Retrospective cohort study of an enhanced recovery programme in oesophageal and gastric cancer surgery

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ABSTRACT

INTRODUCTION Enhanced recovery programmes have been established in some areas of elective surgery. This study applied enhanced recovery principles to elective oesophageal and gastric cancer surgery.

METHODS An enhanced recovery programme for patients undergoing open oesophagogastrectomy, total and subtotal gastrectomy for oesophageal and gastric malignancy was designed. A retrospective cohort study compared length of stay on the critical care unit (CCU), total length of inpatient stay, rates of complications and in-hospital mortality prior to (35 patients) and following (27 patients) implementation.

RESULTS In the cohort study, the median total length of stay was reduced by 3 days following oesophagogastrectomy and total gastrectomy. The median length of stay on the CCU remained the same for all patients. The rates of complications and mortality were the same.

CONCLUSIONS The standardised protocol reduced the median overall length of stay but did not reduce CCU stay. Enhanced recovery principles can be applied to patients undergoing major oesophagogastrectomy and total gastrectomy as long as they have minimal or reversible co-morbidity.

KEYWORDS

Gastric neoplasms – Oesophageal neoplasms – Surgical procedures – Perioperative care – Enhanced recovery

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Enhanced recovery after surgery (ERAS) or fast track programmes have been well established in elective surgery for colorectal resections and joint replacement.^{1–6} These programmes benefit patients, healthcare providers and those commissioning healthcare by providing earlier recovery with faster return to normal activity as well as improvement in quality of care, productivity, consistency and patient experience with innovative and efficient multi-disciplinary practice.⁷ The aim of this study was to examine the approach to and outcomes of the implementation of an ERAS programme in a group of patients admitted for open oesophageal and gastric resections for adenocarcinoma under a single upper gastrointestinal surgeon at a tertiary referral centre.

Methods

A retrospective audit was performed of the periods prior to (control group) and following (intervention group) the implementation of an ERAS pathway. The study was undertaken in a specialist cancer centre that serves a population of 1.6 million, receiving over 350 new oesophagogastric

referrals, and performing approximately 75 oesophageal and gastric resections annually. All patients involved in the study were under the care of a single oesophagogastric surgeon (WHA).

The control cohort consisted of all patients undergoing surgery between 1 January and 31 December 2009. The intervention was then implemented over a three-month period and the intervention cohort comprised all patients from 1 April 2010 to 31 March 2011. Demographic data on age and sex, and use of preoperative chemotherapy were recorded.

Following the introduction of the intervention, all patients who were fit enough for surgery proceeded along the ERAS pathway as the default. Patients who were not deemed fit enough for oesophagogastric resectional surgery were treated using an alternative pathway. (These patients did not undergo resection and were not included in this study.)

Components of enhanced recovery intervention

The ERAS protocol was developed by a team including a surgeon, an intensivist, anaesthetists, critical care and ward nurses, clinical nurse specialists, dietitians, physiotherapists

and hospital managers. All of the members of the development and implementation group contributed to their specific parts of the pathway. The protocol provided a formalised framework for preoperative assessment, perioperative management and postoperative multidisciplinary care (Table 1).

At the first surgical outpatient contact following discussion at the specialist multidisciplinary team meeting,

patients were assessed with regard to their cancer surgery options and their suitability for radical surgery. In addition, patients were fully assessed by a critical care physician, dietitian and physiotherapist. Patients were supported and counselled by a clinical nurse specialist. The aim of the dietetic and physiotherapy intervention was to maximise nutritional status, address any specific eating difficulties

