Initial clinical outcomes after completion of training in a Canadian Royal College thoracic surgery program

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Background: Thoracic procedures are currently performed by general and thoracic surgeons. Initial clinical outcome after training is a good measure of the quality of the surgical training received. **Methods:** We examined the morbidity and mortality for pneumonectomy, lobectomy and esophagectomy during one surgeon's first 2 years of practice; we collected data prospectively. The results were based on the experience of the only dedicated thoracic surgeon (5 years of general surgery and 3 years of thoracic surgery training with certification from the Royal College of Physicians and Surgeons of Canada) at the largest tertiary care hospital of Brown University School of Medicine. **Results:** During the 2-year period, 154 major pulmonary resections (20 pneumonectomies, 134 lobectomies) and 25 esophagectomies (18 transhiatal, 4 Ivor-Lewis, 2 thoracoabdominal, one 3-incision) were performed. Mortality for major lung resection was 1.9% (pneumonectomy 5%, lobectomy 1.5%), and morbidity was 27% (pneumonectomy 35%, lobectomy 26%). Mortality for esophagectomy was 4%, and morbidity was 36% (anastamotic leak 12%). **Conclusions:** These results compare favourably with clinical outcomes published from several large series. Thoracic surgical training in Canada is adequate and prepares surgeons well to perform major thoracic procedures. A database of the initial results from all graduates of thoracic surgery training in Canada is needed. Such a database could be used to compare the initial results of thoracic procedures performed by general and thoracic surgery graduates from Canada and the United States.

Contexte : Les interventions thoraciques sont actuellement pratiquées par des chirurgiens généraux et thoraciques. Le résultat clinique initial après la formation constitue une bonne mesure de la qualité de la formation reçue en chirurgie. **Méthodes :** Nous avons analysé les taux de morbidité et de mortalité à la suite d'une pneumonectomie, d'une lobectomie et d'une œsophagectomie au cours des deux premières années de pratique d'un chirurgien. Nous avons recueilli des données de façon prospective. Les résultats reposaient sur l'expérience du seul chirurgien thoracique spécialisé (5 ans de chirurgie générale et 3 ans de chirurgie thoracique avec certification du Collège royal des médecins et chirurgiens du Canada) au plus important hôpital de soins tertiaires de la Faculté de médecine de l'Université Brown. **Résultats :** Au cours de la période de deux ans, on a pratiqué 154 résections pulmonaires majeures (20 pneumonectomies, 134 lobectomies) et 25 œsophagectomies (18 transhiatales, 4 d'Ivor-Lewis, 2 thoracoabdominales, et une à 3 incisions). Dans le cas de la résection pulmonaire majeure, le taux de mortalité s'est établi à 1,9 % (pneumonectomie 5 %, lobectomie 1,5 %) et le taux de morbidité, à 27 % (pneumonectomie 35 %, lobectomie 26 %). Dans le cas de l'œsophagectomie, le taux de mortalité a atteint 4 % et le taux de morbidité, 36 % (fuite à l'anastomose, 12 %). **Conclusions :** Ces résultats se comparent favorablement aux résultats cliniques publiés à la suite de plusieurs séries d'envergure. La formation en chirurgie thoracique au Canada est adéquate et prépare bien les chirurgiens à pratiquer les principales interventions thoraciques. Il s'impose de créer une base de données sur les résultats initiaux de tous les diplômés de programmes de formation en chirurgie thoracique au Canada. Cette base pourrait servir à comparer les résultats initiaux des interventions thoraciques pratiquées par des diplômés en chirurgie générale et thoracique du Canada et des États-Unis.

In medicine today, the public and people who pay for medical care (especially in the United States) are taking a closer look at clinical outcomes as a measure of the quality of care delivered. Many publications have related the volume of surgical procedures to the morbidity and mortality of those procedures and,

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by inference, to the improved care delivered by centres with a high volume of patients. The results of these large series are based on experienced surgeons. However, there has been a paucity of published literature on new graduates and their morbidity and mortality outcomes immediately after surgical training. Such data may be the best measure of the quality of surgical training received. This becomes important in thoracic surgery because of the complexity of these procedures and the fact that, in North America, thoracic procedures are currently performed by surgeons trained in different paths.

