

# Importance of Dissection of the Hernial Sac in Laparoscopic Surgery for Large Hiatal Hernias

David I. Watson, MD, FRACS; Nicholas Davies, MD, FRACS; Peter G. Devitt, MS, FRCS, FRACS;  
Glyn G. Jamieson, MS, FACS, FRACS, FRCS(Hon)

**Hypothesis:** Laparoscopic repair of large hiatal hernia is an appropriate management strategy.

**Design:** A prospective patient series.

**Setting:** A university teaching hospital.

**Patients:** All patients with hiatal hernias 10 cm or greater in diameter repaired laparoscopically between February 1, 1992, and September 30, 1998.

**Interventions:** Two operative strategies were used for laparoscopic repair: the first, which was used until early 1996, entailed initial esophageal dissection while leaving the sac in the mediastinum. The second involved preliminary dissection of the hernial sac from the mediastinum before dissecting the esophagus.

**Main Outcome Measures:** Successful completion of the procedure using a laparoscopic technique, postoperative complication rate, reoperation rate, and clinical outcome.

**Results:** Eighty-six patients with a large hiatal hernia un-

derwent attempted repair using laparoscopic methods. The median age was 63 years (range, 30-91 years), and 45 patients (52%) were women. There were 30 sliding, 10 rolling, and 46 mixed hiatal hernias. Operating times ranged from 48 to 240 minutes (median, 90 minutes), and 20 procedures (23%) were converted to an open operation. Conversion was significantly more common in the first half of our experience (16 [40%] of 40 patients vs 4 [9%] of 46 patients) before the operative strategy was changed. Esophageal-lengthening procedures were not carried out for any patient. At follow-up of a median of 2 years, 1 patient has moderate dysphagia, 4 patients have reflux symptoms, and 1 patient has undergone further surgery for a recurrent paraesophageal hernia. An overall satisfactory outcome was achieved in 81 patients (94%).

**Conclusions:** Large hiatal hernias can be treated effectively laparoscopically. Dissecting the sac fully from the mediastinum before dissecting the esophagus helps to safely mobilize the esophagus, and we think changing to this strategy is the main reason for the improved laparoscopic success rate reported in the latter half of this series.

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**T**RADITIONALLY, large hiatal hernias have been repaired using an open procedure through either a thoracotomy or an upper midline abdominal incision. These approaches can be associated with substantial morbidity. Laparoscopic surgery has recently become established<sup>1</sup> as the preferred surgical approach for gastroesophageal reflux disease, with the reduction and repair of any associated small hiatal hernia being an integral part of the laparoscopic procedure. The advantages of reduced morbidity and a shortened postoperative hospital stay<sup>1,2</sup> would also be expected in patients with large hiatal hernias who are successfully managed laparoscopically, and early laparoscopic experience with the repair of large hiatal hernias has been reported.<sup>3-8</sup>

Our early experience with this problem was initially discouraging because of our inability to reliably complete the procedure using a laparoscopic approach. Eventually, this led to the development of an alternative operative strategy that has greatly improved the reliability of the laparoscopic approach in our hands. This experience has been reviewed to determine the applicability of laparoscopic repair of large hiatal hernias, to determine strategies that might improve the outcome of this approach, and to assess medium-term outcomes following laparoscopic repair.

## RESULTS

Eighty-six patients who presented to The Royal Adelaide Hospital, Adelaide, South Australia, between February 1, 1992, and September 30, 1998, underwent at-

From the Department of Surgery, University of Adelaide and The Royal Adelaide Hospital, Adelaide, South Australia.

## PATIENTS AND METHODS

We defined a large hiatal hernia as either a hiatal hernia measuring at least 10 cm in length at preoperative endoscopy or herniation of at least half of the stomach into the thorax, determined by preoperative contrast radiographic study or an initial laparoscopic assessment.

The outcome of laparoscopic surgery performed at The Royal Adelaide Hospital, Adelaide, South Australia, for patients with a large hiatal hernia was prospectively assessed to determine the feasibility of this approach and the influence of a change in our surgical technique on the likelihood of completing the procedure laparoscopically. Since late 1991, all patients presenting to our hospital for primary antireflux surgery or the repair of hiatal hernia have been offered laparoscopic treatment, with more than 95% of procedures attempted laparoscopically. Preoperative, operative, and postoperative data have been collected prospectively by an independent data collector (hospital scientist), and these data have been managed on a computerized database. The data collected included details of preoperative and postoperative symptoms, operative technique and success, and complications. Patients were interviewed using a standardized questionnaire 3 and 12 months following surgery and then at yearly intervals. This was achieved by mailing a questionnaire to all patients at predetermined intervals. If the questionnaire was not returned, then follow-up was sought by telephone interview. The database was used to determine those patients who underwent laparoscopic surgery for a large hiatal hernia and their outcome.

