However, few studies have compared HALS to the standard open splenectomy for patients with splenomegaly. As a result, the best technique for the management of massive splenomegaly (open v. HALS) warrants further evaluation. In this study, we review our experience with HALS as it pertains to patients with spleens larger than 20 cm, and we compare this technique to standard open splenectomy.

METHODS

We reviewed splenectomies performed at 5 hospitals in greater Vancouver, BC, between May 1988 and December 2007. Hospital and office charts were analyzed retrospectively, and we excluded patients whose charts lacked information on spleen dimensions from our analysis. Spleen size was based on preoperative imaging. If this information was not available, we used the longest pathologic specimen dimension. Outcomes of interest included duration of surgery, length of stay in hospital, HALS con-

version rates, complications, operative blood loss, transfusion requirements and mortality. Demographic data included age, sex and diagnosis.

We compared patients with spleens larger than 20 cm in the open splenectomy and the HALS groups. The size of 20 cm is based on work by Grahn and colleagues⁸ and Kercher and colleagues.⁹ Only 2 splenectomies in this study were attempted with a non-hand assisted laparoscopic technique. Both procedures were converted to open splenectomy and were excluded from our analysis.

Surgical technique and patient care

Most patients who undergo HALS are vaccinated for encapsulated bacteria (pneumococcus, hemophilus influenza and meningococcus) 2 weeks before surgery. Lower extremity sequential compression stockings and subcutaneous heparin are used for deep venous thrombosis prophylaxis in all patients. A Foley catheter is placed in all patients, and an intraoperative oral gastric tube is placed as needed for exposure.

In the HALS technique, the patient is placed in the right lateral flexed position on a bean bag. The hand port is inserted through a subxiphoid midline incision (see Fig. 1 for patient positioning and port sites). The abdomen can be inflated through the hand port, allowing the laparoscope to visualize additional trocar placements. Alternatively, the



Fig. 1. Patient positioning and location of hand ports (subxiphoid, 12 mm midclavicular subcostal and 5 mm midline and anterior axillary line) during hand-assisted laparoscopic splenectomy.

surgeon's hand can be inserted through the hand port to protect the abdominal contents and to select the placement of a bladeless 12-mm trocar below the inferior pole of the spleen. A 5-mm 45° video laparoscope is inserted to visualize the placement of a 5-mm trocar infero-lateral to the hand port, and the laparoscope is used in this port. A 5-mm assistant trocar is placed in a lateral subcostal position for insertion of a circular retractor.

A variety of vessel-sealing devices and vascular staplers are used. The dissection is begun by mobilization of the splenic flexure of the colon with division of the splenocolic ligament. The gastrosplenic ligament is divided, mobilizing the stomach up to the left crus and exposing the splenic vessels. The splenic artery is isolated and ligated early to decrease the blood supply to the spleen and reduce its size. The splenorenal ligament is then divided, followed by the division of the hilar vessels with an endovascular stapler. The superior pole splenic attachments are divided last. The spleen is placed in an intestinal bag and then morcelated intracorporeally via the hand port until it is small enough to extract through the hand port site.

Clear fluids are initiated on the first postoperative day, and diet is advanced as tolerated. Patients are discharged when tolerating oral intake and when good oral analgesic control is achieved. Computed tomography scans or ultrasounds of the abdomen are obtained before discharge to determine whether splenic or portal vein thrombosis has occurred. Follow-up is routinely 4–6 weeks after discharge unless discussion is required earlier or complications are encountered.

Statistical analysis

We performed statistical analysis with SPSS (version 15.0) software, using the Pearson χ^2 test for all categorical vari-

ables and Student *t* tests for all continuous variables. We considered results to be significant at $p < 0.05$. To detect any potential bias in our results, we analyzed demographic and clinical characteristics, including sex, age and diagnosis, for heterogeneity between the open surgery and HALS groups. The heterogeneity analysis was performed using χ^2 analysis for sex and malignancy rates and the Student *t* test for age.

RESULTS

A total of 217 patients underwent splenectomies between May 1988 and December 2007. Of these, 39 patients had spleens larger than 20 cm. The HALS technique was used for 20 patients, and 19 patients underwent open splenectomy. Preoperative imaging was performed in 73% of patients. Two of the authors (O.P. and A.M.) performed most of the HALS procedures (18 of 20, between 2005 and 2007). The demographic and clinical characteristics for both groups (HALS and open splenectomy), including diagnosis, are listed in Table 1. There was no significant difference in age or malignancy rates between the HALS and open splenectomy groups. Patients in the open splenectomy group did have significantly larger spleens than those in the HALS group (25.3 cm v. 22.9 cm, $p = 0.022$).

