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Original research

The effect of centralisation on the outcomes of oesophagogastric surgery – A fifteen year audit☆

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ABSTRACT

Introduction: Centralisation of oesophagogastric (OG) resectional services has been proposed to improve patient outcomes in terms of perioperative mortality and long-term survival. Centralisation of services occurred in Gloucester 5 years ago. The aim of this paper is to assess if local patient outcomes have benefited from centralisation.

Methods: All oesophagogastric resections performed in our unit over a 15-year period (10-years pre-centralisation and 5-years post-centralisation) were assessed retrospectively. Patient demographics, pathological details and date of death were identified. Perioperative mortality (30 and 90 day) and estimated Kaplan–Meier survival was compared for cases performed pre- and post-centralisation of services.

Results: 456 resections for cancer were performed in the 15-year period; 234 of these were performed pre-centralisation (mean 23.4, range 13–31) and 222 were performed post-centralisation (mean 44.4, range 40–50). Median survival rates for gastric cancer were 1.1 years pre-centralisation and 1.5 years post-centralisation ($p = 0.147$) and median survival for oesophageal cancer improved from 1.1 years to 2.1 respectively ($p = 0.028$). Combined OG 30-day mortality rates improved from 10.3% pre-centralisation to 3.6% post-centralisation ($p = 0.006$, Fisher's exact test).

Discussion: Centralisation of OG services in Gloucester has resulted in twice as many resections being performed locally. Median survival for patients with oesophageal cancer has increased by 1 year and the 30-day mortality rate following resection has reduced by almost two thirds. Although other factors (such as improvements in oncological treatments, staging and critical care management over the 15-year time period) have undoubtedly had roles to play in these improvements, the results of this study support the policy of centralisation of Upper GI cancer services.

1. Introduction

Oesophagogastric (OG) carcinoma has traditionally been associated with poor outcomes, both in terms of operative mortality and long-term outcome.[1] Although these outcomes are greatly influenced by late presentation and an elderly population (often with multiple co-morbidities), the experience of the operating surgeon and the multidisciplinary team may impact on patient survival.[1–3]

In 2001, the Clinical Outcomes Group in the UK recommended the centralisation of OG cancer services into centres with a minimum population of 1 million.[4] In a centre of this size it was expected that 250 cases would be discussed at the OG Multidisciplinary Team meeting (MDT) and 100 resections would be performed annually. The expected increase in surgical experience was thought to improve post-operative outcomes. More recently, in their guidance published in 2010, the Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland calculated that for a population of a million people there would be 52 major OG resections per year.[5] They suggested that an ideal OG unit would consist of four to six surgeons, each performing a minimum of 15–20 resections per year, serving a population of one to two million people.

Where a single institution does not have a sufficient catchment area to support an OG unit, centralisation of services can provide the population and workload to ensure that the minimum number of resections can be achieved. In our region, prior to centralisation,

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resections were being performed at Gloucester, Cheltenham, Worcester and Hereford by independent surgeons. In 2006 the establishment of the Three Counties Cancer Network for OG cancer centralised services at the Gloucestershire Royal Hospital (GRH); the catchment area includes Gloucestershire, Herefordshire and South Worcestershire, a population of just over a million. All OG cases are discussed at a central MDT meeting, which is co-ordinated at Gloucester. We currently have three OG surgeons based locally and have a further two surgeons from Worcester and Cheltenham who perform all perform their resectional work at GRH.

2. Aim

To assess the benefit of centralisation of services, a retrospective 15-year audit was performed looking at patient outcomes pre- and post-centralisation of OG resectional surgery in 2006. 30-day and 90-day mortality and estimated median survival were defined as targets for audit.

3. Methods

All OG resections for carcinoma performed in our unit from 1st January 1996 until 31st December 2010 were identified from a combination of previous departmental audit data, hospital coding data, MDT outcome data and operating diaries. This data included 10-year pre-centralisation of service and 5-years post-centralisation. Patients and demographic details were entered onto a database along with operation date. Histological details were added to the database along with date of death obtained from the hospital patient administration system (PAS). Cancer sites were classified as oesophageal or gastric according to the dataset that was used for recording the pathological findings. The tumour (T) status, node (N) status and stage of each tumour were classified according to the sixth edition of the TNM classification for oesophageal and gastric cancers (sub stages a or b were not used).[6] 30- and 90-day mortality pre and post centralisation were compared using Fischer's exact test. Cancer site and stage specific Kaplan–Meier survival curves were constructed for cases pre and post centralisation and were compared using the Generalised Wilcoxon test. Factors effecting survival were also examined using Cox regression analysis (forward stepwise conditional entry of factors). Factors entered into the model were time period, surgeon, TNM stage, patient age and cancer site. Statistical analysis was performed with IBM SPSS 19 (IBM, Armonk, New York, USA). $p < 0.050$ was considered statistically significant.

