Reduction in length of stay for patients undergoing oesophageal and gastric resections with implementation of enhanced recovery packages

J Tang, DJ Humes, E Gemmil, NT Welch, SL Parsons, JA Catton

Nottingham University Hospitals NHS Trust, UK

ABSTRACT

INTRODUCTION The high mortality and morbidity associated with resection for oesophagogastric malignancy has resulted in a conservative approach to the postoperative management of this patient group. In August 2009 we introduced an enhanced recovery after surgery (ERAS) pathway tailored to patients undergoing resection for oesophagogastric malignancy. We aimed to assess the impact of this change in practice on standard clinical outcomes.

METHODS Two cohorts were studied of patients undergoing resection for oesophagogastric malignancy before (August 2008 – July 2009) and after (August 2009 – July 2010) the implementation of the ERAS pathway. Data were collected on demographics, interventions, length of stay, morbidity and in-hospital mortality.

RESULTS There were 53 and 55 oesophagogastric resections undertaken respectively for malignant disease in each of the study periods. The median length of stay for both gastric and oesophageal resection decreased from 15 to 11 days (Mann–Whitney U, $p < 0.001$) following implementation of the ERAS pathway. There was no significant increase in morbidity (gastric resection 23.1% vs 5.3% and oesophageal resection 25.9% vs 16.7%) or mortality (gastric resection no deaths and oesophageal resection 1.8% vs 3.6%) associated with the changes. There was a significant decrease in the number of oral contrast studies used following oesophageal resection, with a reduction from 21 (77.8%) in 2008–2009 to 6 (16.7%) in 2009–2010 (chi-squared test, $p < 0.0001$).

CONCLUSIONS The introduction of an enhanced recovery programme following oesophagogastric surgery resulted in a significant decrease in length of median patient stay in hospital without a significant increase in associated morbidity and mortality.

KEYWORDS

Oesophageal – Gastric – Malignancy – Resection – Enhanced recovery

Accepted 20 December 2012

CORRESPONDENCE TO

David Humes, Lecturer in Surgery, QMC Campus, E Floor, West Block, Nottingham University Hospitals NHS Trust, Derby Road, Nottingham NG7 2UH, UK, T: +44 (0)115 823 1143; F: +44 (0)115 823 1160; E: david.humes@nottingham.ac.uk

Surgical resections for oesophageal and gastric malignancy are associated with significant morbidity and mortality.¹ Anastomotic dehiscence is the most serious complication of this surgery.² The 2010 National Oesophago-Gastric Cancer Audit reported leak rates of 8.3% (95% confidence interval [CI]: 7.2–9.6%) for oesophagectomy and 5.9% (95% CI: 4.7–7.2%) for gastrectomy.¹ The combination of major surgery and the potential for major complications has resulted in a cautious approach to the postoperative management of these patients.

The use of standardised clinical care pathways following both oesophageal and gastric resection has been shown to reduce length of hospital stay,^{3–6} improve patient satisfaction⁵ and reduce costs.⁴ Optimisation of perioperative parameters affecting patient rehabilitation such as avoidance of prolonged mechanical ventilation, early ambulation, early nutritional support and goal directed management pathways with clearly defined milestones^{7,8} have also been

advocated to improve patient outcomes. There is convincing evidence from colorectal surgery that enhanced recovery after surgery (ERAS) is of benefit in reducing length of stay and complication rates after major open elective surgery.⁹

The Nottingham oesophagogastric unit followed a standard conservative postoperative recovery programme until August 2009. We changed our practice in August 2009 to an ERAS protocol. The aim of this study was to establish if this had resulted in an improved length of stay, morbidity and in-hospital mortality following resection for oesophagogastric malignancy.

Methods

Two cohorts were formed of all patients undergoing resection for oesophagogastric cancer for the year before (August 2008 – July 2009) and after (August 2009 – July 2010) the introduction of the ERAS programme. The patients were iden-

Table 1 Pathways for oesophagectomy/gastrectomy patients before and after implementation of enhanced recovery programme

