Laparoscopic versus open feeding jejunostomy insertion in oesophagogastric cancer

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Abstract

Background: Jejunal feeding is an invaluable method by which to improve the nutritional status of patients undergoing neoadjuvant and surgical treatment of oesophageal malignancies. However, the insertion of a feeding jejunostomy can cause significant postoperative morbidity. The aim of this study is to compare the outcomes of patients undergoing placement of feeding jejunostomy by conventional laparotomy with an alternative laparoscopic approach.

Methods: A retrospective review of data prospectively collected at the Oxford Oesophagogastric Centre between August 2017 and July 2019 was performed including consecutive patients undergoing feeding jejunostomy insertion.

Results: In the study period, 157 patients underwent jejunostomy insertion in the context of oesophageal cancer therapy, 126 (80%) by open technique and 31 (20%) laparoscopic. Pre-operative demographic and nutritional characteristics were broadly similar between groups. In the early postoperative period jejunostomy-associated complications were noted in 54 cases (34.4%) and were significantly more common among those undergoing open as compared with laparoscopic insertion (38.1% vs 19.3%, $P = 0.049$). Furthermore, major complications were more common among those undergoing open insertion, whether as a stand-alone procedure or in conjunction with laparoscopic staging ($n = 11/71$), as compared with insertion at the time of oesophagectomy ($n = 3/86$, $P = 0.011$).

Conclusions: This report represents the largest to our knowledge single-centre comparison of open versus laparoscopic jejunostomy insertion in patients undergoing oesophagectomy in the treatment of gastroesophageal malignancy. We conclude that the laparoscopic jejunostomy insertion technique described represents a safe and effective approach to enteral access which may offer superior outcomes to conventional open procedures.

Background

Oesophageal cancer is the eighth most common cancer worldwide [1]. It is a highly lethal condition, leading to over 400,000 deaths annually [2]. The incidence of weight loss in patients with oesophageal cancer is among the highest of all cancer types. The majority of patients with oesophageal cancer will have experienced a significant degree of weight loss by the time of diagnosis and will have complex nutritional needs [3]. The effect of such weight loss on patient performance status can be detrimental to the delivery of gold-standard multimodal treatment strategies and, consequently, can adversely impact survival outcomes. The likelihood of encountering severe dose-limiting toxicity is substantially greater among individuals with nutritional deficiency who undergo chemotherapy [4]. It is evident, therefore, that the nutritional status of patients with oesophageal cancer should be carefully considered during the diagnostic and staging phases; and routine nutritional assessment should form a central component of the multimodal treatment of patients [5].

In their systematic review and meta-analysis of randomized controlled trials, Mazaki and colleagues demonstrated that, when compared to parenteral nutrition, enteral nutrition was associated with fewer infectious complications, anastomotic leaks, intra-abdominal abscesses, overall complications, and decreased length of hospital stay [6]. Feeding jejunostomy is the most commonly employed approach to enteral nutrition in patients undergoing treatment for oesophageal malignancy, given that sparing of the stomach is necessary for its potential use as a conduit to replace the resected oesophagus.

Jejunostomy insertion can be performed open via laparotomy, laparoscopically, or by percutaneous techniques assisted either endoscopically or using other imaging modalities. In patients with severe dysphagia or with significant weight loss ($\geq 10\%$) at presentation, a jejunostomy is usually placed at the time of the staging laparoscopy or as a stand-alone procedure. The goal is to support the patient's nutritional status and hydration during neo-adjuvant treatment. When a jejunostomy is not indicated before neo-adjuvant treatment it is usually placed at the time of oesophagectomy to provide fluids and nutrition if the oral route is compromised, for instance in the case of anastomotic leak. Given the variation in timing and technique of jejunostomy insertion, the aim of this study is to compare outcomes of subjects undergoing open and laparoscopic jejunostomy insertion in the management of oesophageal malignancy.

Methods

Retrospective review was performed of databases prospectively compiled between August 2017 and July 2019 at the Churchill Hospital, Oxford, UK. The indication for jejunostomy was decided by multidisciplinary team discussion involving surgeons, oncologists, and dietitians according to the severity of dysphagia, weight loss, and nutritional status. Demographic data including age, gender, body mass, preoperative serum albumin, and performance status (Eastern Cooperative Oncology Group, ECOG) were reviewed, in addition to indication for procedure. All jejunostomy procedure-related complications were collated and classified in accordance with Clavien-Dindo (CD) scoring, whereby minor complications are those scoring 2 or less and major complications constitute those scoring 3 or more [7].