Patients who did not have a date of death on the hospital systems but had no local postoperative follow-up were considered lost to follow up. These patients were not included in the long term survival analysis but were included in the 30- and 90-day mortality analysis.

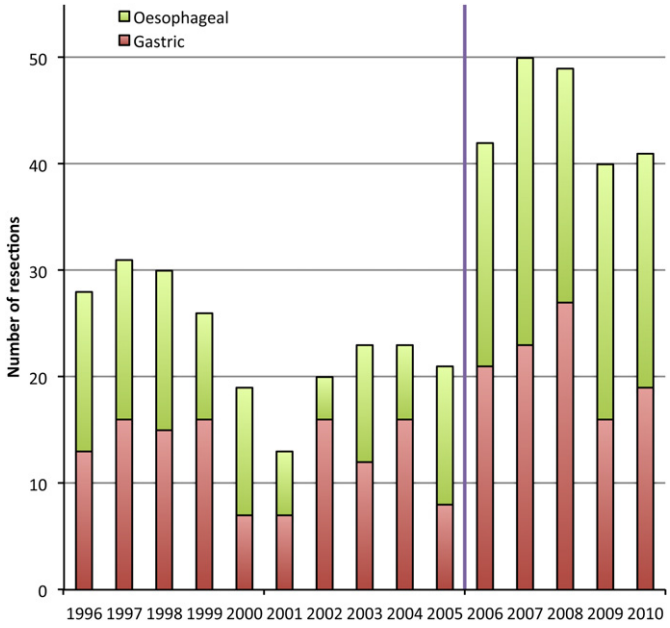

Fig. 1. Operations performed by year.

Table 1
Demographics of patients pre- and post-centralisation.

	Prior to 2006	Since 2006	*p* value
Gastric	126	106	
Oesophageal	108	116	
Total	234	222	
Annual mean (range)	23.4 (13–31)	44.4 (40–50)	<0.001[a]
% Male	74.8%	83.8%	0.018[b]
Gastric	72.2%	79.2%	n.s.[b]
Oesophageal	77.7%	87.9%	0.043[b]
Median age (Range)	68.0 (34.2–90.2)	66.5 (19.4–86.2)	n.s.[c]
Gastric	72.9 (34.2–90.2)	72.8 (19.4–86.2)	n.s.[c]
Oesophageal	63.6 (36.7–81.3)	62.9 (26.4–81.6)	n.s.[c]

[a] t-test.
[b] Chi squared.
[c] Mann Whitney.

4. Results

In total 456 resections were performed in Gloucester over the 15 year period (Fig. 1). 234 of these resections were performed pre-centralisation, giving an average of 23.4 per year (range 13–31). 222 resections were performed post-centralisation, giving an average of 44.4 per year (range 40–50). This increase in number of resections being performed at Gloucester was statistically significant ($p < 0.001$, *t*-test).

In terms of the type of resectional work being performed 126 resections (53.8%) were for gastric cancer and 108 (46.2%) were for oesophageal cancer pre-centralisation. Post-centralisation 106 resections (47.7%) were for gastric cancer whilst 116 (52.3%) were for oesophageal cancer. Patient demographics are shown in Table 1. There were no significant differences in the ages of patients pre- or post-centralisation. Although there was no significant change in the proportion of male patients who had gastric resections (72.2% pre 2006 v 79.2% post 2006, $p = 0.216$ Chi squared), there was a higher proportion of male patients who had oesophageal resections after centralisation (77.8% pre 2006 v 87.9% post 2006, $p = 0.043$ Chi squared).

5. Cancer staging

Analysis of the pathological stages of tumours pre- and post-centralisation did not reveal any significant change for gastric carcinoma. However, there was an increase in the proportion of stage 1 oesophageal cancers after centralisation (6%–16%, $p < 0.05$). The number of resections for other stages of oesophageal was similar pre- and post-centralisation (Table 2).

6. Mortality

Overall the 30-day mortality fell from 10.3% pre-centralisation to 3.6% post-centralisation ($p = 0.006$) (Table 3). The reductions

Table 2
Tumour stage of gastric and oesophageal resections pre- and post-centralisation.

	Gastric			Oesophageal		
Stage	Pre 2006	Post 2006	*p* value[a]	Pre 2006	Post 2006	*p* value[a]
0		1	n.s		3	n.s
1	25	21	n.s	6	19	<0.05
2	17	19	n.s	45	37	n.s
3	62	41	n.s	55	51	n.s
4	22	24	n.s	2	6	n.s
Total	126	106		108	116	

[a] Comparison of column proportions (*z*-test) with Bonferoni correction for multiple comparisons.