Day	2008–2009	2009–2010
-1	Admit	Not admitted until day of surgery
0	Extubate as soon as possible if on ventilator Analgesia: epidural +/- patient controlled analgesia	Extubate as soon as possible if on ventilator Analgesia: epidural or paravertebral +/- patient controlled analgesia
1	Leave critical care	Leave critical care Physiotherapy: chest physio and day 1 milestone: > Sit out of bed
2	Leave critical care	Day 2 physiotherapy milestones: > Sit out of bed > Walk minimum of 10m
3	No set goals	Chest drain: change to valved bag rather than underwater seal Physiotherapy: chest physio and day 3 milestones: > Sit out of bed > Walk the length of the ward x2
4	No set goals	Physiotherapy: chest physio and day 4 milestones: > Sit out of bed > Walk the length of the ward x3
5	No set goals	Oral nutrition: if no clinical evidence of leak > Remove nasogastric tube > Start free oral fluids building up to soft diet during day > Remove chest drain and/or abdominal drain and central line (cannula in place) Chest x-ray 4 hours after removal of chest drain > Analgesia: convert from epidural to oral analgesia (paracetamol, MST +/- NSAIDs) and stop epidural > Reduce jejunostomy feed to 10 hours overnight at 50ml/hr only Day 5 physiotherapy milestones: > Walk freely on ward if possible > Shower
6	No set goals	Confirm discharge plan Ensure patient (or carer) is able to flush jejunostomy safely Day 6 physiotherapy milestones: > Shower > Walk independently > Climb stairs
7	As day 5 of enhanced recovery programme following a routine contrast swallow	Full mobilisation and activities of daily living Nutrition: normal diet and food chart Patient given information about Oesophageal Patients Association, discharge information leaflet after oesophagectomy and contact details for nurse specialist Discharge
8	Assessment for discharge (stairs)	
9	Full mobilisation and activities of daily living Continued assessment for discharge	
10	Discharge	

MST = magnesium salicylate; NSAIDs = non-steroidal anti-inflammatory drugs

tified from a prospectively collected database of all those undergoing resection for oesophagogastric malignancy and a retrospective case note review was undertaken. The patient pathways prior to and following implementation of the ERAS programme are summarised in Table 1.

The preoperative education started in the outpatient clinic with both the consultant surgeon and specialist nurse detailing the pathway to the patient, and providing written information on the milestones that the patient was expected

to meet each day. The anaesthetic team limited the amount of opiates given to the patients and epidural anaesthesia or a paravertebral block was used. Fluid resuscitation intra-operatively was conservative. All patients were extubated following surgery in theatre. The ward and intensive care team of nurses, physiotherapists, pharmacists and trainee doctors received induction into the ERAS programme by the lead consultant (JC). In order to provide continuity of care, the specialist nurse attended the patients on a daily ward

Table 2 Demographics for gastrectomy patients

	2008–2009 (n=26)	2009–2010 (n=19)	p-value (Mann–Whitney U test)
Sex	17M, 9F	13M, 6F	–
Age (range)	71.0 (63.0–76.5)	77 (69.5–82.5)	0.027
LOS in days (range)	15.0 (9.8–20.0)	11 (8.0–12.5)	0.01
P-POSSUM mortality (range)	3.4 (1.8–6.6)	6.0 (2.5–7.6)	0.26
Total gastrectomy	11	8	–
Subtotal/partial gastrectomy	15	11	–

M = male; F = female; LOS = length of stay; P-POSSUM = Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity

Table 3 Demographics for oesophagectomy patients

	2008–2009 (n=27)	2009–2010 (n=36)	p-value (Mann–Whitney U test)
Sex	21M, 6F	29M, 7F	–
Age (range)	68.5 (61.8–78.0)	64.0 (60.0–69.3)	0.09
LOS in days (range)	15.0 (12.0–24.0)	11.0 (8.0–15.5)	0.006
P-POSSUM mortality (range)	5.3 (2.7–6.9)	3.5 (2.7–5.0)	0.01
Open	22	22	–
Laparoscopic assisted	5	14	–
LOS in days – open (range)	14.5 (12.0–30.5)	11.0 (8.0–16.5)	–
LOS in days – laparoscopic assisted (range)	16.0 (11.5–17.5)	10.5 (8.0–16.5)	–

M = male; F = female; LOS = length of stay; P-POSSUM = Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity

round to ensure their goals were reached to drive the ERAS programme.

Data were collected using a standard proforma and stored on a password protected Excel® 2007 spreadsheet

(Microsoft, Redmond, WA, US). The included data were age, sex, co-morbidity, type of operation, use of routine swallow, postoperative complications, death and length of stay. Significant morbidity was defined as patients who had a clinically significant anastomotic leak, pneumonia, pulmonary embolus, myocardial infarction or those who returned to the operating theatre. Mortality was classed as in-hospital death. Those patients diagnosed with pneumonia required clinical and radiological evidence of pneumonia, and were treated for hospital acquired pneumonia in accordance with our hospital microbiology guidelines in the absence of another infective source.