Methods

We prospectively collected morbidity and mortality data after major pulmonary and esophageal resections. Morbidity was defined as any complication requiring intervention or prolonging hospital stay. Mortality was defined as death occurring within 30 days of surgery or death in hospital. Pulmonary procedures included were pneumonectomy and lobectomy for malignant disease. Esophageal procedures included esophagectomy by transthoracic or transhiatal route for both benign and malignant disease. We collected the initial 2-year outcome data of 1 thoracic surgeon who completed 5 years of general surgery followed by 3 years of thoracic surgery training-training, as certified by the Royal College of Physicians and Surgeons of Canada. This surgeon is the only dedicated thoracic surgeon at the largest tertiary care hospital of Brown University School of Medicine in Providence, Rhode Island.

Table 1

Patient demographics

Characteristics	Pulmonary (*n* = 154)	Esophageal (*n* = 25)
Men:women	83:71	21:4
Mean age (range), yr	66.4 (39–87)	63.2 (41–83)
Mean FEV1 (range), L	2.00 (0.76–4.88)	
Mean % FEV1 (range)	76.4 (28–145)	
Mean % DLCO (range)	77.0 (33–134)	
Median length of stay, d	7	13
Pathology, no. (%)	73 (47) adenocarcinoma	19 adenocarcinoma
	44 (29) squamous	2 squamous
	12 (8) large cell	3 high-grade dysplasia
	11 (7) bronchoalveolar	1 peptic stricture
	5 (3) carcinoid	
	4 (3) combined adeno/squamous	
	5 (3) other	
Surgical approach, no. (%)	75 (49) posterolateral thoracotomy	18 transhiatal
	73 (47) muscle-sparing thoracotomy	7 transthoracic
	5 (3) video-assisted thoracic surgery	
	1 (1) sternotomy	
Extent of resection, no. (%)	20 (13) pneumonectomy	
	134 (87) lobectomy	
Pathological stage,no.	34 IA, 58 IB	4 I
	4 IIA, 20 IIB	8 IIA, 2 IIB
	23 IIIA, 9 IIIB	7 III
	3 IV	

DLCO = diffusion capacity of lung for carbon monoxide; FEV1 forced expiratory volume in 1 second.

Table 2

Morbidity and mortality of pulmonary resection

	Surgical procedure; no. (%)		
	Pneumonectomy (*n* = 20)	Lobectomy (*n* = 134)	Overall (*n* = 154)
Mortality	1 (5)	2 (1.5)	3 (1.9)
Morbidity	7 (35)	35 (26)	42 (27)

Results

Demographics for patients undergoing major pulmonary and esophageal resection are shown in Table 1. Of the 20 pneumonectomies, 1 involved pericardial resection and 2 involved partial left atrial resection. Of the 134 lobectomies, 15 were bilobectomies, 4 were sleeve resections, 9 involved the chest wall (3 reconstructed with graft), 1 was with an innominate vein (with native vein reconstruction), and 1 was with diaphragm. The individual with single pulmonary resection approached by sternotomy underwent combined lobectomy and coronary artery bypass. The video-assisted approach involved one 5-cm utility incision (without rib spreading) and 3 ports (two 10-mm and one 5-mm), with lobectomy performed in the same manner as open, that is, individual division of the pulmonary artery, pulmonary vein and bronchus. Of the 7 transthoracic esophagectomies, 4 were by Ivor-Lewis, 2 were by left thoracoabdominal, and 1 was by 3-incision approach. All esophageal pathology was located in the lower esophagus or gastresophageal junction, with the exception of 1 patient who had a midesophageal squamous cell carcinoma resected by 3-incision approach. Eight esophagectomy patients received preoperative concurrent chemotherapy and radiation; 3 patients had complete pathological response.

