Laparoscopic Transhiatal Surgery of the Esophagus

Simon Bann, MB, BS, BSc (Hons), MD, Krishna Moorthy, MBBS, MD, Tracey Shaul, BSc (Hons), RGN, Robert Foley, MB, BCh

ABSTRACT

Objective: Esophagectomy is an operation with high morbidity and mortality. Its adoption as a minimally invasive operation worldwide has been slow, but the potential benefits of reducing the trauma of surgery need to be considered. Our 30-month experience with transhiatal esophagectomy in a district general hospital is presented herein.

Methods: Patients were considered for surgery after radiological staging had excluded inoperable disease. Laparoscopic staging was initially performed. Patients with tumors of the esophagus and high-grade dysplasia in a Barrett’s esophagus were included.

Results: Twenty-nine patients were referred for consideration for resectional surgery. Nine underwent outpatient laparoscopy only. Twenty patients (age range, 34 to 78, 15 males:5 females) underwent resectional surgery. Seventeen transhiatal resections were completed, 2 were converted to open procedures, and 1 transhiatal resection of a benign tumor was performed. Median time of surgery was 415 minutes (range, 320 to 480) and blood loss was 300 mL (range, 200 to 350). The median length of postoperative ventilation and critical care stay were 1 (range, 1 to 4) and 4 (range, 2 to 8) days. Median duration of hospitalization was 17 days (range, 10 to 28). Thirty-day mortality was 0; 1 patient who was converted to an open procedure died after a cerebrovascular event on day 34.

Conclusion: A zero mortality rate for laparoscopic resection and a low-morbidity rate compare well with morbidity and mortality in reported series using this method and open surgery. Laparoscopic transhiatal esophagectomy is an advanced, complex procedure that can be performed safely in a district general hospital setting.

Key Words: Laparoscopic esophagectomy.

INTRODUCTION

Traditionally, esophagectomy has been performed by 1 of 3 routes: a thoracoabdominal approach, a 3-stage procedure also including an anastomosis in the neck, or a transhiatal approach. The transhiatal approach was initially described by Denk in 1913, but was later popularized by Orringer.1 However, all 3 methods have an acknowledged high intraoperative and postoperative morbidity,2–5 as well as mortality rates in published series of up to 23%.6

Minimally invasive surgery has revolutionized many areas of surgery, with laparoscopic cholecystectomy7 and fundoplication accepted as the gold standards in their areas. However, its application in esophagectomy has been slow because of associated complexities. But with the potential to reduce trauma, it is believed that by using these methods it should be possible to reduce the high morbidity and mortality associated with these procedures.

Also widely held concerns are associated with laparoscopic oncologic surgery, because of the possibility of missed lesions, inadequate staging, compromised margins, inadequate lymph node retrieval and tumor dissemination including port-site metastases.8–10 Particular to esophagectomy, concerns also exist that decreased tactile control may possibly increase the risk of injuring adjacent and vital structures in the chest, particularly for tumors above the tracheal bifurcation.

However, this procedure should not only be aimed at cancer surgery, it also has potential benefits and attractions for other areas of treatment including patients with high-grade dysplasia in Barrett’s esophagus, patients whose esophageal strictures are resistant to other treatment, and patients with end-stage achalasia.

The literature shows little agreement for the best application of minimal access techniques to esophagectomy. The most popular method described in the literature is a thoracic esophagectomy coupled with gastric mobilization via laparotomy and a cervical anastomosis.8,11–24 Various other groups have used differing combinations of laparoscopic, thoracoscopic, and open techniques.25–29 The use of hand-assist devices has also been noted.30–35 A large series of minimally invasive esophagectomies using pri-
mobilization has observed a 1.4% mortality rate in 222 consecutive patients. What can be inferred from much of the work with the thoracoscope is that this requires the use of prolonged single-lung ventilation (much in excess of the open methods) and mediastinal trauma remains substantial. This has done little to reduce the morbidity and mortality from this procedure in many series. Two groups in Germany have also described the use of a novel mediastinoscope, though its use has not become widespread, and its use is limited to tumors that are not bulky. The method that is used in our district general hospital is that of a laparoscopic transhiatal esophagectomy. Two groups have reported in the literature their results using this technique, with a long operating time, a high rate of vocal cord palsy, high leakage rates, and a mortality rate of up to 13%. It would appear from these reports and from much of the other work that these methods offer little advantage over traditional methods. The aim of this study was to compare the results of our experience in a small district general hospital with published data, the hypothesis being that surgery in such a setting is comparable to the results in larger centers.

