Early outcomes of surgery for oesophageal cancer in a thoracic regional unit. Can we maintain training without compromising results?[†]

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Abstract

OBJECTIVES: Meaningful exposure to oesophageal cancer surgery during general thoracic surgical training is restricted to few centres in the United Kingdom. Our Regional Tertiary Unit remains a rare 'large-volume' oesophagectomy centre. We aimed to determine the proportion of patients operated by trainees and their perioperative outcomes.

METHODS: From January 2004 to September 2009, 323 patients (229 male and 94 female, median age of 69 (range 40–92) years) underwent oesophagectomy for carcinoma in our Thoracic Surgical Unit. Data were complete and obtained from a prospective departmental database. The preoperative characteristics, operative data and postoperative results were compared between the 120 patients (37%) operated by a trainee (group T) and the remainder 203 patients operated by a consultant (group C).

RESULTS: The overall incidence of mortality, anastomotic leak and chylothorax were 6.5%, 5.3% and 2.2%, respectively. There were no differences in terms of age, gender, tumour location, tumour staging, preoperative spirometry or use of neoadjuvant chemotherapy between the two groups. There was no significant difference between the consultant group and the trainee group in the following key outcome measures: postoperative mortality (8% vs 4%), incidence of respiratory complications (30% vs 25%), hospital stay (14 days vs 13 days) and number of lymph nodes excised (median of 16 vs 14).

CONCLUSIONS: Training in oesophageal cancer surgery can be provided in a large-volume thoracic surgical unit. It does not seem to compromise outcomes or use of resources.

Keywords: Oesophagectomy • Outcome • Morbidity • Mortality • Training

INTRODUCTION

Oesophageal resection is perceived as one of most challenging operations. In spite of careful patient selection and optimisation of preoperative risk factors, it is associated with high mortality and morbidity rate [1]. Historically, a large number of resections were performed in thoracic units in the UK; however, in the last few years these operations are more frequently performed by general surgeons with an upper gastrointestinal interest within the setting of an oesophageal and gastric cancer service.

Oesophageal surgery is now rarely performed in thoracic surgical units in the UK. Numbers of oesophageal resections for cancer by the thoracic surgeons in years 1996–97 and 2004–05 were approximately 940 and 260, respectively [2]. Extended exposure to oesophageal surgery during general thoracic surgical training is restricted to few centres the UK. As there is a clear impact of the relative experience of the surgeon on the operative mortality and the long-term survival after oesophageal

resection, it is of paramount importance to achieve a reasonable level of training before independent practice [3]. The influence of the surgical unit volume and the individual surgeon volume has also been discussed [1,4–8]. Our Regional Tertiary Unit remains a rare 'large-volume' oesophagectomy centre committed to training the younger surgeons. We aimed to determine the proportion of patients operated by trainees and identify the impact of training on the early outcome.

MATERIALS AND METHODS

Patients

The study population comprised of 323 consecutive patients (229 male and 94 female), with a median age of 69 (range: 40–92), who underwent oesophagectomy for carcinoma in the Thoracic Surgical Unit of Nottingham University Hospitals NHS Trust between January 2004 and September 2009. Data were complete and obtained from a prospective departmental

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Table 1: Patients' demographics. Expressed as number (%) or median (range)

	Total N = 323	Group C N = 203	Group T N = 120	p Value
Age	69 (40–92)	70 (49–92)	69 (40–86)	0.7
Older than 75 years	91 (28%)	58 (29%)	33 (28%)	0.9
Male: female	229:94	145:58	84:36	0.8
Body mass index	26 (15–43)	26 (15–23)	26 (16–40)	0.8
Cardiovascular Co-morbidities	174 (54%)	117 (58%)	57 (47%)	0.8
Neoadjuvant Chemotherapy	96 (30%)	73 (36%)	33 (29%)	0.1
FEV ₁ %	93 (41–140)	91 (41–140)	97 (41–140)	0.4

database and reviewed the case notes, where necessary. All patients who underwent oesophagectomy for benign or pre-malignant disease were excluded.