Morbidity and mortality for all patients undergoing major pulmonary resection is shown in Table 2.

Table 3 compares the mortality rate of pneumonectomy and lobectomy with other larger series. Table 4 compares the morbidity rate of pneumonectomy and lobectomy with other larger series and compares the rate of specific complications, in descending order of frequency, that occurred in this study. The single patient with chylothorax after sleeve lobectomy failed conservative management and required operative thoracic duct ligation. There was one death after pneumonectomy by pulmonary embolism and 2 deaths after lobectomy by pneumonia.

Morbidity and mortality for all patients undergoing esophagectomy is shown in Table 5. Table 6 compares the anastamotic leak and mortality rates of transhiatal and transthoracic esophagectomy with other larger series. Table 7 lists the specific complications of all patients undergoing esophagectomy in this study. Three clinical anastamotic leaks occurred after transhiatal esophagectomy, with all patients successfully managed by drainage. There were no contained radiographic leaks in this series. The patient with chylothorax after transhiatal esophagectomy was successfully managed conservatively. There was one death after transhiatal esophagectomy, owing to myocardial infarction.

Table 3

Mortality rates of pulmonary resection compared with large series

			Surgical procedure; %		
Author	Year	No.	Pneumonectomy	Lobectomy	Overall
Current series		154	5	1.5	1.9
Nagasaki et al[1]	1982	961	5.6	1.6	2.1
Ginsberg et al[2]	1983	2220	6.2	2.9	3.7
Ramano and Mark[3]	1992	12 439	11.6	4.2	5.0
Deslauriers et al[4]	1994	783			3.8
Damhuis and Schutte[5]	1996	1577	5.7	1.1	3.1
Duque et al[6]	1997	605	13.4	4.4	6.6
Wada et al[7]	1998	7099	3.2	1.2	1.3

Table 4

Morbidity rates of pulmonary resection compared with large series

Morbidity	Current series	Deslauriers et al[4]	Duque et al[6]
Overall morbidity, %	27	27	32
Lobectomy morbidity, %	26	28	33
Pneumonectomy morbidity, %	35	32	40
Specific complication, %			
Arrhythmia	18	4.7	6.8
Atelectasis	9.1	5.1	3.6
Prolong airleak (> 7 d)	8.4		6.8
Pneumonia	4.5	6.4	5.3
Return for bleeding	2.6		2.5
Empyema	1.9	5.0	4.4
Alcohol withdrawal	1.3		
Chylothorax	1.3		
Respiratory failure/ intubation	1.3	2.4	5.1
Pulmonary embolism	1.3	5.4	0.4
Deep venous thrombosis	1.3		
Wound infection	0.6	2.4	2.5
Ileus	0.6		
Clostridium difficile	0.6		
Bronchopleural fistula		5.1	4.4
Congestive heart failure		2.4	
Cerebral vascular accident		1.9	0.2
Cardiac herniation		1.7	
Myocardial infarction			0.3
Pneumothorax			1.9

Discussion

Clinical outcome data are increasingly important in today's surgical practice, because they may be used to measure the quality of care delivered. Similarly, the quality of a surgical training program can be measured by the initial clinical outcomes of its graduates immediately after training. Published data of immediate results after surgical training are scarce. Roberts[15] described the outcomes of the first 100 coronary bypasses done as a resident with the first 100 bypasses done as an attending physician and found no difference in morbidity and mortality. Ross[16] reported the outcomes of the first 200 carotid endarterectomies performed by 2 surgeons after training with favourable results.

The surgeon in our present study was presented with a unique situation after graduation, being the only dedicated noncardiac thoracic surgeon at the largest tertiary care centre of the university. Such a setting rigorously tests the training of a new graduate and allows for a meaningful comparison with larger published series, because such biases as selecting less complex cases or receiving assistance from senior surgeons are eliminated. In this study, patients were deemed ineligible for major pulmonary resection if the postoperative predicted FEV1 (forced expiratory volume in 1 second) and VO_{2max} (maximum oxygen consumption) were less than 40% and 10 cc/kg/min, respectively, or if a prohibitive major comorbidity was present.