There was only 1 conversion to open splenectomy in the HALS group (5%). This conversion was performed by a surgeon who was performing his first HALS procedure in a patient with myelofibrosis. Complication rates were similar between the HALS and open splenectomy groups (7 of 20 v. 6 of 19, respectively; Table 2). The length of stay in hospital was significantly lower in the HALS group (4.2 d v. 8.9 d, $p = 0.001$; Table 3). Operative blood loss and transfusion rates showed a trend toward improvement in the HALS compared with the open splenectomy group (Table 3).

A weakness that we observed in our comparison between the groups was that many of the open splenectomies were performed during the first half of our study. To reduce this potential bias, we performed a subgroup analysis

Table 1. Demographic and clinical characteristics and conversion rates of patients who underwent HALS versus open splenectomy

Characteristic, no (%)*	HALS	Open splenectomy	<i>p</i> value
Number	20	19	
Age, mean (SD) yr	55.2 (15.9)	53.8 (12.0)	0.77
Sex, male:female	15:5	15:4	0.77
Size, mean (SD) cm	22.9 (2.5)	25.3 (3.7)	0.022
Malignancy	12 (60.0)	13 (68.4)	0.58
CLL or CML	7 (35.0)	8 (42.1)	0.65
Lymphoma	6 (30.0)	5 (26.3)	0.80
AIHA	4 (20.0)	1 (5.3)	0.34‡
Myelofibrosis	1 (5.0)	3 (15.8)	0.34‡
Other†	2 (10.0)	2 (10.5)	1.00‡
Conversions	1 (5.0)	0 (0.0)	1.00‡

AIHA = autoimmune hemolytic anemia; CLL = chronic lymphocytic leukemia; CML = chronic myelogenous leukemia; HALS = hand-assisted laparoscopic splenectomy; SD = standard deviation.

*Unless otherwise indicated.

†Hereditary spherocytosis, atypical lymphoid hyperplasia, immune thrombocytopenic purpura and unknown.

‡Fisher exact test.

Table 2. Complications of patients who underwent HALS versus open splenectomy

Group	No. (%)	Complication*
HALS, <i>n</i> = 20	7 (35)	<ul style="list-style-type: none"> • 4 wound infection • 4 portosplenic vein thrombosis • 2 ileus • 1 pleural effusion
Open splenectomy, <i>n</i> = 19	6 (32)	<ul style="list-style-type: none"> • pneumonia • pancreatitis • <i>Clostridium difficile</i> • delirium • thrombophlebitis • hematoma • pleural effusion

HALS = hand-assisted laparoscopic splenectomy.

*Sum of the number of complications exceeds the number of patients in each group because some patients experienced more than 1 complication.

of the second half of our study period (1998–2007, 10 open splenectomy patients compared with all HALS patients). Results of this analysis showed an improvement in the length of stay in hospital (4.2 d v. 6.8 d, $p = 0.018$), a decrease in estimated blood loss (375 mL v. 1222 mL, $p = 0.05$) and a decrease in the use of red blood cell transfusions (1.3 units v. 0.0 units, $p = 0.111$) in the HALS compared with the open splenectomy group.

The HALS procedure was significantly longer than open splenectomy (163 min v. 115 min, $p = 0.003$). There was no 60-day mortality in either group. The complications experienced by patients in both the HALS and the open splenectomy groups are listed in Table 2. Overall complication rates were similar between the HALS and open splenectomy groups (35% and 32%, respectively).

DISCUSSION

In this study, we compared open splenectomy and HALS for the management of spleens larger than 20 cm. It is one of the largest comparison series of its kind in patients with splenomegaly. Unlike most other studies that have used spleen weight to determine splenomegaly, we chose to use spleen length, as determined by preoperative imaging, since this information can be available to the surgeon via preoperative imaging. We felt this study would more accurately reflect the clinical decision-making required by the surgeon when determining the best operative approach.

In this study, the conversion rate to open splenectomy was 5%, which is comparable to other reported conversion rates.⁶⁻⁹ Most of the HALS procedures were performed by 2 surgeons with strong laparoscopic backgrounds (1 with fellowship training), which may explain our low conversion rate. The 1 conversion was performed by a surgeon who was performing his first HALS procedure. Although there are definite advantages to the HALS technique, such as being able to expose and retract with the hand, it does have a learning curve, which was not addressed in this study.