Continuous data were compared using the Mann–Whitney U test for non-parametric data while categorical data were compared using chi-squared tests. All analysis was undertaken with Prism® version 5 (GraphPad Software, La Jolla, CA, US). The study was approved by the audit office at Nottingham University Hospitals NHS Trust.

Results

In 2008–2009, 27 oesophageal and 26 gastric resections were performed compared with 36 oesophageal and 19 gas-

Table 4 Postoperative complications and in-hospital mortality; no significant differences in proportions using chi-squared test

	Oesophagectomy		Gastrectomy	
	2008–2009 (n=27)	2009–2010 (n=36)	2008–2009 (n=26)	2009–2010 (n=19)
Morbidity	7 (25.9%)	6 (16.7%)	6 (23.1%)	1 (5.3%)
Readmission	4 (14.8%)	7 (19.4%)	2 (7.7%)	5 (26.3%)
Mortality	1 (3.7%)	2 (5.6%)	0 (0%)	0 (0%)

Table 5 Number of postoperative swallows

	Oesophagectomy		Gastrectomy	
	2008–2009 (n=27)	2009–2010 (n=36)	2008–2009 (n=27)	2009–2010 (n=19)
Swallow	21 (77.8%)	6 (16.7%)*	10 (38.5%)	2 (10.5%)**
Leak	3	3	0	0
Contrast aspiration	5 (23.8%)	1 (16.7%)	0	0

*chi-squared test, $p=0.0001$ **Fisher's exact test, $p=0.04$

tric resections being performed in 2009–2010. The patient demographics are detailed in Tables 2 and 3.

Of those patients undergoing oesophageal resection in the first cohort, 25 had Ivor–Lewis resections while 33 patients in the second cohort had Ivor–Lewis resections. A higher proportion of the oesophageal resections were laparoscopically assisted in the second cohort (18.5% vs 38.8%) but this was not statistically significant (chi-squared test, $p=0.10$). There were no significant differences in the median ages between the patients in each study period in either group. The oesophageal resection patients had a lower median predicted Portsmouth Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity (P-POSSUM) in the second study period compared with the first study period (mortality: 5.3% vs 3.5%; Mann-Whit-

ney U test, $p<0.01$). In 2008–2009 four gastrectomy and three oesophageal patients returned to theatre while in 2009–2010 no gastrectomy patients returned to theatre although three oesophageal patients did.

Gastric resection

The median length of stay for gastric resection patients decreased from 15.0 days (interquartile range [IQR]: 9.8–20.0 days) to 11.0 days (IQR: 8.0–12.5 days) (Mann–Whitney U test, $p<0.01$) (Table 2). The vast majority (89.5%) of those undergoing gastric resection in the second study period were discharged between postoperative days 5 and 14 compared with only 46.2% in the first study period (chi-squared test, $p=0.04$) (Fig 1).

There was a decrease in major morbidity for gastric resection patients in the year following the changes but this was not statistically significant (23.1% [$n=6$] vs 5.3% [$n=1$], $p=0.21$). There were no deaths following gastrectomy in either study period (Table 4).

In 2009–2010 readmission rates for gastric resection patients were higher than in 2008–2009 (26.3% vs 7.7%; chi-squared test, $p=0.11$). In 2009–2010, of those readmitted, one patient had a urinary tract infection, two had diarrhoea (one *Clostridium difficile*) and one had abdominal wound dehiscence following trauma.

Following complete gastrectomy, the number of contrast swallows performed decreased significantly ($p<0.04$) from 13 (38.5%) to 2 (10.5%). There were no cases of missed anastomotic leaks where routine swallows were not performed (Table 5).

Oesophageal resection

The median length of stay for patients undergoing oesophageal resection decreased from 15.0 days (IQR: 12.0–24.0

days) to 11.0 days (IQR: 8.0–15.5 days) (Mann–Whitney U test, $p < 0.006$) (Table 3). Over two-thirds (69.5%) of oesophagectomy patients operated on in the second study period were discharged between postoperative days 5 and 14 compared with only 48.1% in the first study period (chi-squared test, $p = 0.08$) (Fig 2). Despite an increase in the number of patients having laparoscopic assisted oesophageal resection, there was no significant difference between the median lengths of stay of patients who had laparoscopic assisted surgery and those who had open surgery (16.0 vs 10.5 days) (Table 3).