These patients received sublobar resection (wedge or segment), external beam radiation or percutaneous radiofrequency ablation as an alternative treatment.

Morbidity and mortality after pneumonectomy and lobectomy in the current study compared favourably with large published series (Table 3, Table 4). The rate of specific complications after major pulmonary resection was comparable with those published by Deslauriers[4] and Duque,[6] whose data were also collected prospectively (Table 4). Our current series revealed a higher incidence of postoperative arrhythmia. We attribute this to the frequent use of continuous cardiac rhythm monitoring during the first 5 postoperative days. All arrhythmias were supraventricular and all were spontaneously converted back to sinus rhythm without the need of electrical cardioversion or long-term anticoagulation. Similar favourable results were seen with esophagectomies. The number of esophageal resections was small, but the mortality and leak rates appeared comparable to large published series (Table 6). From the Veterans Affairs Medical Center database in one of the largest studies, Bailey[17] reported a morbidity rate of 49.5% and a mortality rate of 9.8% in 1777 patients who underwent all esophagectomies. Our data, showing a morbidity rate of 36% and a mortality rate of 4%, compare favourably.

Currently in North America, thoracic procedures are performed by general and thoracic surgeons (certified by the Royal College of Physicians and Surgeons of Canada or the American Board of Thoracic Surgery). Silvestri[18] has shown that major pulmonary resections performed by thoracic surgeons result in better outcomes than those performed by general surgeons. Our data could be used to compare the initial results of graduates from the other training paths and thus compare the quality of training received for performing these thoracic procedures.

The outcomes of the current study are comparable with the results from large series published by more experienced surgeons. Thoracic surgery training in Canada prepares graduates well to perform complex procedures and to care for complex cases. It is likely that our data not only reflect the adequacy of training but also the importance of supporting services available at a tertiary care centre. A team approach, together with anesthesiology, pulmonary, radiology, pathology, critical care medicine and oncology with specialization in thoracic patients, is needed to achieve such favourable outcomes. However, these data are from a single surgeon. To confirm the conclusion, data from other graduates of Canadian thoracic surgery programs and from even more complex thoracic procedures (such as tracheal resections and transthoracic antireflux procedures) are needed. In the future, it may be important to create a database of initial clinical outcomes from new graduates of all surgical specialties. This measure of the quality and adequacy of surgical training received might allow for the identification of areas requiring improvement in the training program.

Table 5

Morbidity and mortality of esophageal resection

	Surgical procedure; no. (%)		
	Transhiatal (*n* = 18)	Transthoracic (*n* = 7)	Overall (*n* = 25)
Mortality	1 (5.6)	0	1 (4)
Morbidity	8 (44)	1 (14)	9 (36)

Table 6

Anastamotic leak and mortality rates of esophagectomy compared with large series

Author	Year	No.	Anastamotic leak, %	Mortality, %
Transhiatal				
Current series		18	16.7	5.6
Katariya et al[8]	1994	1353	15	7.2
Gandhi and Naunheim[9]	1997	1192	12	6.7
Orringer et al[10]	1999	1185	13	4
Transthoracic				
Current series		7	0	0
Lozac'h et al[11]	1997	264	7	4.5
Visbal et al[12]	2001	220	4.5	1.4
Swanson et al[13]	2001	250	8	3.6
Griffin et al[14]	2002	228	4	4

Table 7

Specific complications after esophagectomy (*n* = 25)

Complication	No. (%)
Arrhythmia	4 (16)
Anastamotic leak	3 (12)
Wound dehiscence	2 (8)
Pneumonia	2 (8)
Myocardial infarction	1 (4)
Splenic injury/ splenectomy	1 (4)
Reintubation	1 (4)
Urinary tract infection	1 (4)
Chylothorax	1 (4)
Recurrent nerve injury	1 (4)
Wound infection	1 (4)
Epidural abscess	1 (4)

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