Ventilatory and intensive care requirements following oesophageal resection

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ABSTRACT

INTRODUCTION The aim of this study was to analyse the results of early postoperative extubation following oesophagectomy.

PATIENTS AND METHODS All patients who had undergone oesophageal resection between 1994 and 2001 were identified from a prospectively collected database. Their records were then reviewed in order to analyse morbidity and mortality along with intensive care unit (ICU) and ventilatory requirements. All patients were extubated immediately following surgery and monitored on a surgical high dependency unit (HDU).

RESULTS A total of 98 resections were undertaken (76 men; mean age, 64.3 years; range, 40–80 years). Surgical procedures were Ivor-Lewis (71), left thoraco-abdominal (15) and transhiatal (12) oesophagectomies. Overall, 8 patients died and 13 patients had anastomotic leaks. Sixteen patients required ventilation and admission to ICU, of whom 5 died. Three patients died on HDU following an elective decision not to transfer to ICU. Reasons for ventilation and ICU admission were anastomotic leaks (6), respiratory problems (6), left ventricular failure (1), cardiac arrest (1), small bowel herniation through the hiatus (1) and ischaemic stomach requiring revision of anastomosis (1). No patient required ventilation and admission to ICU within 48 h of original surgery.

CONCLUSIONS Patients undergoing oesophageal resection can be safely managed on a surgical HDU without routine postoperative ventilation. Although ventilation and ICU will be required in a significant number due to postoperative complications, this is unlikely to occur in the first 48 h. The requirement for an ICU bed to be available on the day of surgery should, therefore, no longer be considered necessary. This has important implications for the scheduling of elective oesophageal surgery.

KEYWORDS

Oesophagectomy – Postoperative ventilation – Intensive care

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Oesophagectomy is a major procedure, often undertaken on elderly patients and those with significant co-morbidity. It is common in many units for patients to be managed in the first 24 h or so after surgery in the intensive care unit (ICU), with delayed extubation. Most of the enthusiasm for this stems from work before the advent and wide-spread adoption of thoracic epidural analgesia when several studies suggested results were better following a period of postoperative ventilation, some for up to 2 days.¹ However, there are undoubtedly potential problems associated with this approach including progressive deterioration in lung compliance, functional residual capacity and arterial blood gases. Furthermore, it is the patients with pre-existing lung disease who are most at risk of developing the respiratory complications of ventilation. Weaning may also be

prolonged and difficult in mechanically ventilated patients, and is exacerbated by decreasing respiratory muscle strength in malnourished patients, with a tendency to develop muscle atrophy in mechanical ventilation. Not surprisingly, this is associated with increased morbidity and mortality.²

However, with the more wide-spread use of high thoracic epidural anaesthesia and the increasing prevalence of surgical high dependency units (HDUs), immediate extubation following surgery is becoming more common.³ Indeed, some studies have suggested it produces better results.^{4,5} One study has shown that fatal respiratory complications after oesophagectomy were reduced from 16% to zero by the introduction of double lumen endotracheal intubation, epidural analgesia and early and aggressive postoperative

Table 1 Total morbidity and mortality rates of oesophagectomy patients

Operation	Cases (<i>n</i>)	Patients with complications* (<i>n</i>)	Complications* (<i>n</i> = 36)			Deaths
			Respiratory†	Anastomotic leaks	Other‡	
Ivor-Lewis	71 (72.4%)	23 (32.4%)	10 (14.1%)	10 (14.1%)	6 (8.5%)	6 (8.5%)
Left thoraco-abdominal	15 (15.3%)	4 (26.7%)	2 (13.3%)	1 (6.7%)	2 (13.3%)	1 (6.7%)
Transhiatal	12 (12.2%)	5 (41.7%)	2 (8.3%)	2 (16.7%)	1 (8.3%)	1 (8.3%)
Total	98	32 (32.7%)	14 (14.3%)	12 (12.2%)	8 (8.2%)	8 (8.2%)

*4 patients suffered more than 1 complication.

†Respiratory complications included infection, pulmonary embolism, respiratory failure.

‡Other complications, e.g. cardiac, renal, wound.

physiotherapy and mobilisation, avoiding where possible postoperative ventilation.⁶ This policy also reduces the demand on ICUs, which are already overstretched in most UK hospitals, and prevents the operation being cancelled if an ICU bed is not available. Since 1994, we have followed a policy of routine, immediate postoperative extubation following oesophageal resection, with management of patients on a dedicated surgical HDU.