The surgeon in charge of the patient's care decided the surgical approach and did assign the case to trainee (group T) or consultant (group C). When a consultant had to take over a significant part of the procedure, this would be labelled as performed by a consultant. The postoperative care was consultant-led as per our traditional protocols of care and included at least 2-daily visits. A summary of preoperative characteristics is given in Table 1.

The operative technique used was determined by the tumour location on preoperative endoscopy and the individual surgeon's preference. They constituted oesophageal resection by left thoracophrenotomy, left thoracalaparotomy or Ivor-Lewis or McKeown's approach. In those patients undergoing thoracalaparotomy, the anastomosis was performed either in the chest below the aortic arch or via additional cervical incision.

End points

We proceeded to study the following outcomes:

- (1) The proportion of patients operated on by trainees.
- (2) The postoperative stay in intensive care unit (ITU), total hospital stay and postoperative mortality (30-day or inpatient) in both groups.
- (3) Respiratory complications (defined as pneumonia, sputum retention requiring bronchoscopy, atelectasis, pulmonary oedema, acute respiratory distress syndrome (ARDS), pneumothorax or effusion requiring intervention or respiratory failure) and incidence of chylothorax and anastomotic leaks in both groups
- (4) The number of lymph nodes excised in the two groups as per pathology report, including the number of involved lymph nodes.

Statistical analysis

The data are presented as median (range) and number (percentage) unless stated. The analyses were performed using the χ^2 test for qualitative and Wilcoxon rank test for quantitative data.

Table 2: Operative and pathological data. Expressed as number (%) or median (range)

	Total N = 323	Group C N = 203	Group T N = 120	p Value
Tumour location				
Upper 1/3	12 (4%)	7 (3%)	5 (4%)	0.1
Mid 1/3	54 (17%)	35 (17%)	19 (16%)	
Lower 1/3	137 (42%)	97 (48%)	40 (33%)	
GOJ	120 (37%)	64 (41%)	56 (47%)	
Technique				
Left thoracalaparotomy	107 (33%)	81 (40%)	26 (22%)	ns
Left thoracophrenotomy	146 (45%)	82 (40%)	64 (53%)	
Rt sided thoracotomy (Ivor-Lewis + McKeown)	70 (22%)	41 (20%)	29 (24%)	
Cell type				
Squamous cell	64 (25%)	46 (27%)	18 (21%)	0.6
Adenocarcinoma	182 (70%)	116 (67%)	66 (75%)	
Other	14 (5%)	10 (6%)	4 (4%)	
T stage				
T1	39 (15%)	26 (16%)	13 (15%)	ns
T2	43 (17%)	27 (16%)	16 (18%)	
T3	164 (65%)	109 (65%)	55 (63%)	
T4	8 (3%)	5 (3%)	4 (3%)	
N stage				
NO	105 (41%)	77 (45%)	28 (32%)	ns
N1	147 (57%)	91 (53%)	56 (64%)	
N2	4 (2%)	3 (2%)	1 (1%)	
N3	2 (1%)	0	2 (2%)	

Statistical significance was defined by *p* values of less than 0.05 throughout the study.

RESULTS

Overall results

A total of 120 patients (37%) were operated on by a trainee (group T), and the remaining 203 patients operated by a consultant (group C). The overall incidence of mortality, anastomotic leak and chylothorax were 6.5%, 5.3% and 2.2%, respectively. There were five consultants and 13 trainees during the study period. The trainees entered the unit at various stages of their training and there were no more than two to three trainees at a considered time. The overall complications are given in the Table 3.