Table 1 Enhanced recovery protocol

Pathway	Action
Assessment prior to treatment	Patients categorised <ul style="list-style-type: none"> > No co-morbidity > Minimal/modest co-morbidity > Significant co-morbidity/borderline for surgery <ul style="list-style-type: none"> • Full anaesthetic and medical review <ul style="list-style-type: none"> > Proceed with pathway > Withdraw from surgical pathway > Patients unfit for surgery <ul style="list-style-type: none"> • Withdraw from surgical pathway
Day -5 to day before surgery	Immunonutrition <ul style="list-style-type: none"> > Three drinks of 250ml Oral IMPACT® to be taken daily in the morning, late afternoon and evening (to be given by enteral feeding tube if patient unable to swallow)
Day 0 (prior to surgery)	Carbohydrate loading <ul style="list-style-type: none"> > Drink one sachet of Preload™ up to 2h before surgery > Antiemetic to be given as premedication
Day 0 (following transfer to CCU after surgery)	<ul style="list-style-type: none"> > Nil by mouth > Nasogastric tube (NGT) – free drainage and 4-hourly aspirates > Epidural or patient controlled anaesthesia (PCA) > Nil by jejunostomy tube (oesophagogastrrectomy and total gastrectomy) Additional issues <ul style="list-style-type: none"> > There are no indications for using parenteral nutrition in the first 24h following surgery.
Day 1	Care needs <ul style="list-style-type: none"> > Sit out of bed for 1h morning and afternoon (total 2h) > Pedals: two 10-minute periods > Incentive spirometer: 3 sets of 5 breaths each hour > Engage patient in basic personal care tasks while sitting out of bed > Nil by mouth > Nil by jejunostomy tube > Explanation to patient of surgical procedure performed by surgeons at earliest opportunity > Benefits of enhanced recovery programme explained to patient and family
Day 2	Care needs <ul style="list-style-type: none"> > Sit out of bed for 2h morning and afternoon (total 4h) > Mobilise 30m morning and afternoon (total 60m) > Pedals: four 10-minute periods > Incentive spirometer: 3 sets of 5 breaths each hour > Engage in basic personal care tasks while sitting out of bed > Oral intake: 30ml water hourly. NGT to be spigotted. > Chest drain (oesophagogastrrectomy only). Remove apical chest drain after review by surgical team and intensivists. > If patient is receiving inotropes, use of jejunostomy tube may be delayed. Flush with 30ml sterile water. > Commence 25ml of sterile water hourly via jejunostomy tube. Inform dietitian if patient unable to tolerate. (Standard care plan for newly sited jejunostomy tube.) > If patient experiences abdominal distension, bloating or abdominal pain, stop feed immediately and consult team responsible for patient care Additional issues <ul style="list-style-type: none"> > If jejunostomy feeding is delayed, consider parenteral nutrition.

(continued)

Day 3	Care needs <ul style="list-style-type: none"> > Sit out of bed for 3h morning and afternoon (total 6h) > Mobilise 60m morning and afternoon (total 120m) > Pedals: four 10-minute periods > Incentive spirometer: 3 sets of 5 breaths each hour > Engage in personal care tasks, increasing involvement as tolerated > Oral intake: If tolerated, increase fluids. NGT to be spigotted as tolerated if <150ml in last 6h. > Remove epidural or PCA. Ensure adequate analgesia is able to be administered via another route. (Only consider via jejunostomy if patient is absorbing. Medication to be given in liquid form and flushed.) Remove epidural as per standard policy. > Continue jejunostomy feeding (oesophagogastrrectomy and total gastrectomy) as per standard jejunostomy care plan. If patient experiences abdominal distension, bloating or abdominal pain, stop feed immediately and consult team responsible for patient care.
Day 4	Care needs <ul style="list-style-type: none"> > Remove urinary catheter if patient haemodynamically stable > Sit out of bed for 3h morning and afternoon (total 6h) > Mobilise 100m morning and afternoon (total 200m) > Pedals: four 10-minute periods > Incentive spirometer: 3 sets of 5 breaths each hour > Engage in personal care tasks, increasing involvement as tolerated > Free fluids. NGT to be spigotted as tolerated. > Remove abdominal drain if drained <100ml in 24h > Continue jejunostomy feeding
Day 5	Care needs <ul style="list-style-type: none"> > Sit out of bed for 3h morning and afternoon (total 6h) > Mobilise 100m four times daily (total 400m) > Pedals: four 10-minute periods > Incentive spirometer: 3 sets of 5 breaths each hour > Engage in personal care tasks, increasing involvement as tolerated > Oral intake: If tolerated, proceed to light diet and keep food record chart > Continue jejunostomy feeding Monitoring/maintenance of equipment in situ <ul style="list-style-type: none"> > Remove remaining chest drain(s) (oesophagogastrrectomy) > Remove central venous catheter > Continue jejunostomy feeding
Days 6–10	Care needs <ul style="list-style-type: none"> > Sit out of bed for 3h morning and afternoon (total 6h) > Mobilise 100m four times daily (total 400m) > Pedals: four 10-minute periods > Incentive spirometer: 3 sets of 5 breaths three times a day > Engage in personal care tasks, increasing involvement as tolerated > Encourage oral intake and keep food chart > Dietician to review feed and consider overnight feeding > Teach patient how to administer jejunostomy feed as may be required at home > Remove clips if wound clean and dry on day 10
Discharge	<ul style="list-style-type: none"> > Liaise with community dietetics team regarding jejunostomy > Follow-up appointment at 2 weeks > Nutritional supplements if required. Thromboprophylactic heparin to continue for 6 weeks. > Dietary support and advice on exercise, driving, sexual activity and return to work

