Routes of early enteral nutrition following oesophagectomy

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ABSTRACT

INTRODUCTION Oesophagectomy for cancer is a challenging procedure with a five-year overall survival rate of 15–20%. Early enteral nutrition following oesophagectomy is a crucial component of the postoperative recovery and carries a significant impact on the outcome. Different methods of enteral feeding were conducted in our unit. The aim of this study was to examine the efficacy and safety of nasojejun tube (NJT), jejunostomy tube (JT) and pharyngostomy tube (PT) feeding after oesophagectomy.

METHODS A retrospective review was carried out of prospectively collected data on patients with oesophageal cancer who underwent an oesophagectomy between 2011 and 2014. The primary outcome was feeding tube related complications such as occlusion, dislocation and leak. The secondary outcomes were length of stay and 30-day morbidity.

RESULTS A total of 90 oesophagectomies were included in the study. A NJT was inserted in 41 patients (45.6%), a JT was used in 14 patients (15.5%) and a PT was the route for enteral nutrition in 35 patients (38.9%). In total, five patients (5.5%) developed tube related complications. There were no tube related complications in the NJT group but one JT patient (7.1%) developed tube related cellulitis ($p=0.189$) and four PT patients (11.4%) developed tube related haemorrhage ($p=0.544$), tube dislocation ($p=0.544$) or cellulitis ($p=0.189$). The median length of stay and 30-day postoperative morbidity were similar between the groups.

CONCLUSIONS NJT feeding is a less invasive, feasible route for early enteral nutrition following oesophagectomy. A randomised controlled trial is recommended to verify these findings.

KEYWORDS

Oesophagectomy – Nasojejun tube – Jejunostomy tube – Pharyngostomy tube

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Approximately 400,000 people die from oesophageal cancer worldwide every year, equating to 5% of all cancer related mortality.¹ The clinical presentation is often late and diagnosis is made at an advanced stage.

The aim of surgery in oesophageal cancer is to achieve curative resection and to accomplish a functioning anastomosis. Several factors affect the outcome following surgery such as respiratory complications, anastomotic leak and the postoperative nutritional status of the patient, which has a direct impact on the healing process and recovery.² Patients with oesophageal cancer are likely to suffer from weight loss and malnutrition secondary to an obstructive tumour. Following oesophageal resection, these patients will remain without oral feeding for 5–7 days. Early enteral nutrition (EN) was therefore advocated to improve nutritional outcomes and decrease the incidence of postoperative complications.³ Early EN has been found to decrease the length of hospital stay (LOS) and lead to a better outcome than parenteral nutrition (PN), in addition to reducing the total cost of patient care.^{4,5}

Early EN following oesophagectomy is usually maintained via a nasojejun tube (NJT), a jejunostomy tube (JT) or a

pharyngostomy tube (PT). The use of a NJT for EN after oesophagectomy was first reported by Page *et al*; however, this method was compared only with PN.⁶ Conversely, another trial compared NJT versus JT feeding following oesophagectomy.⁷ There was no evidence to suggest that one technique should be favoured over the other.

Although PT feeding is not a new technique, it has not been compared with NJT or JT feeding previously. The use of EN is not without complications, and feeding tube related obstruction, dislocation, cellulitis and return to theatre have been reported.^{7,8} Another drawback is prolonged ileus or patients' intolerance to EN, which has resulted in feeding cessation in some cases.⁴ Every technique has its own benefits and risks, and the choice of feeding method is often at the surgeon's discretion. The aim of this study was to evaluate the outcomes of three routes for EN following oesophagectomy in our centre.

Methods

Patients who underwent oesophagectomies at West Hertfordshire Hospitals NHS Trust between 2011 and 2014 were

reviewed. The upper gastrointestinal (GI) unit has a prospectively maintained database that includes basic demographics and clinical data such as age, sex, date of surgery, tumour site, type of operation performed and tumour histology. All patients who underwent open or laparoscopic (hybrid) transthoracic (Ivor Lewis, McKeown) oesophagectomies for cancer and who had early EN during the study period were included. Patients were excluded if they underwent oesophageal surgery for benign disease or trauma, as were those who underwent palliative resections.

Three techniques were used in our institution. The triple lumen NJT (Freka® Trelumina, 150cm, 9/16Fr; Fresenius Kabi AG, Bad Homburg, Germany) consists of a feeding lumen for jejunal feeding, a decompression lumen for simultaneous decompression and a ventilation lumen for ventilation during active suction (Fig 1). The NJT is inserted at the end of the procedure, using an endoscope to place it in the proximal jejunum. The tube is secured to the patient's nose with a silk suture and adhesive tape. Feeding is started 24 hours after surgery using a standard protocol.