Consultants versus trainees

The patient profile for two groups with regard to age, body mass index (BMI), forced expiratory volume in 1 s (FEV₁), preoperative chemotherapy and cardiac co-morbidities were compared. There was no significant difference between the median ages of the patients operated by the two groups. The proportion of patients who received preoperative chemotherapy was 29% in the trainee group and 36% in the consultant group (*p* = ns). The trainees operated on 47% of patients who had cardiac co-morbidities whilst in the consultants group it was 58% (*p* = ns).

Table 3: Results on number of lymph nodes excised. Expressed as median (range)

	Number lymph nodes submitted $p = 0.09$	Number of positive lymph nodes $p = 0.02$
Consultant group $N = 203$	16 (2–38)	1 (0–32)
Trainee group $N = 120$	14 (1–44)	2 (0–25)
Total $N = 323$	15 (1–44)	1 (0–32)

Table 4: Postoperative results. Expressed as number (%) or median (range)

	Total $N = 323$	Group C $N = 203$	Group T $N = 120$	p Value
Hospital stay (days)	13 (9–168)	14 (9–116)	13 (9–92)	0.1
Mortality	21 (6.5%)	16 (7.9%)	5 (4.2%)	0.2
Respiratory complications	91 (28%)	61 (30%)	30 (25%)	0.2
Cardiovascular complications	104 (32%)	66 (32%)	38 (32%)	0.9
Chylothorax	7 (2.2%)	6 (3%)	1 (0.8%)	0.3
Anastomotic leak	17 (5%)	12 (6%)	5 (4%)	0.6

The tumour and operative data are summarised in Table 2.

The proportion of patients with T1–T2 stage was 29% for trainees whilst 32% for the consultants. In other words, trainees performed resections on T3–T4 tumours in 71% of the cases, whereas the other group resected 68% of such tumours. The proportion of tumours with N0 and N1 lymph nodes status was 32% and 64%, respectively. In the consultant group, it was 45% and 53%, respectively. The location of the tumour in the oesophagus was comparable in the two groups. It appeared that the trainees performed more patients with gastro-oesophageal junctional (GOJ) tumours (47%) than the consultants (31%). However, the tumour characteristics with regard to T or N stage were not significant statistically.

There were no differences in the number of lymph nodes harvested between the two groups ($p = 0.09$). However, we encountered a larger number of positive lymph nodes in the trainees group of cases, $p = 0.02$ (Table 3).

The postoperative outcomes are given in Table 4.

The in-hospital mortality of the trainee group was 4.2%, whereas it was 7.9% in the consultant group ($p = 0.2$). The proportion of patients who developed respiratory complications in the trainee group was 24% whilst in the other group it was 30% ($p = 0.2$). The incidence of chylothorax was 0.8% and 3% in the trainee and consultant groups, respectively ($p = 0.3$). The anastomotic leak rate was 4.2% and 6% in the same order ($p = 0.6$). The median hospital stay was 13 days in the trainee group and it was 14 in the other group ($p = 0.1$).

In summary, there were no differences in terms of preoperative, tumour and operative characteristics between the two groups. Early outcomes following the oesophageal resections were also similar between the groups.

DISCUSSION

Oesophagectomy carries significant morbidity and mortality rates. In present-day surgical practice, oesophageal resections are performed by general, upper gastrointestinal (GI), thoracic and cardiothoracic surgeons. It has been demonstrated that dedicated training in thoracic surgery has an independent association with the early outcome after oesophageal resection [9, 10]. The operative volume (units performing over 20 resections per year) is also important to achieve low mortality rates around 5% [7].

It is a general belief that procedures performed by trainees might compromise patient outcome, therefore lead to higher morbidity and mortality rates. Goh et al. revealed that most patients were reluctant to have a trainee surgeon operating on them, and the decision was strongly related to the level of education and the age of the patient [11].