and optimise cardiopulmonary fitness. Existing co-morbidity was assessed for potential impact on surgery including specialist cardiac or respiratory review and cardiopulmonary exercise testing.

Patients were prescribed 750ml of immunonutrition (Oral IMPACT®; Nestlé Health Science, Liverpool, UK) to be consumed daily for five days before the operation. On the day of surgery, patients received a carbohydrate loading drink consisting of 50g of glucose (Preload™; VitaFlo, Liverpool, UK) two hours preoperatively.

All patients underwent general anaesthesia, and were consented for placement of a thoracic epidural, arterial line and central venous cannula. Lung protective ventilation strategies were employed. Surgery was performed by an open approach consisting of subtotal or total gastrectomy (with D2 lymphadenectomy) for gastric cancer or Ivor-Lewis oesophagogastrrectomy with radical two-field lymphadenectomy for lower third oesophageal and oesophagogastric junctional cancer. A feeding jejunostomy was placed routinely in patients undergoing oesophagogastrrectomy and

total gastrectomy. Perioperative fluid management was goal directed with measurement of cardiac output aiming for neutral fluid balance to reduce the likelihood of postoperative pulmonary complications.

Following surgery, patients were extubated and admitted initially to the critical care unit (CCU; level 3 facility). The postoperative pathway defined early mobilisation, active respiratory exercise with incentive spirometry, early introduction of oral intake and nutritional support. All patients were allowed to commence oral water on day 2. Patients were reviewed daily to decide whether it was appropriate to proceed to the next stage of the pathway. Removal of chest and wound drains was specified by the protocol but modified according to clinical progress. Jejunostomy feeding commenced on day 2. Once established, patients were taught self-administration of jejunostomy feeding.

Prior to implementation of the ERAS protocol, patients were referred for review by surgeons and clinical nurse specialists to other members of the multidisciplinary team as was felt to be appropriate. The immunonutrition was not given to patients prior to the ERAS protocol and the anaesthetic technique was at the discretion of the anaesthetist (with the majority of patients undergoing thoracic epidural). All patients were admitted to the CCU for immediate postoperative care but there was no formalised pathway for their postoperative course.

Outcome measures

The primary outcome measures were total length of stay and length of stay on the CCU including extra days following readmission to the CCU or to the surgical centre. Comparisons between the control and intervention cohorts were made using the independent t-test for continuous variables and Fisher's exact test for categorical variables. The comparison of total length of stay and length of stay on the CCU for all patients was made using the Mann-Whitney U test.

Secondary outcome measures were in-hospital mortality and the rate of early complications graded by the Clavien-Dindo classification (Table 2).⁸ For comparison of results, patients were separated into three resection groups: oesophagogastrectomy, total gastrectomy and subtotal gastrectomy.