Table 3
30 and 90 day mortalities for gastric and oesophageal resections.

	Prior to 2006	Since 2006	*p* value[a]
30 day mortality	10.3%	3.6%	$P = 0.006$
Gastric	9.5%	2.8%	$P = 0.058$
Oesophageal	11.1%	4.3%	$P = 0.076$
90 day mortality	15.0%	9.0%	$P = 0.061$
Gastric	15.9%	7.5%	$P = 0.068$
Oesophageal	13.8%	10.3%	$P = 0.539$

[a] Fischer's exact test.

in mortality were similar for both gastric and oesophageal cancers, but analysis of this data did not reach significance due to the relatively small numbers of operations in each group. We noted a reduction in 90-day mortality from 15% pre-centralisation to 9% post-centralisation for all resections, but this was not statistically significant. Mortality from 30 to 90 days was similar before centralisation (4.3%) and after centralisation (5.8%). However, whereas all ten of the patients who died in this period before centralisation had stage 3 or 4 disease, six of the thirteen patients who died in this period after centralisation had stage 1 or 2 disease and died of complications of surgery (anastomotic leaks, chest sepsis or pulmonary embolism), generally after prolonged stays in the intensive care unit.

7. Survival

We noticed an improvement in patient survival for both gastric and oesophageal cancer resections (Fig. 2). Median survival following gastric resection increased from 1.1 years to 1.6 years post-centralisation for all cancer stages. This was not statistically significant ($p = 0.147$, Generalised Wilcoxon test). Median survival following oesophageal resection increased from 1.1 to 2.1 years post-centralisation for all cancer stages. This improvement in survival was statistically significant ($p = 0.028$).

There could be many reasons for this improved survival in the last 5 years compared to the previous 10 years. However when survival results (for gastric and oesophageal resections combined) were examined in three time periods (1996–2000, 2001–2005, 2006–2010) rather than two, there was no difference in median survival between 1996 and 2000 (estimated median survival 1.29 years) and 2001–2005 (1.21 years, $p = 0.668$ Generalised Wilcoxon test) whereas median survival from 2006 to 2010 was significantly longer (1.92 years, $p = 0.042$ verses 1996–2000 and $p = 0.013$ verses 2001–2005). This suggests that rather than a gradual improvement in results over the entire time period 1996–2010 (as may be expected if the improved outcomes were purely related to general improvements in areas such as critical care and neo-adjuvant/adjuvant oncological therapy), there was a stepwise improvement occurring around 2006, coinciding with the centralisation of Upper GI cancer services in our unit.

Table 4
Results of Cox regression analysis showing odds ratios and 95% confidence interval of significant factors.

	p value	OR	95% CI	
Stage 1	<0.001			
Stage 2	0.028	1.621	1.053	2.494
Stage 3	<0.001	3.031	2.044	4.495
Stage 4	<0.001	5.974	3.693	9.665
Cancer centre	0.026	0.760	0.597	0.968

8. Cox regression analysis

In order to establish which factors had improved our survival outcomes a Cox regression analysis was performed. The variables that were assessed were: cancer stage, patient age, surgeon, cancer centre (pre/post centralisation) and whether the cancer was gastric or oesophageal. Of these variables, only TNM stage and the effect of centralisation were found to be significant independent factors (Table 4).

9. Discussion

There are many reasons why oesophagogastric surgery is associated with poor survival outcomes, including late presentation, patient age and co-morbidities. However, over the past decade, many studies have confirmed that OG resection surgery has

