En bloc and standard esophagectomies by thoracoscopy

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Ann Thorac Surg 1993;56:675-679
DOI: 10.1016/0003-4975(93)90949-I

En Bloc and Standard Esophagectomies by Thoracoscopy

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Subtotal esophagectomy was attempted by right thoracoscopy on 13 patients, 10 having cancer and 3 long caustic stenosis. Thoracoscopy was converted into thoracotomy in 2 patients, owing to loss of selectivity in one-lung ventilation in 1 and injury to a right intercostal artery flush to the aorta in the other. One patient with cancer underwent an esophageal bypass operation only, owing to tumor invasion into the lung at exploratory thoracoscopy. The ten esophagectomies that could be performed in totality by thoracoscopy consisted of seven en bloc resections of the esophagus with extensive lymph node clearance in the posterior mediastinum, and three standard resections without any lymph node dissection. Postoperative complications included one death due to hepatic failure, two cases of acute pneumonitis, and one persistent chest wall discomfort at the trocar sites. Up to 51 lymph nodes were found in the resected specimens of the cancer patients. Six of the 7 cancer patients who were discharged from the hospital after esophagectomy completed by thoracoscopy were alive at 2 to 20 months of follow-up. Five of them were disease free. The study shows that esophageal resections as extensive as those carried out by thoracotomy can be performed by thoracoscopy. It suggests that prompt management of untoward injury to any mediastinal structure adjacent to the esophagus is less easy by thoracoscopy than by thoracotomy, and that classic complications of open thoracic surgery may occur after thoracoscopy as well.

(Ann Thorac Surg 1993;56:675–9)

En bloc esophagectomy for cancer was described by Skinner [1] in the United States 10 years ago and performed by us later [2]. The underlying principle is the removal of the esophagus itself, all lymph nodes and soft tissues in the posterior mediastinum, and even mediastinal structures such as the azygos vein and the thoracic duct. Dissection is carried out as far from the esophageal wall as feasible in an attempt to remove in totality those neoplastic processes limited to the esophagus, or at most invading some of the adjacent lymph nodes. Until recently, a right thoracotomy was the only surgical approach available for achieving such an extensive thoracic procedure.

Standard esophagectomy (ie, resection limited to the esophagus itself) is usually carried out either by right thoracotomy or through the hiatus without thoracotomy to remove esophageal tumors as a palliative measure or to resect long peptic or caustic stenoses unresponsive to medical therapy.

The recent developments in minimal access surgery incited us to perform both kinds of esophagectomy through five 1-cm incisions in the right chest wall under video control. The present article reports our preliminary experience with those thoracoscopic procedures.

Presented at The First International Symposium on Thoracoscopic Surgery, San Antonio, TX, Jan 22–23, 1993.

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Material and Methods

Patient Population

From September 1991 to March 1993, resection of the esophagus was attempted by right thoracoscopy in 13 patients, 10 having cancer and 3 a long caustic stenosis not suitable for endoscopic dilation. Esophageal tumors were not suspected to adhere to mediastinal structures adjacent to the esophagus, or to have metastasized into distant organs on the basis of full-scale preoperative work-up including standard chest roentgenography, barium esophagogram, upper digestive tract endoscopy, computed tomographic scan of the chest and upper abdomen, bone scintigraphic scan, and liver ultrasonography.

The tumor was located in the upper third of the thoracic esophagus in 1 patient, in the middle third in 3, and in the lower third in 6. A long caustic stenosis of the thoracic esophagus had developed in 3 patients early after lye ingestion that was suicidal in origin. All patients were thin and had no past history of thoracic surgery.