Results

There were 62 resections during the study period (35 prior to implementation of the ERAS protocol and 27 following implementation). There were similar proportions of the type of operation in both cohorts (Table 2). The mean ages of both patient groups were also similar (65.7 years control group vs 68.0 years intervention group, $p=0.311$). There was no statistically significant difference between the proportions of patients who had undergone preoperative chemotherapy (57.1% control group vs 77.8% intervention group, $p=0.110$). The overall median hospital stay was reduced by 3 days following the intervention (Mann-Whitney U test, $p=0.008$). The median stay on the CCU remained constant at 6 days (Mann-Whitney U test, $p=0.235$).

For those undergoing oesophagogastrectomy, the mean age was similar prior to and following the intervention

Table 2 Clavien-Dindo classification of complications⁸

Grade	Definition
I	Any deviation from normal postoperative course without need for intervention
II	Deviation from normal postoperative course requiring pharmacological intervention
III	Deviation from normal postoperative course requiring surgical/radiological/endoscopic intervention
IIIa	Not requiring general anaesthesia
IIIb	Requiring general anaesthesia
IV	Life threatening complication requiring intensive care
IVa	Single organ dysfunction
IVb	Multiple organ dysfunction
V	Mortality

(64.3 vs 62.8 years respectively, $p=0.700$) as was the proportion of patients who had received preoperative chemotherapy (62.5% vs 88.9% respectively, $p=0.355$). There was a reduction in the median total length of stay by 3.5 days and the median CCU stay was 7.5 days for the control group and 7 days for the intervention group.

Patients undergoing total gastrectomy showed a trend of being older in the intervention group but this difference did not reach statistical significance (mean: 71.0 vs 60.9 years, $p=0.076$). Similar proportions had undergone preoperative chemotherapy (85.7% control group vs 90.9% intervention group, $p=1.00$). The median total hospital stay fell by 3 days and the median stay in the CCU remained constant.

Those undergoing subtotal gastrectomy were of similar age prior to (mean: 69.6 years) and following (mean: 69.9 years) the intervention, and similar proportions had undergone preoperative chemotherapy (33.3% control group vs 42.9% intervention group, $p=1.00$). The median total in-patient stay and CCU stay were each reduced by 1 day.

Complications

Overall, there were two patients in each cohort who suffered complications of Clavien-Dindo grades IIIb, IV or V. There was one death (1/27, 3.7%) in the intervention group. This patient developed early postoperative complications with pulmonary and renal dysfunction, which were not thought to be related to the pathway. Two patients developed postoperative complications in each group after oesophagectomy. In the control group, one patient developed a chyle leak, and one was readmitted after discharge with a pleural effusion and pericarditis (which was managed with antibiotics). In the intervention group, one patient required a tracheostomy for respiratory support and a second was readmitted with a pericardial effusion, which required surgical drainage. There were no complications after total gastrectomy in either group. A patient in each of the control

Table 3 Results of study cohorts

Operation	Cohort	Number of patients	Median CCU stay (range) in days	Median hospital stay (range) in days
Oesophagogastrrectomy	Control	16	7.5 (5–41)	20.5 (14–56)
	Intervention	9	7 (6–26)	17 (11–29)
Total gastrectomy	Control	7	5 (2–10)	18 (16–22)
	Intervention	11	5 (3–9)	15 (10–36)
Subtotal gastrectomy	Control	12	3 (2–19)	13 (9–28)
	Intervention	7	2 (1–9)	12 (8–42)
Overall total	Control	35	6	18
	Intervention	27	6	15

CCU = critical care unit

and intervention groups was readmitted to the CCU after subtotal gastrectomy because of pulmonary complications.