All patients underwent surgery in the reverse Trendelenburg position, with both legs extended in stirrups and the surgeon positioned between the patient's legs. Port placement is identical to that used for laparoscopic antireflux surgery in patients without a large hiatal hernia. Full details of this technique have been reported previously.<sup>9,10</sup> A Nathanson liver retractor (Cook Australia, Eight Mile Plains, Queensland) is placed through an epigastric stab incision to facilitate stable retraction of the left lobe of the liver and good exposure of the esophageal hiatus.

In the first half of our experience (up to early 1996), patients underwent surgery using a technique that

entailed initial reduction of the stomach and other contents of the hernia into the abdomen. This was achieved by applying traction on the gastric cardia using an atraumatic laparoscopic grasping instrument. The esophagus was then dissected through the back of the hernia sac, a tape was passed around the esophagus, and the gastroesophageal junction was pulled into the abdomen to facilitate full dissection of the esophagus and the esophageal hiatus. The esophageal hiatus was then repaired using interrupted non-absorbable laparoscopic sutures, and a fundoplication (usually a loose Nissen) was performed. In other words, no attempt was made to dissect the sac out of the chest. The procedure was performed as it would have been at open operation before 1991.

Subsequently (from early 1996), because of a poor rate of completion of the procedure laparoscopically, the technique was changed. Instead of attempting initially to reduce the contents of the hernia sac to define the esophagus, attention was focused on dissection of the hernia sac from the mediastinum. First, the peritoneum is divided at the edge of the esophageal hiatus, ie, the neck of the hernia sac. The sac is then separated from the adjacent mediastinal structures with predominantly blunt dissection, and the sac is progressively reduced into the abdomen. This is facilitated by an assistant pulling firmly downward on the sac. As dissection proceeds, the contents of the hernia sac are reduced and the esophagus comes into view.

Once the sac has been completely reduced, an instrument can then be passed behind the esophagus and a tape drawn around it. This can be used to further facilitate downward and anterior retraction of the gastroesophageal junction to enable the hiatal pillars to be fully dissected behind the esophagus. The hiatus is then repaired behind the esophagus, although additional sutures can be placed in front if needed to avoid excessive tension on the repair. A fundoplication is performed to complete the procedure. If a Nissen fundoplication is to be performed, the short gastric vessels are not divided because the gastric fundus is already mobile. In addition, excision of the now-redundant hernia sac from the abdominal cavity is unnecessary because it can be pulled downward as the fundoplication is formed around the abdominal esophagus, so that it lies loosely below the completed fundoplication but is still attached to the gastric cardia.

tempted laparoscopic repair of a large hiatal hernia. During the same period, another 640 patients without a large hiatal hernia underwent a laparoscopic antireflux procedure. Forty-five patients were women, and 41 were men; their ages ranged from 30 to 91 years (median, 63 years). Thirty patients (35%) were older than 70 years, and 12 (14%) were older than 80 years. Twenty-nine patients (34%) had had a previous open abdominal operation; 16 of these were upper abdominal procedures (predominantly cholecystectomy).

All patients had evidence of a large hiatal hernia at preoperative endoscopy (80 patients) or barium meal examination (62 patients) (some patients had both). In addition, endoscopy revealed the presence of ulcerative esophagitis in 62 patients (78%) examined. Of the 62 patients who underwent barium meal examination, more than 50% of the stomach in 43 patients (69%) was sited

intrathoracically. Sixty-seven patients (78%) underwent preoperative esophageal manometry. This test was not tolerated by 4 patients (5%), and 15 patients (19%) underwent surgery for a giant paraesophageal hernia (some semiurgently) without manometric assessment.