Extensive En-Bloc Esophagectomy

Using a double-lumen intubation system (Carlen's endotracheal tube) and with the patient on his left side, five 1-cm holes are created in the wall of the right side of the chest, one through the seventh interspace, two through the fifth, and two through the ninth. However, exact positioning of the holes may vary according to the patient's own thoracic anatomy and the location of the tumor in the esophagus (fourth, sixth, and eighth inter-

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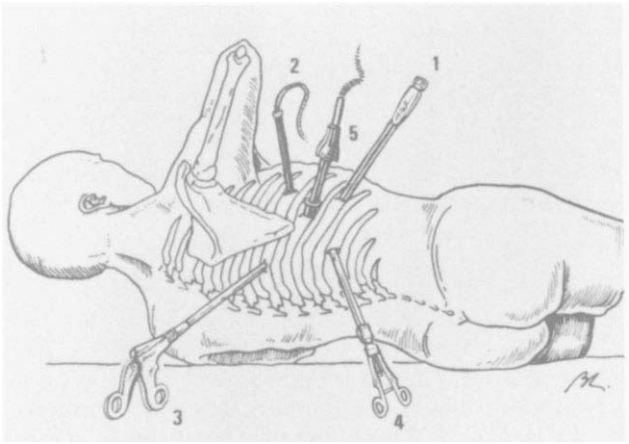

Fig 1. The patient is turned on his or her left side. Five holes are created in the chest wall to insert a lung retractor (1), a suction device (2), a grasper (3), insulated scissors (4), and the video-endoscope (5).

spaces) (Fig 1). The working instruments are two 10-mm video-endoscopes, one of 0 degrees and one of 30 degrees, a lung retractor (Endoretract, US Surgical Corp, Norwalk, CT), a suction device, one or two Johan's graspers (Micro France, Bourbon L'Archambaut, France), insulated scissors (Minishears, US Surgical Corp), a clip applier (Ethicon, Inc, Somerville, NJ), a Dubois right-angle dissector (Micro France), and an Endo-GIA 30 stapler (US Surgical Corp).

The posterior mediastinum is entered through two longitudinal incisions in the right mediastinal pleura, one alongside the right sympathetic cord and one alongside the right wall of the trachea in the upper part of the chest, and alongside the pericardium in the caudal part. All the right intercostal veins and the distal segment of the left hemiazygos vein going into the right azygos vein are divided between metal clips. The right azygos vein is also divided between metal clips or using an Endo-GIA 30 stapler just above the diaphragm. Care must be taken when removing soft tissues and nodes surrounding the terminal segments of these veins just in front of the spine so that the initial segments of all the right intercostal arteries remain intact [3]. The thoracic duct is identified for division just above the diaphragm between the descending aorta and the right azygos vein in front of the spine. The segment of the thoracic duct up to where it crosses behind the upper third of the esophagus is included in the bloc. The anterior aspect of the descending aorta is cleared up. This step of the procedure requires careful identification and clippage of two or three very small arteries entering the esophageal wall [4]. The posterior mediastinal bloc is freed from the pericardium, the right pulmonary veins, and the left mediastinal pleura. After identification of the lower aspect of the right main bronchus, subcarinal soft tissues and lymph nodes are dissected and removed en bloc. Division of the azygos arch using an Endo-GIA 30 stapler gives access to the lower part of the trachea to initiate clearance of the soft tissues alongside the membranous wall. The right vagus nerve is divided. The left recurrent nerve can sometimes be identified, and the lymph nodes alongside removed. Posteriorly, middle and upper mediastinal dissection leads to division of the left vagus nerve just below the left main bronchus, and one or two large esophageal arteries originating from the aortic arch, and to removal en bloc of the right hemiazygos vein, which is divided at the apex of the chest either between metal clips or using the Endo-GIA 30 stapler.

The final result of the procedure is a real skeletonization of the posterior mediastinum (Fig 2). During the whole procedure, the esophageal wall is not visualized, except in the upper third owing to paucity of the surrounding soft tissues at this level (Fig 3). The esophageal bloc is eventually abandoned in the chest. The chest is drained by two tubes inserted through two of the parietal holes. The three other holes are closed. The patient is then placed in the recumbent position for laparotomy and cervicotomy. The esophagus is divided at cervical level and pulled down to the abdomen. Digestive continuity is restored by pulling the whole stomach up to the neck [5]. In previously gastrectomized patients or when the cardia is included in the tumor area, a colon interposition is performed [6].