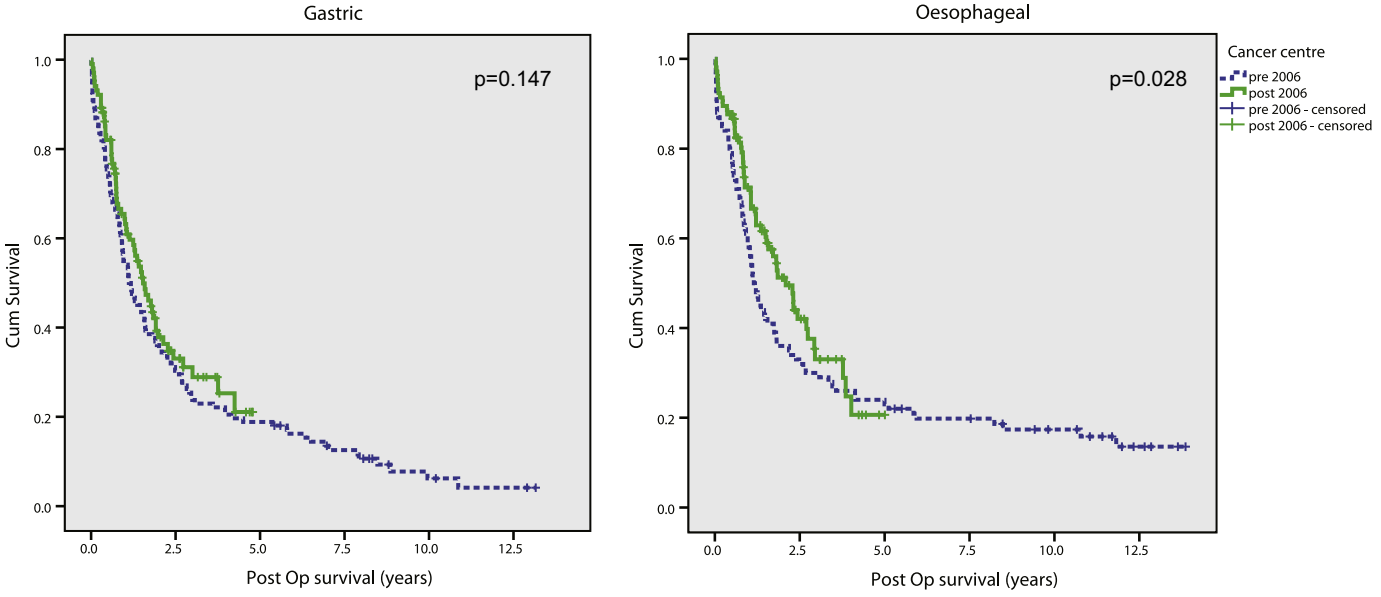

Fig. 2. Kaplan–Meier estimated survival curves for gastric and oesophageal cancer.

improved outcomes, particularly in terms of postoperative mortality, when performed in institutions that have a high turnover of cases.[7–13] What is less clear is whether this benefit is due to the experience of an individual surgeon, or the collective experience of the unit.[14,15] Specialisation of a surgeon should increase their experience and technical abilities, but the impact of other healthcare professionals needs to be considered; both other medical staff who specialise in OG cancer (radiologists, pathologists and oncologists) and nursing, theatre and ITU staff whose experience greatly impacts on patient care.[3] Long term survival has been shown to benefit greatly with increasing hospital volume in surgery for pancreatic cancer,[16] but for OG cancer the relationship between hospital volume and long term survival is less clear.[11] In addition to patient load, case mix clearly impacts on survival outcomes.[17]

Centralisation has enabled smaller resectional units to combine to ensure that they reach the current AUGIS guidelines regarding the size of population served and number of operations performed.[5] Our results have shown the impact that centralisation has had on the OG resectional service at Gloucester. We are now performing almost twice as many operations locally post-centralisation. We have shown that patients have lower 30-day mortality and improved long-term survival following centralisation of services five years ago. Surgical expertise is likely to play an important role in this improvement of outcomes, but other factors should be considered. The collective experience of the unit (including theatre staff, nursing staff, radiology, intensive care staff, physiotherapists and dieticians) is also vital to improve patient outcome. Moreover, better patient selection, via a unified MDT with appropriate preoperative staging in the form of endoscopic ultrasound and PET, is likely to play a significant role in our improvements in outcome; improved patient selection, via the MDT, is likely to be the reason why the proportion of stage 1 oesophageal cancers has increased post-centralisation.

This data therefore supports the policy of centralisation to achieve the current AUGIS guidelines. Our results are consistent with previous literature showing improvements in perioperative mortality in high volume centres, and also provide evidence of improvements in long term survival.

The main limitation of this study is that although we have shown an association between improved outcomes at our unit and the centralisation of services, we have not proved that this improvement is directly related to centralisation. In addition, we have only looked at two outcome measures: postoperative mortality and overall survival. In this study we have not examined the impact of centralisation on other important outcomes such as postoperative morbidity and complications, hospital stay, cost or quality of life. Another limitation is that in our pre centralisation cohort we have only considered the patients treated at our unit, and not at the other units performing surgery for OG cancer.

10. Conclusion

Our experience with centralisation has shown that smaller units can survive and flourish within the current AUGIS recommendation. The improvements in morbidity and mortality support the guidelines and are in line with previous data. The impact on survival is likely to be both due to individual surgical experience and the collective unit expertise.

Ethical approval

Not required.

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None.

Conflict of interest

None.

Author contribution

A. Boddy: Study design, data collection, data analysis, writing.
J. Williamson: Data analysis, writing.
M. Vipond: Study design, writing.

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