Of the patients undergoing attempted laparoscopic repair, 30 (35%) were found to have a predominantly sliding hernia, 10 (12%) predominantly a paraesophageal hernia, and 46 (53%) a mixed hernia. Although 20 procedures (23%) were converted to an open operation, the likelihood of conversion fell significantly when the operative strategy was changed (**Table 1**). The conversion rate was 40% (16/40) for our initial technique and 9% (4/46) for the latter operative strategy ( $P < .001$ , Fisher exact test). Of 11 patients whose procedure was converted because of difficulty reducing the hernia laparoscopically, all proved to have adequate esophageal length

**Table 1. Reasons for Conversion From Laparoscopic to Open Procedure**

Reason	No. of Patients	
	No Sac Dissection (n = 40)	Sac Dissected (n = 46)
Unable to reduce hernia	9	2
Excessive intra-abdominal fat	3	0
Bleeding from left lobe of liver	1	0
Large left lobe of liver	1	1
Adhesions	1	0
Perforation of esophagus*	1	1
<b>Total</b>	<b>16 (40%)</b>	<b>4 (9%)</b>

\*Patients had dense periesophagitis.

once the dissection of the sac had been completed at open surgery, and construction of a satisfactory intra-abdominal fundoplication was not difficult.

Two procedures were converted to an open operation following esophageal perforation. In both patients, dense periesophagitis made esophageal mobilization and identification of tissue planes difficult, leading to perforation of the posterior aspect of the esophagus. The esophagus was successfully repaired, and the repair was covered by a Nissen fundoplication. Both patients recovered uneventfully.

The operating time ranged from 48 to 240 minutes (median, 90 minutes). The hiatal defect was repaired by posteriorly placed sutures alone in 72 patients, a combination of posterior and anterior hiatal sutures in 11 patients, and anterior hiatal repair alone in 3 patients. A median of 3 sutures (range, 1-7 sutures) was used for hiatal repair, and in most patients, the sutures were placed using a figure-of-8 technique, so that 3 corresponds to about 5 to 6 interrupted sutures and 7 to about 12 interrupted sutures. A fundoplication was constructed in all patients, with 70 patients undergoing a Nissen fundoplication, 15 patients an anterior 180° fundoplication, and 1 patient a posterior partial fundoplication. Esophageal-lengthening procedures were not carried out in any patient because we did not encounter notable esophageal shortening in this series.

Postoperative complications occurred in 11 patients (**Table 2**), with 4 patients requiring early reoperation for a problem occurring in the first postoperative week. One patient underwent laparoscopic reoperation on the seventh postoperative day for severe dysphagia. An anterior fundoplication anchored to a long posterior repair was constructed at the first operation. This resulted in total esophageal obstruction due to acute angulation of the distal esophagus. The fundoplication was undone, and because the patient did not have preoperative reflux symptoms, she was left with the hiatal repair only. This resulted in the complete restoration of swallowing, and she was discharged 2 days later. Two patients had an acute paraesophageal hernia identified on a routine postoperative barium swallow examination on the third postoperative day. Both underwent laparoscopic reoperation on the fourth postoperative day, during which the wrap was found to have partially dis-

**Table 2. Complications Occurring Within 30 Days of Laparoscopic Repair of Large Hiatal Hernia**

Complication	No. of Patients	
	No Sac Dissection (n = 40)	Sac Dissected (n = 46)
Acute paraesophageal hernia	1*	1*
Dysphagia	0	1*
Gastric obstruction	1*	0
Pneumothorax	1	1
Pulmonary infection	3†	0
Wound infection	1†	0
Pulmonary embolus	1†	0
Deep vein thrombus	1	0
<b>Total</b>	<b>8 (20%)</b>	<b>3 (6%)</b>

\*Patient underwent reoperation within first week.

†Patient had a procedure that was converted to an open operation.

rupted and migrated into the chest. The stomach was reduced, and the fundoplication was redone, followed by an uneventful recovery and discharge from the hospital 5 and 6 days later, respectively. A further barium swallow examination demonstrated no hernia at the time of discharge from the hospital. In the fourth patient, one of the initial patients in our overall experience of laparoscopic antireflux surgery, gastric obstruction developed due to incorrect construction of the fundoplication with too distal a piece of the stomach. Open surgical revision was performed on the sixth postoperative day, followed by a slow but otherwise uncomplicated recovery.

All patients in this series underwent a barium swallow examination on the second or third postoperative day. Apart from the 2 patients in whom early acute hernias developed, all other studies demonstrated that the hiatal hernia had been completely reduced and that the fundoplication appearance was satisfactory. The median hospital stay for all patients was 3 days (range, 2-12 days), and for those patients whose procedure was converted to an open procedure, the median stay was 7 days (range, 4-12 days).