Minimal En Bloc Esophagectomy

In elderly patients with a small tumor, en bloc esophagectomy is made less extensive by maintaining the right azygos and the right hemiazygos veins. In such an in-

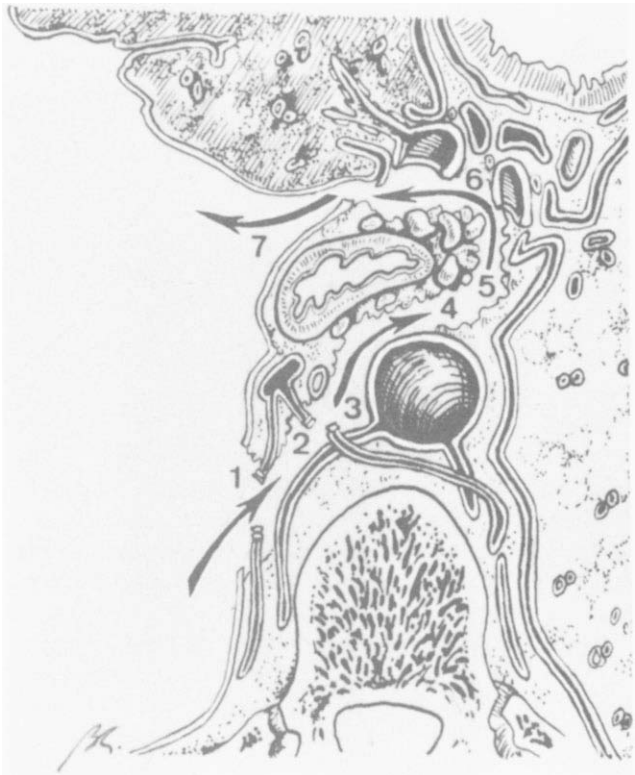

Fig 2. Transverse section of the mediastinum at the level of the seventh vertebral body. Mediastinal dissection is carried out flush to the organs adjacent to the esophagus. Note the right mediastinal pleura (1), the left hemiazygos vein (2), the right-sided intercostal arteries (3), the descending aorta (4), the left mediastinal pleura (5), the subcarinal area (6), and the right lung ligament (7).

stance, an initial pleural incision is made inside the right azygos vein, the arch of which is transected using the Endo-GIA 30 stapler. The rest of the mediastinal dissection is similar to that described for the extensive en bloc esophagectomy.

Standard Esophagectomy

In standard esophagectomy, mediastinal dissection is carried out flush to the esophageal wall itself without any lymph node clearance. When hard adhesions exist between the esophagus and the adjacent mediastinal structures, as occurs after caustic injury, dissection may be carried out within the fibrotic muscular layers of the esophagus to avoid any damage to vital structures such as the respiratory airways and the aorta.

Results

Feasibility

Esophagectomy was completed by thoracoscopy in 10 patients. Thoracoscopy was converted into thoracotomy in 2 patients. The reason for conversion was a loss of selectivity in one-lung ventilation when 90% of the esophageal dissection had already been completed by thoracoscopy in one patient with caustic esophagitis, and injury to a right intercostal artery flush to the descending aorta in 1 patient with cancer. The esophagus of 1 cancer patient was only bypassed using Postlethwait's technique [7] owing to the intraoperative finding of tumor invasion into the right lung parenchyma, which had not been suspected at preoperative investigation of the chest.