METHODS

The Operation

The patient is placed supine on the table with an operative setup similar to that of a laparoscopic Nissen fundoplication. The port placement involves a 10-mm port in the epigastrium with 12-mm working ports on either side. A 5-mm port is placed for retraction in the anterior axillary line below the left coastal margin, and a Nathanson liver retractor is placed to aid exposure of the hiatus. The technique is similar to that described by Swanstrom; however, we have not found it necessary to use 45-mm instruments. The operation proceeds much as the open procedure with the mobilization of the stomach on the right gastroepiploic arcade. The operation differs from the open procedure in that the transhiatal mobilization is carried to the level of the bronchial vessels under direct vision. This dissection is a combination of blunt dissection and dissection with the Harmonic scalpel. A gastric tube is created with an Endo-GIA staple gun, which is then oversewn with absorbable suture for delivery of the specimen to the neck. This is a running suture and was introduced after case 6. During this procedure, a partial dehiscence of the staple line occurred on delivery to the neck. Since this change, no further dehiscence has occurred. The dissection can normally be achieved using standard 30-mm instruments and one series of port placements. Occasionally, because of the patient habitus modifications to these placements have to be entertained. It has not been necessary either to perform a pyloroplasty or mobilize the duodenum.

An open dissection is performed in the neck to mobilize the upper esophagus. This is achieved through an incision along the anterior border of the sternomastoid, with division of the omohyoid muscle and exposure and mobilization of the esophagus away from the trachea and prevertebral fascia, avoiding the recurrent laryngeal nerve. The specimen is then delivered to the neck by a combination of gentle traction from above and gentle manipulation from below with the laparoscopic instruments. In the neck, the specimen undergoes resection, and anastomosis is performed using an Endo GIA stapling device. Closure with drainage is achieved in layers.

Occasionally, a left subcostal incision is required to deliver a bulky specimen if there is difficulty in passing through the hiatal orifice. The size of the wound is dependent to a certain extent on patient habitus and specimen size. If such an incision was used then this was also used to place a jejunostomy for enteral feeding. Alternatively, this can be achieved via the nasogastric route.

Data Collection

A retrospective data analysis was carried out with data entered into an Excel database.

RESULTS

Twenty-nine patients were referred for consideration of laparoscopic transhiatal esophagectomy after radiological assessment as being possibly suitable for resection. However, 9 patients were found at diagnostic laparoscopy to have advanced disease and therefore were discharged the same day. Of the 20 patients operated on, 17 underwent a laparoscopic transhiatal resection with cervical anastomosis. One had a laparoscopic transhiatal resection of a tumor, which histologically was a gastrointestinal stromal tumor. All statistical figures given (unless specified otherwise) are the median followed by the inter-quartile ranges.

Demographics

The patients’ ages ranged from 34 to 78 with a median age of 63. Fifteen were males and 5 were females. Pathologies included 2 squamous cell carcinomas, 1 gastrointestinal...
stromal tumor, 6 high-grade dysplasias (2 contained early invasive carcinoma), and 11 adenocarcinomas.

One patient had previously had an open fundoplication and laparoscopic revision before the esophagectomy.

The median time of the procedure was 415 minutes (range, 320 to 480) (Figure 1); this is the total operative time taken including any surgical breaks. It should be noted that from patient 7 the oversewing of the gastric tube added some 40 minutes to 60 minutes to the time of the procedure. The total blood loss as recorded by the nursing staff was 300 mL (range, 200 to 350).

Intraoperative Complications

Two operations were converted to open procedures, one because of intraabdominal dissection difficulties. This was in relation to the identification and transection of the left gastric artery (patient 10). The second occasion was for a high esophageal tumor. Initially, thoracoscopy was attempted; however, because of previous tuberculosis apical adhesions were present, and the lung would not deflate, precluding access and an endoscopic procedure (patient 12). This patient also then had a prolonged stay in the critical care complex but was discharged from the unit; unfortunately, on day 33 the patient suffered an extensive cerebrovascular accident and died on day 34. Seven patients required left upper quadrant incisions; this was to deliver the specimen. The incision was small and of a size sufficient to deliver the specimen from the abdominal cavity. The reasons for nondelivery of the specimen varied, but included bulky tumors and in one case a single band of attachment in the mediastinum, which could not be identified.