Surgical Techniques

For both the open and laparoscopic techniques described, a 9 Fr feeding jejunostomy tube kit was used (Freka® Surgical Jejunostomy Set ENFit®, Fresenius Kabi). Open insertion was performed via a midline laparotomy employing the Witzel technique - the most common method of jejunostomy creation [8]. The duodenojejunal (DJ) flexure was identified and a loop of jejunum selected and confirmed to reach the abdominal without excess tension. The jejunostomy tube was introduced into the jejunum using the dedicated kit through a purse string suture made with absorbable monofilament on the small bowel. A 2 cm submucosal tunnel was created with the introducer and subsequently a short Witzel tunnel made with 3/0 absorbable monofilament to prevent leak of enteric content. The small bowel was secured to the abdominal wall with parachuting sutures, and the jejunostomy secured to the skin with the flange provided using non absorbable braided or monofilament sutures. Where open jejunostomy was

performed concurrently with open oesophagectomy, the jejunostomy was introduced via the established abdominal incision.

Laparoscopic jejunostomy insertion was performed using a three-port technique modified from Senkal and colleagues (Fig. 1. An additional movie file demonstrates the technique in further detail, see Additional file 1) [9]. Briefly, a 12mm laparoscopic port was placed in the right flank to accommodate the laparoscope, and a further two 5mm working ports were inserted under vision. The DJ-flexure was identified, and a loop of proximal jejunum confirmed to reach the abdominal wall with ease was selected. Placement of two absorbable braided sutures in a 'W' configuration was performed to define a square area that would become the jejunostomy insertion point (Fig. 1B). The four ends of the two sutures were retrieved outside the abdominal cavity through a 2-3mm skin incision using Endo Close™ Trocar Site Closure Device (Covidien, USA), and ensuring that the points of retrieval or exit from the peritoneum are adequately spaced to mirror the square area created by the sutures placed at the jejunum (Fig. 1D). The jejunostomy kit's introducer is inserted through the abdominal wall into the jejunum, thereby permitting direct passing of the tube distally. Positioning is visually verified and tested by saline infusion. The intra-abdominal pressure is lowered to 5mmHg to enable parachuting of the small bowel up to the abdominal wall upon tying of the extracorporeal sutures. The procedure is completed by securing the jejunostomy tube using the flange supplied as per the open approach aforementioned.

Statistical Analyses

Statistical analyses were performed using GraphPad Prism v7.0 Software. Group comparisons of continuous variables were performed by t test, where normality was confirmed using the D'Agostino-Pearson, or by Mann-Whitney U test where not normally distributed. Chi-square or Fisher's-exact test, when appropriate, were used to compare categorical variables. A P value of less than 0.05 was considered significant.

Results

After performing a database search, 175 consecutive jejunostomy procedures were identified during the study period, 157 of which were associated with the management of oesophageal malignancy and therefore eligible for inclusion. Of this cohort, 126 subjects underwent open jejunostomy insertion while 31 underwent laparoscopic insertion. Comparison of subject characteristics between both groups is shown in Table 1. While groups were comparable for gender, body mass index (BMI), serum albumin, and pre-procedural performance status, the laparoscopic group were marginally younger than those undergoing open surgery (P = 0.014).

Table 1: Comparison of preoperative demographic and nutritional variables.

	Open jejunostomy (n=126)	Laparoscopic jejunostomy (n=31)	P value
Mean age (y)	66.9	62.6	0.014
Male gender n (%)	99 (79%)	21 (68%)	0.20
Mean Body Mass Index (kg/m ²)	27.9	26.7	0.36
Mean preoperative serum albumin (g/L)	32.3	31.0	0.20
Median performance status (ECOG)	0	0	>0.95

Comparison of operative outcomes is shown in Table 2. Of note, there are significantly fewer total complications encountered following laparoscopic insertion as compared with open (P = 0.049). Subgroup analysis of minor (CD≤2) complications indicated a trend towards fewer complications among the laparoscopic group, though this did not reach significance (16.1% vs 27.8%, P = 0.182). A similar trend was noted among major complications (3.2% laparoscopic vs 10.32% open, P = 0.187). Although there was a small but significant difference of approximately 4 years in mean age among groups, increasing age was not noted to be associated with higher rates of complications (P = 0.10). One death occurred in the cohort of 157 cases (0.6%), and this was following open jejunostomy insertion at the time of staging. The death was associated with the perforation of a closed bowel loop involving a segment between the obstructive oesophageal tumour and the jejunostomy site.

Table 2: Comparison of open and laparoscopic operative outcomes.