There was a reduction in the morbidity rate for oesophageal resection patients from 25.9% ($n = 7$) to 16.7% ($n = 6$) although this was not statistically significant. The in-hospital mortality rate was 3.7% ($n = 1$) and 5.6% ($n = 2$) respectively in 2008–2009 and 2009–2010 (Table 4).

The readmission rate following oesophagectomy increased from 14.8% ($n = 4$) to 19.4% ($n = 7$) (chi-squared test, $p = 0.73$). In 75% ($n = 6$) of readmissions in 2009–2010 following oesophageal resection, no specific complication was found compared with 25% ($n = 1$) in 2008–2009.

Twenty-one contrast swallows (77.8%) were performed following oesophagectomy in 2008–2009 compared with only six (16.7%) in 2009–2010 (Table 5). All swallows performed in the first study period were due to clinical suspicion of a leak whereas only one of the swallows in the second study period was performed in a patient with suspicion of an anastomotic leak. A third (2/6, 33.3%) of the swallows performed in 2009–2010 confirmed a radiological leak whereas only a tenth (9.5% 2/21) of the swallows confirmed a leak in 2008–2009. The rate of contrast aspiration was 23.8% (5/21) in 2008–2009 and 16.7% (1/6) in 2009–2010.

Discussion

This study reports the implementation of an ERAS programme aimed at improving the length of stay and outcome from major oesophagogastric resection for upper gastrointestinal malignancy. At our institution, it was possible to reduce the length of stay without a significant increase in major complications or mortality. Larger studies from multiple centres will be required to validate the results.

The oesophagectomy patients in 2009–2010 had a lower median age and lower predicted mortality using P-POSSUM. This may reflect a healthier population expected to be discharged earlier. However, the gastrectomy patients had a higher median age in the second study period and a higher predicted mortality, suggesting that patient selection was not entirely responsible for the reduction in length of stay.

Although increased in the second study period, the use of laparoscopically assisted surgery was not associated with a marked reduction in length of stay compared with those patients undergoing an open procedure. All patients were identified from a prospectively collected database of patients having resection for oesophagogastric malignancy.

Other literature

The mortality and morbidity data compare favourably with national audit data¹ (oesophageal resection 4.5% and

gastric resection 6.0%) and other series in which standardised clinical pathways have been used.^{3–5} The length of stay reported is in line with other high volume centres that have implemented similar protocols for oesophageal resection.^{4,5} The length of stay for gastric resection compares favourably with other reports following implementation of fast track surgery regimes.^{6–10} The study by Wang *et al* reported a median length of stay of 6 days following resection in a fast track protocol.⁶ However, the majority of patients in their study had a distal gastric resections. Low *et al* were the first to report on the role of clinical pathways to improve outcomes after oesophageal cancer surgery.⁵

The pathway we describe is more conservative in parts but follows the broad outline of that in Low *et al*'s original paper.⁵ The main differences are the earlier mobilisation on postoperative day 1, a faster target to intensive care unit (ICU) discharge of 12–18 hours and the use of a contrast swallow on the fifth postoperative day in the clinical pathway described by Low *et al*. Our aspiration is to reduce ICU length of stay further as our programme develops.

The use of routine contrast swallows at approximately the seventh postoperative day has been performed historically to examine the integrity of the oesophageal anastomosis before recommencing oral feeding.¹¹ However, more recent studies seem to suggest that swallows should only be performed on clinical concern because of the low sensitivity of this method for detecting leaks.^{11–15} The evidence to support the use of routine contrast swallows is lacking and some studies have shown that swallows should only be requested in cases where an anastomotic leak is suspected clinically.¹¹

Since stopping the routine use of swallows, we have not noted an increase in morbidity or mortality following oesophageal resection or total gastrectomy. It would appear that swallows can be safely requested based on clinical suspicion of a leak. Furthermore, we noted a contrast aspiration rate of more than 20% on swallows performed following oesophageal resection, which is similar to rates quoted by Boone *et al*.¹² We would therefore advocate the use of contrast swallows only in instances where a leak is suspected on clinical grounds.