Nutrition

All patients were commenced on enteral feeding from day 2 at the latest. This was either via a nasogastric tube placed at the time of surgery or via a jejunal tube that was tunneled at the time of surgery. This enteral feeding continued until full oral feeding was possible and thus lasted for a median of 8 days (range, 7 to 14). A contrast swallow was performed at a median of 7 days (range, 6 to 8). Three of these studies showed leaks (15%) at the level of the anastomosis; 2 of these were on the initial study, 1 was demonstrated on a repeat study. This patient also experienced an upper gastrointestinal bleed (patient 15) (see postoperative complications). The leaks were managed conservatively with enteral feeding continued via the nasogastric or jejunal route.

Postoperative Complications

Figure 2 displays the length of postoperative ventilation and days spent in the intensive care unit. One laparotomy for omental bleeding was necessary on the first postoperative day (patient 14). Four patients developed pneumonias that were identified radiologically and by positive microbiology. One patient developed bilateral pleural ef-
fusions that clinically produced dyspnea. These required drainage, but settled rapidly with this intervention.

Four patients had clinically identified and significant vocal cord palsies. These all settled rapidly on conservative management, none requiring intervention. One postoperative death (patient 12) occurred. This was a patient converted to an open procedure, and he died of a cerebrovascular accident on day 34 postoperatively.

One patient had a sudden and massive hematemesis from a duodenal ulcer that led to a cardiorespiratory arrest (patient 15). This was successfully managed medically with no requirement for further surgery, and the patient was discharged home on day 65 postoperatively, with no long-term adverse sequelae.

The median length of in-patient hospital stay was 17 days (range, 10 to 28).

Histology

All patient specimens when examined showed clear resection margins both proximally and distally as well as circumferentially. Two of the 6 patients with Barrett’s showed histologically an early invasive cancer. A median number of 5 (range, 2 to 6) lymph nodes were found by histological examination; however, this was a retrospective study, and the completeness of the examination for these can’t be commented upon. Four of the patients were found to have evidence of metastatic spread to the nodes at the time of pathological staging.

Follow-up

On follow-up, most patients have required anastomotic dilatation. These patients have presented with some degree of dysphagia. All have settled with anastomotic dilatation performed with sedation in an outpatient endoscopy unit setting. These have required serial dilatations over a number of weeks.

Three deaths occurred on follow-up (at a mean 11 months after surgery) from recurrent disease. All of these have been in patients who were node positive at the time of surgery.

DISCUSSION

Over a thousand patients have been reported in the literature as having undergone a laparoscopic or laparoscopically assisted esophagectomy. The results regarding morbidity and mortality are mixed and vary between the centers and methodologies. The results achieved in our series are certainly comparable for mortality and morbidity with those seen in previous series for transhiatal esophagectomy

Table 1.

| Series         | n  | Conversion to Open | Hoarseness | Anastomotic Leakage | Operating Time (min) | Lymph Node Dissection | Blood Loss (mL) | Mortality |
|----------------|----|--------------------|------------|---------------------|----------------------|-----------------------|----------------|-----------|
| Swanstrom39    | 9  | 0                  | 6          | 0                   | 390                  | 6                     | 290           | 0         |
| DePaula40      | 24 | 2                  | 2          | 6                   | 256                  | 11                    | 4             |           |
| Current series | 20 | 2                  | 4          | 2                   | 415*                 | 5                     | 300           | 1         |

*Total operative time including any breaks taken by the surgeon.
staple line, adding some appreciable time to the length of the procedure for patient 7.

In terms of pathology, it would appear that satisfactory margins of clearance have been obtained in those patients with a cancer. A transhiatal approach also has the advantage of ensuring in those patients with high-grade dysplasia in a Barrett’s esophagus that as much of the esophageal mucosa is removed as possible, in theory lowering the risk of malignant change. The method would also appear to provide adequate staging of lymphatic spread with a median of 5 nodes removed. However, because this was a retrospective study, the completeness of the pathologist’s examination of the specimen for nodes cannot be addressed. Within the confines of this paper, we will not discuss either the advantages or disadvantages of extended lymphadenectomy for esophageal cancer because this is beyond the scope of this work, but if lymph node involvement is present then systemic disease is obviously present. A recent large, randomized, controlled trial examining open transhiatal and transthoracic surgery failed to show a significant difference in survival between the 2 methods.42

Compared with time reported in other results, the time to discharge is slow;40 however, further work must be undertaken at ensuring an earlier discharge of the patient including the possibility of earlier introduction of oral intake. As a part of this contrast, swallows are now being performed on day 2 so that fluids could potentially be introduced at an earlier stage. The earlier the return to oral nutrition in a group where dysphagia and consequent malignant malnourishment have had a profound effect should not be underestimated. This potential advantage of endoscopic surgery must be explored. This early study however will not exclude a delayed leak, but this possibility must be explored.