	Open jejunostomy (n=126)	Laparoscopic jejunostomy (n=31)	P value
All Complications	48 [38.09%]	6 [19.35%]	.049
Minor Complications (CD≤2)	35 [27.77%]	5 [16.13%]	.182
Gastrointestinal complications (Diarrhoea, postoperative ileus, abdominal pain, discomfort with feeding)	16 [12.70%]	3[9.67%]	
Jejunostomy site infection	10 [7.94%]	1 [3.22%]	
Discomfort at jejunostomy site	1 [0.79%]	0	
Small bowel obstruction	1 [0.79%]	0	
Bleeding	1 [0.79%]	1 [3.22%]	
Dislodgement/falling-out/replacement	5 [3.96%]	0	
Superficial dehiscence	1 [0.79%]	0	
Major Complications (CD≥3)	13 [10.32%]	1 [3.22%]	.187
Jejunostomy site infection	1 [0.79%]	0	
Replacement	3 [2.38%]	0	
Small bowel obstruction	2 [1.59%]	1 [3.22%]	
Blockage/obstruction	3[2.38%]	0	
Intra-abdominal sepsis	1 [0.79%]	0	
Intra-abdominal leak	1 [0.79%]	0	
Dislodgement/falling-out	1 [0.79]	0	
Death	1 [0.79%]	0	

Jejunostomy insertion was performed as a stand-alone procedure or in conjunction with a laparoscopic staging procedure (SP), which is to say prior to definitive oesophagectomy, in 71 of 157 cases. The remaining 86 cases underwent insertion at the time of tumour resection procedure (RP). If inserted at oesophagectomy, whether the abdominal portion of the operation was performed minimally invasively determined whether or not the jejunostomy was inserted laparoscopically (23/86, 26.7%) or open (63/86, 73.3%). Whether jejunostomy was performed laparoscopically (8/71, 11.3%) or open (63/71, 88.7%) at SP was determined by surgeon preference. Thus, of those individuals undergoing open jejunostomy insertion, half (63/126) were at SP and the other half at RP; while of those individuals undergoing

laparoscopic jejunostomy insertion, 25.8% (8/31) were at SP while the remaining 74.2% were at RP. As outlined in Table 3, there was a trend towards a higher incidence of complications in the SP group (29/71, 40.8%) as compared with the RP group (25/86, 29.1%) this did not reach statistical significance ($P = 0.122$); however, the rate of *major* complications was significantly different ($P = 0.011$), a finding predominantly attributable to the particularly high rates of major complications seen in jejunostomies inserted by open technique at the time of staging or as stand-alone procedures (11/63, 17.5%).

Table 3: Comparison of operative outcomes when feeding jejunostomy inserted at the time of tumour resection procedure (RP) or prior to resection as either a stand-alone or staging procedure (SP).

	Jejunostomy prior to oesophagectomy ('staging, SP')		Jejunostomy performed at oesophagectomy ('resection, RP')		
	Open jejunostomy (n=63)	Laparoscopic jejunostomy (n=8)	Open jejunostomy (n=63)	Laparoscopic jejunostomy (n=23)	P value
All Complications	27 [42.86%]	2 [25%]	21 [33.33%]	4 [17.39%]	Staging vs resection: 0.122 Open at staging vs open at resection: 0.271
Minor Complications	16 [25.40%]	2 [25%]	19 [30.16%]	3 [13.04%]	Staging vs resection: 0.974 Open at staging vs open at resection: 0.477
Major Complications	11 [17.46%]	0	2 [3.17%]	1 [4.35%]	Staging vs resection: 0.011 Open at staging vs open at resection: 0.016

Discussion

The integration of appropriate nutritional support into the overall management of patients undergoing curative treatment for cancer of the oesophagus is of utmost importance to the successful completion of neoadjuvant therapy and of surgery, as well as to survival outcomes [10,11]. Feeding jejunostomy is the preferred approach to long-term enteral feeding and, since minimally invasive techniques have many

advantages, total laparoscopic or laparoscopically assisted methods of feeding jejunostomy insertion have garnered increasing attention [12].