There was a non-significant increase in readmissions in the year following the implementation of the ERAS pathway. These readmissions were largely for non-significant complications. This suggests that these patients may well require increased support and contact following discharge to enable them to recover safely at home. In a study of patients following a colorectal enhanced recovery programme, it was found that the majority of patients had ongoing symptoms and concerns four weeks following surgery.¹⁴ The authors recommended the use of nurse driven telephone contact lines to allow patients easy access to advice in an attempt to reduce acute hospital admissions. Further preparation of the patient for discharge with detailed information regarding the postoperative recovery has been recommended following other major procedures.¹⁵ The success of ERAS programmes is dependent on multidisciplinary management of the patient at all time points from diagnosis to follow-up.¹⁶

Conclusions

Length of stay following oesophagogastric resection can be reduced by implementation of enhanced recovery measures without a significant increase in morbidity and mortality.

References

1. *National Oesophago-Gastric Cancer Audit 2010*. Leeds: NHS Information Centre; 2010.
2. Alanezi K, Urschel JD. Mortality secondary to esophageal anastomotic leak. *Ann Thorac Cardiovasc Surg* 2004; **10**: 71–75.
3. Cerfolio RJ, Bryant AS, Bass CS *et al*. Fast tracking after Ivor Lewis esophagogastric resection. *Chest* 2004; **126**: 1,187–1,194.
4. Zehr KJ, Dawson PB, Yang SC, Heitmiller RF. Standardized clinical care pathways for major thoracic cases reduce hospital costs. *Ann Thorac Surg* 1998; **66**: 914–919.
5. Low DE, Kunz S, Schembre D *et al*. Esophagectomy – it's not just about mortality anymore: standardized perioperative clinical pathways improve outcomes in patients with esophageal cancer. *J Gastrointest Surg* 2007; **11**: 1,395–1,402.
6. Wang D, Kong Y, Zhong B *et al*. Fast-track surgery improves postoperative recovery in patients with gastric cancer: a randomized comparison with conventional postoperative care. *J Gastrointest Surg* 2010; **14**: 620–627.
7. Brodner G, Pogatzki E, Van Aken H *et al*. A multimodal approach to control postoperative pathophysiology and rehabilitation in patients undergoing abdominothoracic esophagectomy. *Anesth Analg* 1998; **86**: 228–234.
8. Neal JM, Wilcox RT, Allen HW, Low DE. Near-total esophagectomy: the influence of standardized multimodal management and intraoperative fluid restriction. *Reg Anesth Pain Med* 2003; **28**: 328–334.
9. Varadhan KK, Neal KR, Dejong CH *et al*. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. *Clin Nutr* 2010; **29**: 434–440.
10. Grantcharov TP, Kehlet H. Laparoscopic gastric surgery in an enhanced recovery programme. *Br J Surg* 2010; **97**: 1,547–1,551.
11. Lamb PJ, Griffin SM, Chandrashekar MV *et al*. Prospective study of routine contrast radiology after total gastrectomy. *Br J Surg* 2004; **91**: 1,015–1,019.
12. Boone J, Rinkes IB, van Leeuwen M, van Hillegersberg R. Diagnostic value of routine aqueous contrast swallow examination after oesophagectomy for detecting leakage of the cervical oesophagogastric anastomosis. *ANZ J Surg* 2008; **78**: 784–790.
13. Honing J, Pultrum BB, van der Jagt EJ *et al*. Routine or on demand radiological contrast examination in the diagnosis of anastomotic leakage after esophagectomy. *J Surg Oncol* 2009; **100**: 699–702.
14. Wennström B, Stomberg MW, Modin M, Skullman S. Patient symptoms after colonic surgery in the era of enhanced recovery – a long-term follow-up. *J Clin Nurs* 2010; **19**: 666–672.
15. Theobald K, McMurray A. Coronary artery bypass graft surgery: discharge planning for successful recovery. *J Adv Nurs* 2004; **47**: 483–491.
16. Low DE. Evolution in perioperative management of patients undergoing oesophagectomy. *Br J Surg* 2007; **94**: 655–656.

Review articles

The *Annals* publishes reviews that meet the following criteria:

- The review deals with a clinically relevant subject within the practice of any surgical specialty.
- The review contains a brief introduction, a methods section that describes the search strategy used and a clear analysis of all relevant publications.
- Clear conclusions are reached.
- A structured abstract with similar sections is required.

If you are considering submission of a review, please read the relevant section in the instructions to authors (<http://www.rcseng.ac.uk/publications/submissions/authorinstructions.html>) and if you have any doubt about the suitability of the topic, communicate with the Associate Editor (annals@rcseng.ac.uk).