Long-term follow-up must continue because this study considered only the early morbidity and mortality. This will be essential if this procedure is to be considered from an oncological study. Comparison with open data should also occur because this article reports the experience of a single surgeon, allowing for a reasonable comparison between open and laparoscopic techniques. What has not been considered in this study is patient acceptability, preference, and return to normal function compared with these things in open traditional surgery. Empirically, with earlier mobilization, lower analgesic requirements, and earlier return to oral feeding, one would expect minimal access techniques to have advantages and enhanced patient satisfaction. This will require rigorous study.

CONCLUSION

We conclude that laparoscopic transhiatal resection of the esophagus in this series was both safe and feasible in a district general hospital with results similar to those in centers of excellence. The technique should be more widely offered to patient as an acceptable and safe option.

References:

1. Orringer MB, Marshall B, Stirling MC. Transhiatal esophagectomy for benign and malignant disease. J Thorac Cardiovasc Surg. 1993;105:256–277.

2. Lee RB, Miller JL. Esophagectomy for cancer. Surg Clin North Am. 1997;77:1169–1195.

3. Law SYK, Wong J. Complications: prevention and management. In: Management of Upper Gastrointestinal Cancer. Daly JM, Hennesey TPJ, Reynolds JV, eds. London: WB Saunders; 1999;12:240–262.

4. Wholesly BP, Law S, Murthy SC, et al. Analysis of reduced death and complication rates after esophageal resection. Ann Surg. 2001;233:338–344.

5. Law S, Fok M, Wong J. Risk analysis in resection of squamous cell carcinoma of the oesophagus. World J Surg. 1994;18:339–346.

6. Birkmayer JD, Siewers AE, Finlayson EVA, et al. Hospital volume and surgical mortality in the United States. N Engl J Med. 2002;346:1128–1137.

7. National Institute of Health. National Institutes of Health Consensus development conference on gallstones and laparoscopic cholecystectomy. Am J Surg. 1993;165:390–396.

8. Law S, Fok M, Chu KM, et al. Thoracic esophagectomy for esophageal cancer. Surgery. 1997;122:8–14.

9. Segalin A, Bonavina L, Rosati R, et al. Parietal seeding of esophageal cancer after thoracoscopic resection. Dis Esophagus. 1994;7:64–65.

10. Dixit AS, Martin CJ, Flynn P. Port site recurrence after thoracoscopic resection of oesophageal cancer. Aust NZ J Surg. 1997;67:148–149.

11. Law S, Fok M, Wei WI, et al. Thoracic esophageal mobilization for pharyngolaryngoesophagectomy. Ann Thorac Surg. 2000;70:418–422.

12. Peracchia A, Rosatti R, Fumagalli U, et al. Thoracoscopic dissection of the esophagus for cancer. Int Surg. 1997;82:1–4.

13. Gossot D, Fourquier P, Celerier M. Thoracoscopic esophage-
gectomy: Technique and Initial results. *Ann Thorac Surg.* 1993; 56:667–670.

14. Kawahara K, Maekawa T, Okabayashi K, et al. Video assisted thoracic esophagectomy for esophageal cancer. *Surg Endosc.* 1999;13:218–223.

15. Coosemans W, Lenu TE, Van Raemdonck DE. Thoracoscopic surgery the Belgian experience. *Ann Thorac Surg.* 1993;56:721–730.

16. Akaishi T, Kaneda I, Higuchi N, et al. Thoracoscopic en bloc total esophagectomy with radical mediastinal lymphadenectomy. *J Thorac Cardiovasc Surg.* 1996;112:1533–1540.

17. Collard J-M, Lengele B, Otte JB, et al. En-bloc and standard esophagectomies by thoracoscopy. *Ann Thorac Surg.* 1993;56:675–679.

18. Azagra JS, Ceuterick M, Goergen M, et al. Thoracoscopic in oesophagectomy for oesophageal cancer. *Br J Surg.* 1993;80:320–321.

19. McAnena OJ, Rogers J, Williams NS. Right thoracoscopically assisted oesophagectomy for cancer. *Br J Surg.* 2004;81:236–238.