Patients and Methods

All patients who had undergone oesophageal resection between January 1994 and June 2001 were identified from a prospectively collected database, which included data on age, sex, histological diagnosis, operation performed, date of surgery, details of complications and in-hospital mortality. These records were then reviewed in order to analyse additional information on ICU requirements and ASA grade. The operative procedures depended on the site of tumour and the state of the patient but the Ivor-Lewis sub-total oesophagectomy with two-field lymphadenectomy was performed preferentially.⁷

All patients undergoing a thoracotomy underwent single lung anaesthesia and a thoracic epidural. Standard procedure was to place the epidural catheter in a low thoracic position (T9–10 to T11–12). Intra-operative administration of 10–15 ml of 0.5% bupivacaine and 1.5–2 mg of diamorphine was followed postoperatively by an epidural infusion of 0.125% bupivacaine and 30 µg/ml diamorphine at 10–15 ml/h. More recently, we have employed a second upper epidural catheter (T2–3 or T3–4) for Ivor-Lewis procedures administering 3–5 ml 0.125% bupivacaine per hour. This seems to provide improved analgesia for patients undergoing upper right thoracotomy.⁸ Patients were extubated in the recovery room and a routine postoperative chest X-ray obtained to ensure full re-expansion of the lungs. Patients

were then transferred to a large surgical HDU. This had a nurse:patient ratio of 1:2 (with nurses who are experienced in the management of complex postoperative patients) and facilities for both invasive and non-invasive monitoring, in addition to non-invasive ventilatory support. Patient management in the HDU was supervised by the operating surgical team in conjunction with the anaesthetic staff. The epidural catheter remained for as long as adequate analgesia was obtained, usually 48–72 h, but sometimes longer. After 72–96 h, most patients progressed to an intravenous, patient-controlled, analgesia system using morphine. Anastomotic integrity was assessed on day 6 with a water-soluble contrast study following which oral nutrition was commenced and the chest drains were removed.

Data were entered into an electronic spreadsheet and analysed using statistical SPSS software (Statistical Package for Social Sciences, SPSS Inc., Chicago, IL, USA). The statistical analyses presented use standard descriptive statistics and conventional tests of significance for comparisons. Statistical significance was set at the 5% level.

Results

Over the 7.5-year period, following the establishment of the unit in 1994, 100 oesophageal resections were undertaken (76 men; mean age, 64.3 years; age range, 40–80 years). Of the 98 procedures performed, 81 were for adenocarcinomas and 17 for squamous carcinomas. The operations included 71 Ivor-Lewis oesophagectomies, 15 left thoraco-abdominal procedures, and 12 transhiatal resections (Table 1). A total of 32 patients suffered complications (4 patients had more than one complication): there were 7 chest infections (including one MRSA pneumonia), 4 pleural effusions (2 were infective from associated chest infections), 2 pulmonary emboli, 2 wound infections, 1 empyema, 1 pancreatic fistula, 1 ischaemic proximal stomach (requiring a return to theatre for revision),

Table 2 ICU admission rates for oesophagectomy patients

Operation	Patients requiring ICU admission (n)	Reasons for admission			Deaths on ICU
		Respiratory failure†	Anastomotic leaks	Other	
Ivor-Lewis (n = 71)	12 (16.9%)	4 (5.6%)	6 (8.5%)	2 (2.8%)	3 (4.3%)
Left thoraco-abdominal (n = 15)	2 (13.3%)	1 (6.7%)	0 (0.0%)	1 (6.7%)	0 (0.0%)*
Transhiatal (n = 12)	2 (16.7%)	1 (8.3%)	0 (0%)	1 (8.3%)	1 (8.3%)
Total (n = 98)	16 (16.3%)	6 (6.1%)	6 (6.1%)	4 (4.1%)	4 (4.1%)

*One patient with MRSA pneumonia and chronic renal failure gradually deteriorated and died on HDU 1 month following surgery, after having initial treatment on ICU. †Respiratory failure due to infection or collapse.

1 small bowel herniation through the hiatus (found to be perforated on return to theatre), 1 cardiac failure, 1 cardiac arrest (following which the patient survived), 1 anastomotic stricture and 1 acute-on-chronic renal failure. Thirteen patients had anastomotic leaks (13.3%). Of these 13 anastomotic leaks, 7 were managed on HDU and survived, with the remaining 6 requiring ventilation and transfer to ICU (5 died, 1 recovered: 2 patients required return to theatre). Overall, 16 patients required ventilation and admission to ICU (16.3%) and 8 patients died in total (8.2%): 4 patients died on the ICU (Table 2), 3 patients died on HDU and one patient died on the ward. Of the 3 patients who died on HDU, 2 died following an elective decision not to transfer to ICU (one patient with MRSA pneumonia and chronic renal failure 1 month after surgery, who gradually deteriorated after having initially been treated on ICU; one patient with severe chronic obstructive pulmonary disease (ASA 4) in whom a decision had been made pre-operatively, that postoperative ventilation would not be undertaken if non-invasive ventilatory support was inadequate; and one patient who deteriorated rapidly from cardiorespiratory problems on day 3 after surgery and died before he could be transferred to the ICU). The one patient who died on the ward gradually deteriorated from a prolonged leak and advanced disease having initially been treated on the ICU. Reasons for ICU admission were anastomotic leak (6), respiratory failure (6) and one each of cardiac arrest (successfully resuscitated and thought to be due to an acute vaso-vagal problem due to the thoracic epidural analgesia), cardiac failure, small bowel herniation through the hiatus and ischaemic stomach requiring revision of anastomosis. No patient required ventilation and admission to ICU within 48 h of original surgery.