This study, which represents the largest to our knowledge comparison of total laparoscopic and open jejunostomy insertion in the setting of oesophageal cancer, shows that laparoscopic feeding jejunostomy can be performed safely and with the potential for significantly lower rates of morbidity. Furthermore, the study highlights the risk of major complications among subjects undergoing jejunostomy insertion by laparotomy as a stand-alone procedure. This finding is in keeping with the literature, wherein reported complication rates for this approach range widely but can reach 37% and beyond in some series [12,13]. One explanation for the higher rates of complication encountered in stand-alone open jejunostomy insertions is that such procedures are generally performed as 'mini-laparotomies' to avoid the morbidity of larger incisions. As a consequence, they may not afford sufficient exposure and access to ensure adequate visualisation of the DJ-flexure, jejunum, and abdominal wall. Suboptimal exposure can lead to inadvertent injury, kinking or narrowing of the lumen, and difficulties with fixation to the abdominal wall. The laparoscopic technique described here enabled excellent visualisation of the DJ-flexure and of the abdominal wall, and the use of the Endo CloseTM device makes parachuting the jejunum to the abdominal wall uncomplicated. The direct puncture of the jejunum, without tunnelling, was a source of concern at the beginning of our experience, but leakage of enteric content was encountered in only one case and was successfully managed with antibiotics and temporary suspension of enteral feeding. A second consideration is that open procedures may be performed by less experienced junior surgeons as compared with laparoscopic approaches. In our series, the number of laparoscopic jejunostomy insertions was relatively lower (31 vs 126 open) due to the fact that only one surgeon in our unit employs the laparoscopic technique and, as a consequence, all such procedures were either performed by this senior surgeon or by a trainee under his direct supervision.

The postoperative mortality in our series of 157 patients was 0.6%, again mirroring published reports. The single death involved a subject with an obstructing tumour at the gastro-oesophageal junction, a closed-loop obstruction which was diagnosed late, and multiple comorbidities. While mortality rates are low, the significant risks of minor or major complications highlight the value of careful patient selection pre-operatively, emphasise the importance of patient counselling and informed consent, and focus attention on the development of improved surgical approaches.

The cost-effectiveness of laparoscopic surgery is often questioned. Though not formally assessed in our study, in broad terms the cost of the equipment and length of operation time should be balanced against potential benefits regarding the length of stay, cosmesis, reduced analgesic requirements, and improved outcomes. It is important to note, that laparoscopic jejunostomy insertion was predominantly performed in conjunction with either staging laparoscopy or with minimally invasive oesophagectomy, and thereby incurred no significant additional equipment costs. This study is limited by its retrospective nature and in that data is derived from a single centre. Though this represents the largest comparative study of total laparoscopic and open jejunostomy insertion in the setting of oesophageal cancer, the nevertheless is limited by its relatively small patient population. Future prospective studies comparing laparoscopic

versus open feeding jejunostomy insertion are required to determine the superiority of either approach. Our report focuses on patients undergoing treatment for oesophageal malignancy and, however likely, it remains to be confirmed whether the findings hold true in patients undergoing jejunostomy insertion in the contexts of gastric, pancreatic, or hepatic malignancies for instance.

Conclusions

Feeding jejunostomy represents a key adjunct in the treatment of oesophageal malignancy. Though considered by some to be a routine, innocuous procedure, open insertion of feeding jejunostomy is a procedure which should not be underestimated. Keeping in mind the aims of successful neoadjuvant treatment and the reduction of early postoperative morbidity, any complications arising from such a procedure could jeopardise potential benefits and incur significant costs. The total laparoscopic approach outlined here can serve as a safe, effective alternative with the associated advantages of minimally invasive surgery.

Abbreviations

BMI: Body mass index

CD: Clavien-Dindo Score

DJ: duodenojejunal

SP: Staging/Stand-alone Procedure

RP: Resection Procedure

Declarations

Ethics approval and consent to participate

The present study conforms to the Declaration of Helsinki. Ethical approval is waived per Oxford Central University Research Ethics Committee guidelines (CUREC). Written informed consent was provided for the use of intraoperative images.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available due to patient data confidentiality but are available from corresponding author upon reasonable request.

Competing interest

The authors declare they have no competing interests.

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Author contributions

BS, GB, BH, MN, AG were involved in conception and design; RG, RM, NM performed operations and were involved in manuscript reviews; SM, BS, BH, GB, MN, AG were involved in data interpretation, and manuscript preparation. All authors have read and approved the manuscript.

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Figures

Figure 1

Laparoscopic Jejunostomy technique. (A) Two jejunal sutures inserted in 'W' configuration leaving an approximately 1cm² box target as shown in red in schematic representation (B). (C) Endo Close™ device introduced via a 2-3mm skin incision for retrieval of suture ends. (D) peritoneal entry must be judged to ensure creation of a 1cm² box configuration which mirrors that at the jejunum. (E) Jejunostomy insertion trocar targeted at centre of jejunal box target. (F) Jejunostomy tube delivered via trocar, with visual confirmation of placement towards distal limb, and saline flush of tube for confirmation of patency and positioning. (G) Antirotation suture placed at nearby distal jejunal limb.

Supplementary Files

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