Follow-up has extended for as long as 5 years (median, 2 years), with 6 patients (7%) being unavailable for follow-up. Six patients have undergone a further operation since their primary repair; 2 patients had incisional hernias 18 months and 2 years following conversion of their initial surgery to an open procedure, and 2 patients had solitary port-site hernias develop that were repaired in the day surgery unit. In addition, one of the early patients underwent an open revision 11 months following her first procedure because of an incorrectly constructed fundoplication that resulted in partial gastric obstruction due to the previously described bilobed effect.<sup>9</sup> In the last patient, a recurrent paraesophageal hernia developed 6 months after the original procedure. She underwent attempted laparoscopic repair, although this was converted to an open procedure because of difficulties defining the hiatal anatomy. The fundoplication was intact, but the fundus of the stomach had herniated through a normal-sized esophageal hiatus. The fundoplication was undone, and the hiatus was enlarged to facilitate reduc-

tion of the hernia. The hiatal ring did not require further repair, although the fundoplication was reconstructed and sutured to the hiatal ring to prevent further recurrence. To date, this is the only late recurrence in this series.

Of the 58 patients who have been observed for longer than 12 months, 12 (21%) have occasional minor dysphagia, although all of these patients are fully satisfied with the outcome of their surgery, and they all eat a normal diet. One additional patient has persistent dysphagia that is severe enough to necessitate avoiding lumpy solid foods. The overall incidence and severity of postoperative dysphagia in this group of patients were less than the 41% incidence of dysphagia found preoperatively in the same group of patients.

In 4 patients (5%), further symptoms of reflux have developed, although only 1 of these patients has symptoms that are not relieved by acid suppression. An overall satisfactory outcome was achieved in 75 (94%) of the 80 patients who underwent postoperative clinical assessment, with 2 patients unhappy because of their need to undergo additional surgery and 3 patients troubled by adverse effects of the original procedure.

#### COMMENT

Hiatal hernia can be broadly classified into 3 types: sliding, paraesophageal, or mixed, with pure paraesophageal and mixed hernias constituting a minority of hiatal hernias. Nevertheless, these hernias can contain a substantial part or even all of the stomach, and patients can present with chest pain due to intermittent obstruction, gastric volvulus, or both, the latter being a potentially fatal complication. Large hiatal hernias are more common in older patients. Unfortunately, because open repair of a large hiatal hernia requires an upper midline abdominal incision for surgical access, the morbidity associated with this approach can be considerable. This may be one of the reasons why elective repair has not been offered consistently to elderly patients with this problem.

Since the development of laparoscopic techniques for antireflux surgery, a number of surgeons have reported<sup>3-8</sup> early experiences with the repair of large hiatal hernias and paraesophageal hernia. These reports have confirmed feasibility but have usually presented results from small series, with only limited follow-up. In addition, some of these reports<sup>3,4,7,11,12</sup> describe average operating times of 150 to 320 minutes. Our experience confirms that laparoscopic repair is technically feasible and that when an appropriate technique is applied, the operation can be performed safely and efficiently. In addition, the outcome, with follow-up now as long as 5 years, is good, and there is a low risk of hernia recurrence.

Patients with large hiatal hernias are a different group from those requiring fundoplication for reflux. The patients we operated on for large hiatal hernias were on average 20 years older than patients without hiatal hernias being seen for elective antireflux surgery.<sup>10</sup> In addition, they were more likely to be female, and the laparoscopic repair is technically more difficult than surgery performed for reflux alone. Some of the technical

difficulties are easier to overcome if the surgeon is experienced or if an appropriate operative strategy is applied. The realization that dissection of the hiatal sac should be the first operative step and the primary focus of laparoscopic dissection greatly improved our ability to complete the procedure laparoscopically. Understanding this strategy is the key to success for the problem of large hiatal hernias. Although an argument can be made that the improvement in our results was a "learning curve" phenomenon, most of these procedures were performed by surgeons well beyond the learning stage, and so a learning curve effect can be at least partially discounted.

Controversy exists about the need to add an esophageal-lengthening procedure to the repair of large hiatal hernias,<sup>13</sup> with opinion divided about the incidence of esophageal shortening. Kauer et al<sup>13</sup> have recommended the use of a tailored approach to antireflux surgery, with an open thoracic approach advocated for patients having a hiatal hernia of longer than 5 cm. They suggest that this strategy allows the surgeon to better assess esophageal length and to more liberally apply esophageal-lengthening procedures. Support for this approach has been offered by Swanson et al,<sup>14</sup> who recommend the more liberal use of a laparoscopic Collis gastroplasty technique for large hiatal hernias, with approximately 10% of patients undergoing laparoscopic antireflux surgery deemed to need a lengthening procedure. Our experience, however, suggests that the problem of esophageal shortening has been overstated. Lengthening procedures did not seem necessary for any patient in our experience, and the low incidence of recurrent herniation in the series tends to confirm the efficacy of our approach. Perdakis et al<sup>15</sup> report similar outcomes from a series of 65 laparoscopic repairs of paraesophageal hiatal hernias. Lengthening procedures were not performed for any of their patients.