Thoracic epidural analgesia was successfully inserted in 99% of our patients. The one unsuccessful case was in a patient with severe arthritis of the spine in whom no epidural catheter was inserted. This resulted in poorer pain relief and subsequent left lung collapse, which required 3 days in ICU due to respiratory failure. The patient survived

to hospital discharge. However, it should also be noted that high thoracic epidural analgesia was considered to be a contributory factor in the asystolic cardiac arrest experienced by one of the patients.

There was no significant difference in the requirement for ventilation on ICU according to which operation was performed (Fisher's exact test: value = 0.172; $P = 1.00$); 16.9% of the Ivor-Lewis oesophagectomies ($n = 12$), 13.3% of the left thoraco-abdominal oesophagectomies ($n = 2$) and 16.7% of the transhiatal oesophagectomies ($n = 2$) required ICU admission.

There was no significant difference between the ages of the ICU and non-ICU groups ($P = 0.76$, Mann-Whitney U-test). The median age of the ICU and non-ICU groups were 63.5 years (Q1 = 60.5 years; Q3 = 71.25 years) and 63.0 years (Q1 = 56.5 years; Q3 = 71.5 years), respectively. The proportions of men to women in the ICU (12M:4F = 75%:25%) and non-ICU (62M:20F = 75.6%:24.4%) groups were also almost exactly equal.

ASA scores were collected for all 98 oesophagectomy patients (Table 3). There was no significant statistical difference between the ASA scores of the ICU and non-ICU groups ($p = 0.42$, Mann Whitney U-test).

Table 3 ASA grades of oesophagectomy patients in the ICU and non-ICU groups

ASA grade	ICU group (n = 16)	Non-ICU group (n = 82)
1	2 (12.5%)	22 (26.8%)
2	7 (43.8%)	31 (37.8%)
3	5 (31.3%)	27 (32.9%)
4	1 (6.3%)	2 (2.4%)
5	0 (0.0%)	0 (0.0%)

There was no significant statistical difference between the ASA scores of the ICU and non-ICU groups ($P = 0.42$, Mann Whitney U-test).

The mean postoperative hospital stay for patients not requiring ICU was 17 days (range, 6–47 days) and for those requiring ICU 44 days (range 3*–142 days; *patient died). Not surprisingly, there was a very significant difference between the length of hospital stays of the ICU and non-ICU groups ($p < 0.001$, Mann-Whitney U-test).

Discussion

This study has demonstrated that although postoperative ventilation and ICU support was required in 16% of our patients undergoing oesophageal resection, it is not required within the first 48 h. Patients can be safely managed by early extubation and care on a surgical HDU with mortality and morbidity similar to those reported from other centres.^{9,10} The two most frequent and significant complications following oesophageal resection are anastomotic leakage and pulmonary complications and this was also the case in our study.^{6,11,12,14} In our study, 6 of the patients who required re-intubation had anastomotic leaks and it is generally accepted that the median time for presentation post-surgery is around 8 days.¹⁵ Although it is possible that ICU care might lead to better postoperative management within the first 48 h and as a result reduce the subsequent complications of gastric tube ischaemia and anastomotic leakage, prolonged intubation *per se* would be unlikely to reduce these complications. Similarly, respiratory complications following oesophagectomy remain a significant problem and it is also unlikely that routine postoperative ventilation would reduce the incidence. The use of thoracic epidural analgesia has certainly facilitated the implementation of a policy of early extubation in our unit and was successful in 99% of our patients. We would emphasise, however, that these are complex patients and an appropriate level of staffing and monitoring is essential in the HDU. In fact, following a move to our new hospital site in 2003, the ICU also houses HDU beds and, therefore, our patients have the benefit of intensive care support but without postoperative ventilation.

Hulscher *et al.*¹⁴ compared extended transthoracic resection versus limited transhiatal resection for adenocarcinoma of the oesophagus and noted a median ICU–MCU (medium care unit) stay of 2 days (range, 0–38 days) with the transhiatal group and 6 days (range, 0–79 days) with the transthoracic group. The median ventilation time was 1 day (range, 0–19 days) in the transhiatal group and 2 days (range, 0–76 days) in the transthoracic group. As reported here, their study had pulmonary complications and anastomotic leakage as the main complications, but also a higher rate of cardiac complications (17/106 in transhiatal group and 30/114 in transthoracic group). The ASA scores of their studied population were either 1 or 2 (predominantly 2, but no higher). This contrasts to our study population, which

contained 35 (35.7%) patients with ASA grade 3 or 4. This may explain, in part, our higher in-hospital mortality rate of 8% (compared to 4% with the transthoracic group and 2% with the transhiatal group in their series).

Conclusions

Oesophageal resection remains a procedure with a high morbidity and significant mortality and ICU is still required at some stage in a significant number of patients (16% in our study). As all these complications developed after 48 h in our cohort of patients, the requirement to keep an available ICU bed free before commencing oesophagectomy should no longer be considered necessary. This has important implications for the scheduling of elective surgery.

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