Discussion

The application of ERAS approaches to oesophageal and gastric cancer surgery has a number of practical implications, some of which need to overcome individual bias in view of the complexity of the procedures. Most major oesophageal and gastric resections are long procedures, and can include opening two body cavities. There are significant physiological disturbances inherent in the surgery. Adequate postoperative pain control is fundamental to satisfactory and comfortable patient recovery. Unlike colorectal surgery, anastomotic complications cannot be minimised by defunctioning procedures. Traditionally, many have deferred introducing oral intake until confirmation of a healed anastomosis by radiology despite data highlighting that routine contrast radiology does not influence rates of anastomotic leak.⁹ Nutritional support is a key component of recovery after oesophageal and gastric surgery, and approaches should concentrate on both pre and postoperative phases.^{10,11}

The basis to all previous studies has been the establishment of an agreed protocol, which is followed carefully throughout the patient pathway. Several studies have reported experience with oesophageal resection^{12–16} and gastric resection^{17–21} but reports of a unit's experience with both are rarer.²² Laparoscopic surgery was undertaken in some studies^{19–21} whereas others examined open surgery only.^{12,14–17}

Variations in perioperative management included use of epidural analgesia,^{12,13,15,17,20,25} the role of jejunal feeding^{12–14,16} with most opting for early enteral feeding^{12–16} and avoidance or early removal of drains.^{12–21} Radiological contrast studies were undertaken in the majority of studies^{12,14,15,19,22} although they were not used in all.^{16–18} Complication rates varied, ranging from 7% to 45%.²⁴ Specifically, rates for anastomotic leak were reported as 0–4%.²⁴ Mortality rates varied from 0% to 3%.²⁴ Reductions in length of hospital stay were reported in the majority of studies that included control groups.²⁴ Patient

satisfaction was reported as very good to excellent in 96% of patients.¹² In one study, the cost of care was reduced in the intervention group by 13%.¹⁷

In patients over the age of 70 years and those who had received neoadjuvant chemotherapy, 3 studies reported lack of compliance with the ERAS protocol.^{12–14} Low *et al* found no difference in patients who received neoadjuvant chemotherapy.¹⁵

In the UK, these criteria include most of those presenting for surgery as the median age of oesophageal and gastric cancer patients is 74 years,²⁵ and 65% and 41% receive neoadjuvant chemotherapy for oesophageal and gastric cancer respectively.²⁶ Low *et al* have shown, however, that this group of older patients can be mobilised early after surgery with gradual withdrawal of active support such that they are able to leave hospital quickly, and with reduced rates of complications and readmission.¹⁵ In our study, the rates of chemotherapy were higher than the national average. Although not statistically significant, the rates of chemotherapy were slightly greater in the intervention group for all three procedures. This adds further support to previous work demonstrating that ERAS approaches can be undertaken in this group of patients.¹⁵

This study has confirmed a reduction of 3 days in the median patient stay after oesophagogastrrectomy and total gastrectomy by implementing an ERAS pathway without impacting on the rate of serious complications. The median length of stay in the CCU was the same for the intervention and control groups. The CCU in our institution combines level 2 and 3 facilities as well as level 1 or high dependency care. We have observed that the initiation of the ERAS interventions in the critical care setting has a key effect, enabling earlier discharge from the normal inpatient facility.

Although the reduction in length of stay is significant, an equally important outcome has been the careful review of practice and associated improvements in quality of care following multidisciplinary teamworking to produce a complex care plan. The success of this approach has been due to the inclusion of all relevant disciplines at different

stages of the pathway. The preoperative assessment and optimisation of patients with respect to nutrition and cardiopulmonary fitness has not been described in previous studies.

Conclusions

This study was designed to evaluate ERAS principles in a series of consecutive unselected patients, and to demonstrate that ERAS can be applied to the majority of patients undergoing major oesophageal and gastric resection. The challenge for the future is to understand how refinements to the pathway can be introduced to improve outcomes further. The key is education of all involved including patients and all clinical staff. It is essential that the results of the interventions are shared regularly with all those providing inpatient care to promote and maintain interest in the process.

Compliance with the pathway and patient experience of the pathway need to be evaluated carefully. This will identify areas for refinement and further interventions that are acceptable to patients. This is planned to include not only the prehospital admission and the inpatient experience but also (in the medium term) a review of patient reported outcomes three months after surgery.

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