Kercher and colleagues⁹ reported a mean duration of surgery of 146 minutes, which is comparable to our mean duration of 163 minutes. In our study, the difference in duration of surgery between HALS and open splenectomy was 48 minutes. This additional time can be explained

partly by increased patient positioning time, as well as increased time bagging and morcelating the enlarged spleen to minimize the incision size. Placement of the massive spleen into the extraction bag is often the most challenging part of the HALS procedure.

We believe our morbidity results were somewhat inflated in the HALS group owing to better follow-up information. Office and hospital charts were reviewed over the last 2 years of our study. We found that wound infection and nonocclusive portosplenic vein thrombosis (PSVT) accounted for 73% of the complications observed in the HALS group. In patients discharged early from hospital, wound infections may not have been evident on hospital charts. Despite these potential biases in our analysis, we are currently looking at the possible interaction between the hand port and the surgeon’s gown as a potential cause of higher wound infection rates. Sometimes, the hand port will come into contact with the surgeon’s sleeve above the glove, and if the gown is not completely fluid-resistant, contamination can occur. In addition, the use of routine postoperative surveillance imaging for PSVT in the HALS group likely accounted for the increased number of patients who experienced this complication. When these 2 complications were excluded, morbidity in the HALS group fell to 15%, which is similar to other reported rates.^{8,9}

Portosplenic vein thrombosis accounted for 4 of the complications in the HALS group, but was not reported in the open splenectomy group. Symptoms of this condition typically include abdominal pain and fever. The incidence of PSVT in the HALS group was 20%. This contrasts with the 9.8% rate of PSVT reported by Loring and colleagues.¹⁰ They reported a high rate of asymptomatic patients (20%–40%). This may explain the low rate of PSVT in the open splenectomy group, which lacked postoperative imaging. Pietrabissa and colleagues¹¹ and Stamou and colleagues¹² found that splenomegaly and thrombocytosis were major risk factors for PSVT, which would support the higher rates of PSVT found in our study. None of our patients experienced long-term sequelae related to PSVT. All PSVT resolved with anticoagulation therapy by the 2- to 3-month follow-up visits. We believe follow-up imaging for all splenectomies performed for splenomegaly is essential to improve potential complications from PSVT.

Just as the technique and postoperative care for splenectomy has changed in the last 20 years, so have the indications for splenectomy. The use of splenectomy as a purely diagnostic and staging procedure has greatly diminished over the last 2 decades. Staging splenectomy has gone from 40% of splenectomies between 1963 and 1982¹³ to 9% between 1988 and 2001.¹⁴ Indications for splenectomy today are generally for the treatment of associated cytopenias and for symptomatic splenomegaly, which can cause pain and early satiety. The impact of this changing practice on our study was not assessed and is a limitation of our

Table 3. Postoperative results of patients who underwent HALS versus open splenectomy

Measure	Group; mean (SD)		p value
	HALS, n = 20	Open splenectomy, n = 19	
Postoperative LOS, d	4.2 (3.0)	8.9 (5.0)	0.001
Estimated blood loss, mL	375 (227)	935 (877)	0.08*
Transfusion, no. units	0 (0)	0.8 (1.7)	0.06*
Length of surgery, min	163 (50)	115 (40)	0.003

HALS = hand-assisted laparoscopic splenectomy; LOS = length of stay in hospital; SD = standard deviation.

*Independent samples Student t test with unequal variances formula.

analysis. We do know, however, that the preoperative diagnoses of our splenectomy patients were comparable in the HALS and open splenectomy groups. The high male predominance in our splenomegaly group is explained by the typical chronic lymphocytic leukemia sex distribution (2:1, male:female).

We believe that HALS has many technical advantages over the purely laparoscopic technique when dealing with a massive spleen. Compared with standard laparoscopic instruments, the hand allows for greater atraumatic exposure of the spleen. The hand also allows for easy tamponade of any bleeding that may be encountered during dissection, which is often a reason for conversion to open splenectomy and excessive blood loss. The hand eases the technically challenging manipulation of the spleen into a retrieval bag. The hand port also adds little incisional morbidity, as a larger utility port is often required for spleen removal in laparoscopic splenectomy.

CONCLUSION

Our study supports the use of the HALS technique in patients with spleens larger than 20 cm. When compared with open splenectomy, HALS resulted in a significantly reduced length of stay in hospital. It is a valuable technique to have in the surgeon's armamentarium when treating patients with splenomegaly.

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