20. Dexter SP, Martin IG, McMahon MJ. Radical thoracoscopic esophagectomy for cancer. *Surg Endosc.* 1996;10:147–151.

21. Mitchell I, Corless DJ, Deligliani E, et al. Thoracoscopic esophagectomy. *Minim Invasive Surg.* 1994;3:307–310.

22. Cuschieri A. Thoracoscopic subtotal oesophagectomy. *Endosc Surg Allied Technol.* 1994;2:21–25.

23. Darzi A, Monson J. Thoracoscopic oesophagectomy-minimally invasive direct vision oesophageal mobilization for cancer. *Dis Esophagus.* 1994;7:27–31.

24. Smithers BM, Gotley DC, McEwan D, et al. Thoracoscopic mobilization of the esophagus. A 6 year experience. *Surg Endosc.* 2001;15:176–182.

25. Lloyd DM, Vipond M, Robertson GS, et al. Thoracoscopic oesophago-gastrectomy- a new technique for intra-thoracic stapling. *Endosc Surg Allied Technol.* 1994;2:26–31.

26. Robertson GSM, Lloyd DM, Wicks A, et al. No obvious advantages for thoracoscopic two stage oesophagectomy. *Br J Surg.* 1996;83:675–678.

27. Liu HP, Chang CH, Lin PJ, et al. Video-assisted endoscopic esophagectomy with stapled intrathoracic esophagogastric anastomosis. *World J Surg.* 1995;19:745–747.

28. Lee KW, Keung KF, Wong KK, et al. One-stage thoracoscopic oesophagectomy; ligature intrathoracic stapled anastomosis. *Aust N Z J Surg.* 1997;67:131–132.

29. Jagot P, Sauvanet A, Berthoux L, et al. Laparoscopic mobilization of the stomach for oesophageal replacement. *Br J Surg.* 1996;83:540–542.

30. Luketich JD, Schauer PR, Christie NA, et al. Minimally invasive esophagectomy. *Ann Thorac Surg.* 2000;70:906–911.

31. Watson DI, Jamieson GG, Devitt PG. Endoscopic cervico-thoraco-abdominal esophagectomy. *J Am Coll Surg.* 2000;190:372–378.

32. Watson DI, Davies N, Jamieson GG. Totally endoscopic Ivor Lewis esophagectomy. *Surg Endosc.* 1999;13:293–297.

33. Nguyen NT, Follete DM, Wolfe BM, et al. Comparison of minimally invasive esophagectomy with transthoracic and transhiatal esophagectomy. *Arch Surg.* 2000;135:920–925.

34. Luketich J, Alvelo-Rivero M, Buenaventura P, et al. Minimally Invasive Esophagectomy. *Ann Surg.* 2003;2003:486–495.

35. Bumm R, Holscher AH, Feussner H, et al. Endodissection of the thoracic esophagus. Technique and clinical results in transhiatal esophagectomy. *Ann Surg.* 1993;218:97–104.

36. Bumm R, Feussner H, Bartels H, et al. Radical transhiatal esophagectomy with two-field lymphadenectomy and endodissection for distal esophageal adenocarcinoma. *World J Surg.* 1997;21:822–831.

37. Becker H, Buss G, Mentges B, et al. Endoscopic esophagectomy. *Adv Surg.* 1993;26:397–410.

38. Buss G, Kaiser J, Manncke K, et al. Endoscopic microsurgical dissection of the esophagus (EMDE). *Int Surg.* 1997;82:109–112.

39. Swanstrom LL, Hansen P. Laparoscopic total esophagectomy. *Arch Surg.* 1997;162:943–947.

40. DePaula A, Hashiba K, Ferreira E, et al. Transhiatal approach for esophagectomy. In: Toouli J, Gossot D, Hunter JG, eds. *Endosurgery*. New York, NY: Churchill Livingstone; 1996;293–299.

41. Osugi H, Takemura M, Higashino M, et al. Learning curve of video-assisted thoracoscopic esophagectomy and extensive lymphadenectomy for squamous cell cancer of the thoracic esophagus and results. *Surg Endosc.* 2003;17(3):515–519.

42. Hulscher JB, van Sandick JW, de Boer AGEM, Wijnhoven BPL, Tijssen JGP, Fockens P. Extended transhiatal resection compared with limited transhiatal resection for adenocarcinoma of the esophagus. *N Engl J Med.* 2002;347(21):1662–1669.