There have been several reports looking at the issue of training in oesophageal resections. Putnam et al. reported an overall mortality rate of 6.8% among the thoracic surgical residents who performed the oesophageal resection in 221 patients in seven years [12]. Their anastomotic leak rate, respiratory complication rate and chyle leak was 9%, 9%, and 4%, respectively. In our study, the trainees group had same complications at 4.2%, 24% and 0.8%, respectively. However, our respiratory complications rate is a bit higher, but this might be explained by differences in the definition of complications. Other studies have reported similar incidence of respiratory complication to us [13, 14].

Other manuscripts described similar mortality and complication rates, including anastomotic leaks, in patients operated upon by trainees [15, 16]. Hospitals supporting fellowship training or surgical residency programme did not have higher rates of mortality or total complications [16]. Further, it was interesting that they found that the mortality increased once > 100 cases per year were performed. The reasons for this are not entirely clear but it may reflect with experience that higher-risk patients are offered resection.

Training of junior doctors in other major surgical procedures has been examined in a number of articles: Trainees can perform pulmonary lobectomies without compromising short- or intermediate-term patient outcome [17]. Outcomes after cardiac surgery have been reported similar between consultants and supervised trainees both in raw data [18] and in a risk-stratified setting [19]. Overall hospital stay or costs after cardiac surgery are not compromised either [20].

Borowski et al. investigated the involvement of surgical trainees in surgery for colorectal cancer and their effect on outcome, and revealed that there was no difference in anastomotic leak rates, operative mortality or survival between unsupervised trainees, supervised trainees and consultants when case-mix adjustment was applied [21]. With careful supervision, intracranial aneurysm surgery can be safely delegated to trainees without compromising patient outcomes [22].

A multicentre prospective study of total hip replacements found that there was no significant difference in outcome between the operations undertaken by trainees and trainers [23]. However, they noted that the total operation time was significantly shorter when the assistant was a surgeon's assistant. By contrast, adverse effects on outcome following certain operations such as varicose vein surgery [24] and lower limb amputations by unsupervised trainees have been reported.

We acknowledge that there are potential areas of bias in our work, which is the result of a retrospective study. In addition, the consultants tend to stay in the unit for longer time, whereas the trainees tend to leave the unit after varying periods of time. Therefore, the exact number of cases performed by a trainee varied between 2 and 40. The results of our study could be biased by the disparity between the two groups. Therefore, the conclusions derived for all 5 years may not equally represent certain periods within the study time.

The reason that the mortality for trainees is lower could be for two reasons. First, there could be a selection process going on, which means that although the demographics and tumour characteristics between the two groups look the same, there are some hidden features which most certainly mean that the consultants are doing some of the more complex cases.

Second, it is very likely that if a trainee encountered difficulty during a procedure that the consultant would take over and complete the operation. Unfortunately, our data are retrospective and they have not been recorded on our database as to how often this has occurred. In summary, our data suggest that training in oesophageal cancer surgery can be provided in a large-volume thoracic surgical unit. It does not seem to compromise outcomes, and will maintain the flow of new well-trained specialists for the future.

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APPENDIX A. CONFERENCE DISCUSSION

Dr M. Ferguson (Chicago, IL): This is a stimulating and informative study describing outcomes of esophagectomy for cancer among CT trainees and consultant surgeons in a busy unit in Nottingham. This topic is important because, as surgery for small volume, yet critical procedures becomes more regionalized, there is less opportunity for training. This is especially the case in the U.K. and the rest of Europe where much of the esophageal surgery is being performed by general surgeons rather than CT surgeons.

The unit in which this work was done is considered a high volume unit. The definition of high volume varies depending on who is categorizing the data. Most clinical surgeons will agree that high volume exceeds a certain number per year, such as 20 or 30 per surgeon. From a statistical perspective, high volume is often defined as the top quintile or decile of annual volume. From a payor's perspective, high volume is perhaps cynically defined as that volume which directs patient flow into the proper number and distribution of clinical units.

The annual number of esophagectomies in the unit in this study was 56, which most I think would consider to be high volume. However, the annual number of esophagectomies per consultant was about 7, which most surgeons would not consider to be high volume. My first question then is, how was high volume defined in this study and is that volume sufficient to differentiate the performance of trainees from consultant surgeons?