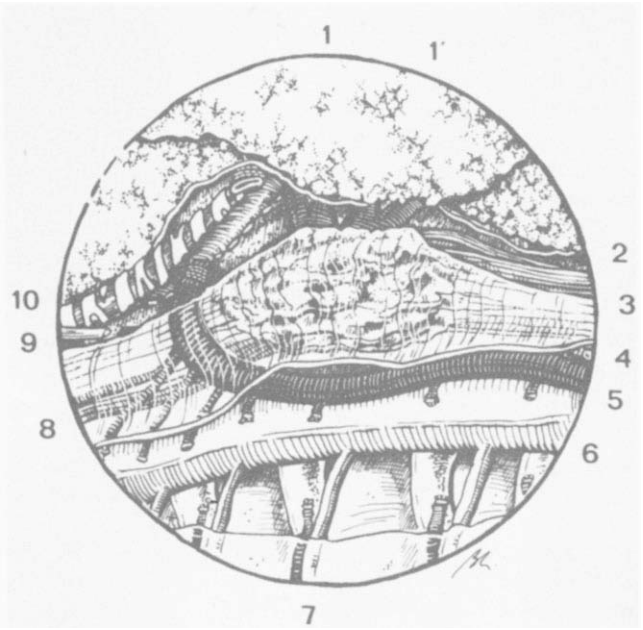

Fig 3. Final result of an extensive en bloc resection of the esophagus. All the mediastinal structures adjacent to the esophagus have been cleared from the surrounding soft tissues and lymph nodes. Note the upper right pulmonary vein (1), the lower right pulmonary vein (1'), the left vagus nerve (2), the esophagus (3), the thoracic duct (4), the right azygos vein (5), the descending aorta (6), the right intercostal vessels (7), the divided azygos arch (8), the right vagus nerve (9), and the trachea and right main bronchus (10).

Table 1. Thoracic Procedure: Duration, Hemoglobin Blood Level, and Blood Transfusion

Patients[a]	Esophageal Resection	Duration of Thoracic Procedure (min)	Hemoglobin Blood Level (mg/100 mL)		Blood Transfusion (U)
			Initial	Final	
1	SR	310	11.5	11	0
2	MEBR	160	11.5	10.4	0
3	SR	190	12.4	11	0
4	EEBR	390	11.8	11.4	0
5	SR	240 + 60[b]	12.2	10.8	0
6	EEBR	390	12.4	10.7	0
7	EEBR	60 + 120[b]	10.6	8.1	2
8	EEBR	270	13	11.3	0
9	MEBR	225	11.6	11.2	0
10	SR	180	10.1	9.8	0
11	MEBR	150	11.4	12	0
12	EEBR	240	8.2	10.9	3

[a] The patients are listed in chronologic order. [b] Duration of the thoracotomy that followed thoracoscopy in 2 patients.

EEBR = extensive en bloc resection; MEBR = minimal en bloc resection; SR = standard resection.

Thoracoscopic esophagectomies consisted of four extensive en bloc, three minimal en bloc, and three standard esophageal resections. Thoracoscopic time ranged from 150 to 390 minutes depending on the extent of the mediastinal dissection (removal of the azygos veins or not, lymph node clearance or not) and on the experience of the surgeon with the thoracoscopy technique. Table 1 gives the duration of the thoracic procedure, the hemoglobin blood level before and at the end of the procedure, and the number of packed red blood cell units required for each patient. Digestive continuity was restored by gastric pull up to the neck in 11 patients and colon interposition in 2 patients.

Postoperative Complications

Postoperatively, 1 patient died of hepatic failure related to inadvertent ligation of a 2-mm-diameter left hepatic artery, which was, in retrospect, the only artery to the liver. Ascites and abdominal sepsis developed in spite of successful microvascular anastomosis.

Pneumonitis developed in 2 patients. One patient with cancer in whom thoracoscopy was converted into thoracotomy was treated by antibiotic therapy and physiotherapy only. The second patient required assisted ventilation for 3 weeks for severe pneumonitis due to digestive juice aspiration after extensive en bloc esophagectomy by thoracoscopy. One patient with caustic esophagitis complained of chest pain at the level of some of the parietal holes. Chest pain spontaneously subsided within 2 months of follow-up.

Pathologic Findings

Postoperative microscopic examination of the resected specimens of the 7 patients with cancer who underwent

en bloc esophagectomy by thoracoscopy disclosed a number of lymph nodes ranging from 21 to 51. The resected lymph nodes were normal in 4 patients and were invaded by the neoplastic process in 3 patients. The number of metastatic lymph nodes was 1, 4, and 11, respectively.