Some of the controversy about the need for esophageal lengthening may be related, at least in part, to surgeons' previous experience with the repair of large hiatal hernias. Surgeons accustomed to undertaking such surgery through an open abdominal incision know that the reduction of the stomach and any other contents of the hernial sac is usually a simple maneuver. On the other hand, and presumably because of the raised intra-abdominal pressure, at the beginning of laparoscopic repair of a large hernia, it is usually difficult or even impossible to reduce the stomach into the peritoneal cavity before commencing dissection. When the hernia sac is dissected completely from the mediastinum, however, an adequate esophageal length usually becomes apparent as the dissection of the sac progresses, and the hernia is readily and completely reducible. This discrepancy is thought to occur because the posterior wall of a large hiatal hernia is often formed by the gastric fundus. Hence, a large hiatal hernia is analogous to a sliding inguinal hernia, in which part of the sac wall is formed by the colon. Full reduction of the sac, therefore, reduces the stomach into the abdomen and reveals that it is not esophageal shortening that has prevented reduction. Rather, it is the fundus forming the posterior wall of a hiatal hernia sac. This sac balloons into the thorax dur-



ing laparoscopic insufflation and can make reduction of the gastric fundus difficult. This conclusion is supported by the lack of esophageal shortening found in patients whose procedure had been converted to an open procedure because of difficulty reducing the stomach laparoscopically in our initial experience. Our assessment error was to think that because we could not pull the esophagus into the abdomen before any dissection was performed, the esophagus must be short. This usually led to conversion to an open procedure, during which the esophagus was always found to be of adequate length. Hence, we think a lengthening procedure is rarely necessary and that to correctly assess esophageal length, the surgeon must fully dissect the sac from the mediastinum.

## CONCLUSIONS

Laparoscopic repair with dissection of the hernia sac is the preferred technique for patients with large hiatal hernias. This conclusion is supported by the laparoscopic success rate during the latter half of our experience, along with the low hernia recurrence rate and the low incidence of long-term dysphagia and recurrent reflux.

*Corresponding author: David I. Watson, MD, FRACS, Department of Surgery, University of Adelaide and The Royal Adelaide Hospital, Adelaide, South Australia 5000, Australia.*

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## IN OTHER AMA JOURNALS

### ARCHIVES OF INTERNAL MEDICINE

#### Vitamin E and Coronary Artery Disease

*Anne P. Spencer, PharmD; Deborah Stier Carson, PharmD; Michael A. Crouch, PharmD*

**V**arious studies have evaluated the antioxidant effects of vitamin E in the prevention or treatment of coronary artery disease (CAD). In vitro data suggest that vitamin E protects against oxidation of low-density lipoprotein and decreases the deposition of atherogenic oxidized low-density lipoprotein in arterial walls. Various observational and epidemiological studies also suggest a relationship between vitamin E serum concentrations or intake and CAD. One prospective, randomized trial suggested that low-dosage vitamin E supplementation (50 IU/d) decreases the risk of angina in patients without previously diagnosed CAD. Another study, using high-dosage vitamin E supplementation (400 or 800 IU/d), demonstrated a decrease in the combined end point of nonfatal myocardial infarction and cardiovascular death in patients with established CAD. Discordant data, however, have been published that imply no cardiovascular benefit of low-dosage vitamin E supplementation (50 IU/d) and detrimental effects if vitamin E is combined with beta carotene. At this point, clinicians should emphasize a low-fat diet with high intake of fruits and vegetable sources containing vitamin E. Supplemental vitamin E may be considered in patients at high risk for CAD or with documented CAD, but the potential beneficial effects should be weighed against possible long-term adverse effects. If vitamin E supplementation is initiated, the literature suggests dosages of 100 to 400 IU/d, with the higher dosage considered in patients with documented CAD. Additional investigation is warranted to further define the role of vitamin E supplementation in CAD and to critically evaluate the optimal dosage, duration of use, and method of consumption (dietary vs supplemental). (1999;159:1313-1320)

*Corresponding author: Anne P. Spencer, PharmD, Medical University of South Carolina, College of Pharmacy, 280 Calhoun St, QF309B, PO Box 250140, Charleston, SC 29425.*