One of the questions raised by the authors is how should trainee surgeons be instructed in the performance of uncommon operations. Obviously the CT trainees in Nottingham are fortunate in being at a high volume center, but is this number sufficient for adequate training? By my estimate, the number of procedures performed annually by trainees during the period of study was

low. My second question is, what do the authors believe to be an adequate number of esophagectomies for adequate training?

Finally, most surgical trainees will not undergo instruction at high volume centers for operations such as esophagectomy. How do the authors suggest that such trainees receive instruction in these types of operations?

Dr Handagala: I know in the literature there have been papers published in the 1990s where the high volume centers are considered as units performing more than 20 cases per year, but in our study the trainees performed nearly 120 cases during this five-year period. That comes to about 24 cases per year if you divide it between five years. I think the Nottingham unit is a special unit when you consider it is not a pure upper GI training unit but a general thoracic surgical unit. Because the four surgeons enrolled are interested in doing esophageal surgery, I don't think any other U.K. unit gets this much important esophageal surgery if you consider the volume rate.

Dr T. Lerut (Leuven, Belgium): The presentation confirms the general idea that trainees can perform equally as well as their trainers and their consultants, but perhaps the question comes in line with that of the previous discussion. There were five consultants, but is there in the unit a specialization, where one or two consultants are more specifically concentrating on the esophageal part of the work as compared to the others who are concentrating more, for instance, on the pulmonary part? As to the trainees, it may be important to know at what stage trainees are allowed to do an esophagectomy. I presume they would be trainees at a more senior stage of their training. Is there a protocol: at how many esophagectomies does a trainee have to assist before being allowed to do esophagectomy independently? Is there a first stage where the trainee performs some steps of the operation - for instance, a gastric tabulation - and then in another patient a lymphadenectomy, and in a third patient an esophageal anastomosis? Could you comment on how the protocol operates before you get to the stage of doing it entirely yourself?

Dr Handagala: The surgeons who performed the esophageal resections, the trainees are usually in their third year of general surgical training when they are in the thoracic training program. Out of the three surgeons performing at the moment, the extent to which the trainee is given the opportunity

to operate independently differs between individual surgeons. This is a common factor for all the surgeons irrespective of their specialty. Trainees initially assist the surgeon, then partly perform, and later become the principal operator

Dr M. El Jamal (Amman, Jordan): You compared the outcomes and the results in two groups: first, the group which was performed by consultants and the second which was performed by the trainees. My question refers to the trainees. In which year of training were they allowed to perform this kind of surgery, third year, fourth year, or those who finished their training and are awaiting examination? And the second question, were these trainees allowed to operate independently or they were supervised by the consultant or they were assisted by the consultant?

Dr Handagala: As I said, it is after the third year of the formal training program, and regarding the independent surgery, initially the trainees assist the surgeon for about 15 to 20 cases and then take over the function of principal operator. Otherwise, I don't think any of the surgeons would allow the trainee to operate.

Dr A. Martin-Ucar (Nottingham, UK): Just a brief comment. The unit is run by only three esophageal surgeons within the thoracic unit. There has been a change of personnel in the five-year period. The same with the trainees. There are not 13 trainees in there all the time doing one esophagectomy a year. At any one time, there are two or three trainees doing training with us, so they do an average of about 20 esophagectomies per year between them. And so the numbers are not exactly what Professor Ferguson was saying.

Regarding the level of training, we are part of the regional training program, and a lot of trainees are cardiothoracic trainees doing one year of thoracic training, which may be the second year, the fourth year, or the fifth year of their training. I was doing esophagectomies supervised by my colleagues when I was in second year. Some other surgeons will do them in their final year of training.

I hope that clarifies a little bit how we perform in the unit. But we are basically the final training thoracic esophageal unit in the UK, and it is a real shame.