Follow-up Evaluation

Six of the 7 patients with cancer who were discharged from the hospital after thoracoscopic esophagectomy were alive in April 1993. The follow-up period was 2, 4, 10, 12, 16, and 20 months, respectively. Five were disease free, and one had enlarged lymph nodes in the mediastinum at computed tomographic scan of the chest but his general condition was excellent. One patient who had 11 metastatic lymph nodes died of lung metastases 14 months after extensive en bloc esophagectomy by thoracoscopy. The patient with cancer in whom extensive en bloc esophagectomy had eventually to be completed by thoracotomy was alive at 13 months without evidence of neoplastic recurrence at computed tomographic scan. The patient who underwent a Postlethwait esophageal bypass operation died of neoplastic spread a few months later. He was able to eat solid food until his death. The 3 patients with caustic esophagitis were, of course, alive and their alimentary comfort was satisfactory.

Comment

This article shows that extensive esophageal resections are feasible by right thoracoscopy. This is attested to by the number of lymph nodes seen in the resected specimens of our patients, which was always as large as that usually found by our pathologists after esophagectomy by thoracotomy. Whereas standard esophagectomy performed close to the esophageal wall itself seems to be an easy procedure to complete by thoracoscopy, safe performance of en bloc esophagectomy, even made minimal by not resecting the azygos veins, obviously requires routine experience with major esophageal surgery. Indeed, mediastinal dissection close to the descending aorta and the membranous wall of the trachea and main bronchi is not easy, even when carried out by a conventional open thoracic approach. For example, untoward injury to any esophageal, bronchial, or right-sided intercostal artery, which commonly and inconsequentially occurs when en bloc esophagectomy is performed by thoracotomy, is much more difficult to control and repair through five 1-cm holes in the chest wall than through a long thoracic incision. In the former instance, the latent period between the inadvertent injury itself and its management is much longer than with open surgery. Moreover, our opinion is that such an intraoperative complication is more likely to occur with the thoracoscopic than with the conventional approach because of the relative inexperience of any thoracic surgeon with major thoracoscopic procedures at the present time, the long arm of the thoracoscopic instruments, and all the technical problems related to the functioning of the videoendoscope, the microcamera, and the television screen, which, when they occur, usually interrupt the procedure for a few seconds or minutes. Therefore, any attempt to perform en bloc esophagectomy by thoracoscopy has to fulfill the following conditions:

1. Routine experience with major esophageal surgery for each member of the surgical team
2. Thorough knowledge of the surgical anatomy of the esophagus [4]
3. Presence of the conventional surgical instrumentation on a table located inside the operating room
4. Prompt decision of opening the chest as soon as any major technical problem becomes evident
5. Good selection of the patients: thin patients with a short distance between the spine and the sternum, and having esophageal tumors not suspected to adhere to the main mediastinal structures adjacent to the esophagus at preoperative investigation of the chest.

Several potential advantages of esophagectomy by thoracoscopy over the same procedure carried out by thoracotomy have been claimed in recent surgical meetings devoted to minimal access surgery. These were (1) reduction of chest pain just after the operation and in the long run, (2) lower incidence of postoperative respiratory complications, and (3) reduction of aesthetic sequelae.

Chest pain is experienced by all patients after conventional thoracotomy, and some of them (5%) may persistently complain of residual thoracic discomfort in the long run. However, this is a less critical problem today than it was in the past. There exist now different ways to prevent and minimize this symptomatology, ie, division of the intercostal muscles a few millimeters from the periosteum of the lower rib, posterior division of the intercostal nerve, and use of local anesthesia and epidural analgesia. The surgical courses of our patients demonstrate that persistent chest pain may be experienced after thoracoscopy as well, probably because of compression of the intercostal nerve by a trocar inserted into the chest through a narrow interspace.

Respiratory complications are very common in the postoperative course of major thoracic surgery such as extensive esophagectomy by thoracotomy. However, it would be fallacious to believe that these respiratory complications are related to the type of incision only. Rather, numerous other factors may account for the occurrence of postoperative respiratory complications after esophagectomy, even made by thoracoscopy (ie, a history of heavy smoking and alcohol abuse in most patients with esophageal cancer, behavioral disorders in patients who have just attempted suicide by lye ingestion, extensive dissection carried out close to the membranous wall of the respiratory airways, and, above all, aspiration due to regurgitation of digestive juice into the mouth (as occurred to one of our patients after extensive en bloc esophagectomy by thoracoscopy).

In our opinion, postoperative parietal discomfort plays an accessory role in the occurrence of postoperative respiratory complications after major thoracic procedures. This point of view is shared by other authors who have reported their preliminary experience with esophagectomy by thoracoscopy [8, 9].

The third point, ie, reduction of the aesthetic sequelae, only addresses the few patients who require subtotal esophagectomy for a benign disease, and is not applicable when dealing with cancer patients.

No definite conclusion can be drawn from our initial experience with thoracoscopic esophagectomy, as is the case with other surgical teams [8, 9], owing to the small number of patients who have been operated on in this way until now, and the absence of any long-term follow-up for cancer patients. However, right thoracoscopy appears to be an alternative approach to the esophagus in patients with a benign disease such as a long peptic or caustic stenosis, and in those cancer patients who obviously can only benefit from a palliative esophagectomy. In such situations, dissection carried out flush to the esophagus can be done safely far from the adjacent vital structures. For instance, the risk of damage to the left recurrent nerve is probably less than with the transhiatal approach. The latter, however, is a quicker surgical procedure. Further experience is required to define the place of en bloc esophagectomy by thoracoscopy in the management of patients with small tumors of the esophagus, and to know whether such an extensive surgical procedure can be routinely performed with safety in patients less selected than those of the present series. In our opinion, this new approach is unlikely to improve long-term survival and cure of cancer patients because lymph node clearance that can be performed in the posterior mediastinum by thoracoscopy cannot be more extensive than that achieved by a classic thoracotomy. Finally, the surgeon has to abandon the thoracoscopic procedure and open the chest whenever the carcinologic rules cannot be respected.

We thank Nadine Thiebaut for her assistance.

References

1. Skinner DB. En bloc resection for neoplasms of the esophagus and cardia. J Thorac Cardiovasc Surg 1983;85:59–71.
2. Collard JM, Otte JB, Reynaert M, Fiasse R, Kestens PJ. Feasibility and effectiveness of en bloc resection of the esophagus for esophageal cancer. Results of a prospective study. Int Surg 1991;76:209–13.
3. Collard JM, Laterre PF, Reynaert M, Otte JB, Kestens PJ. Unusual but severe complications following en bloc resection of the oesophagus for cancer. Gullet 1992;2:129–31.
4. Liebermann-Meffert D, Luescher U, Neff U, Ruedi T, Allgower M. Esophagectomy without thoracotomy: is there a risk of intramediastinal bleeding? Ann Surg 1987;206:184–92.
5. Collard JM, Otte JB, Jamart J, Reynaert M, Kestens PJ. An original technique for lengthening the stomach as an oesophageal substitute after oesophagectomy. Preliminary result. Dis Esoph 1989;2:171–4.
6. Otte JB, Lerut T, Collard JM, Breckx JF, Gruwez J, Kestens PJ. Les plasties coliques de l'oesophage. Acta Chir Belg 1982;82:389–96.
7. Postlethwait R. Technique for isoperistaltic gastric tube for esophageal by-pass. Ann Surg 1979;189:673–6.
8. Gossot D, Fourquier P, Celerier M. Thoracoscopic esophagectomy: technique and initial results. Ann Thorac Surg 1993;56:667–70.
9. Descottes B. Thoracoscopic esophagectomy. Presented at the Eighth Giornate Internazionali Sulle Malattie Dell'esofago. Milan, Italy, March 15–16, 1993.