A needle catheter technique is employed for insertion of the JT (Freka®, 75cm, 9Fr; Fresenius Kabi; Fig 2). A 14G long split cannula/introducer (white, 13cm) is inserted intramurally into the wall of the proximal jejunum for approximately 5cm and the tip of the cannula/introducer is then inserted into the lumen. The introducer is removed and the JT is threaded through the needle for 25–30cm. The needle is withdrawn, and the JT is secured with purse string and seromuscular sutures. Following this, a short split needle (blue, 10.5cm) is inserted at 45° through the anterior abdominal wall and the other end of the JT is threaded backwards to exit

Figure 1 Freka® Trelumina nasojejunal tube (reproduced with permission from Fresenius Kabi)

Figure 2 Freka® surgical jejunostomy set (reproduced with permission from Fresenius Kabi)

the abdomen. The needle is then split and removed, and the jejunum is sutured to the anterior abdominal wall. The JT is secured to the skin with a non-absorbable suture.

The triple lumen PT (Freka® Trelumina) is inserted using an artery forceps directed laterally into the pyriform recess, located behind the posterior tonsillar pillar, inferior and medial to the greater cornu of the hyoid bone. A small incision is made laterally in the neck over the tip of the artery forceps. The PT is grasped with a clamp and retracted from the mouth, and then grasped with an endoscopic forceps to be placed in the proximal jejunum. The tube is sutured to the skin of the neck (Fig 3).

EN was discontinued before discharge in all groups and all feeding tubes were removed prior to discharge except for the JT. JT patients were reviewed in the outpatient clinic after two weeks to evaluate their need for supplementary feeding. If prolonged feeding was anticipated, a JT was the preferred EN route.

Case notes and the hospital electronic database were used to collect data on patients who met the inclusion criteria. Data collected comprised ASA (American Society of Anesthesiologists) grade, body mass index, route of EN, anastomotic leak, respiratory complications, wound complications, feeding tube related complications, LOS and 30-day morbidity. The primary outcome was feeding tube related complications such as occlusion, dislocation and leak. The secondary outcomes were 30-day morbidity and LOS.

Statistical analysis

All data were inserted into Excel® (Microsoft, Redmond, WA, US) and analysed with SPSS® version 20.0 (IBM, New York,

Figure 3 Pharyngostomy tube insertion technique

US). Normality assumptions were demonstrated with histograms and the Kolmogorov–Smirnov test. Differences between groups were examined with one-way analysis of variance for continuous parametric variables, the Kruskal–Wallis test for continuous non-parametric variables and the chi-squared test for categorical variables (Fisher's exact test if cell count was <5). A *p*-value of <0.05 was considered statistically significant.

Results

A total of 90 oesophagectomies were performed during the study period. There were 75 men (81.1%) and 17 women (18.9%). The median age was 66 years (range: 41–80 years). Nine patients (10%) were current smokers, thirty-nine (43%) were ex-smokers and forty-two (47%) were non-smokers. The body mass index was 19.0–27.5kg/m² in 26 patients (29%), 28.0–30.5kg/m² in 39 patients (43%) and 31.0–38.0kg/m² in 25 patients (28%).

All patients underwent preoperative oesophagogastroduodenoscopy. Staging with computed tomography (CT) was performed in all patients, positron emission tomography CT in 87 patients (97%), endoscopic ultrasonography in 47 patients (52%) and laparoscopy in 79 patients (88%). The Eastern Cooperative Oncology Group performance status was 0 in 68 patients (76%), 1 in 15 patients (17%), and 2 in seven (8%). In terms of ASA grade, 9 patients (10%) were classified as

grade 1, 57 patients (63%) were grade 2, 22 patients (24%) were grade 3 and 2 patients (2%) were grade 4.

An Ivor Lewis two-stage oesophagectomy was performed in 88 patients (98%) while a three-stage oesophagectomy was undertaken in 2 patients (2%). The abdominal phase was performed laparoscopically in 46 patients (51%) and using an open approach in 42 cases (47%). A further two patients (2%) had their procedure converted from laparoscopic to open. The thoracic phase was performed using a right thoracotomy in 89 cases and the thoracoscopic procedure of 1 patient was converted to an open procedure. Histological examination revealed the presence of an adenocarcinoma in 82 patients (91.1%), a squamous carcinoma in 6 patients (6.6%), a signet ring cell adenocarcinoma in 1 patient (1.1%) and an undifferentiated basaloid carcinoma in 1 patient (1.1%).

Feeding tubes

Patient characteristics and demographics are illustrated in Table 1. A NJT was inserted in 41 patients (45.6%), a JT in 14 patients (15.5%) and a PT in 35 patients (38.9%). A statistically significant difference was present between the feeding route and the approach for the abdominal phase (laparoscopic or open). For most of the operations involving a NJT, the abdominal phase was conducted laparoscopically while for JT and PT patients, the abdominal phase was conducted more frequently using an open approach (Fisher's exact test, *p*=0.043) (Table 1).

Table 1 Patient characteristics and demographics

Variables	NJT (n=41)	JT (n=14)	PT (n=35)	p-value
Mean age (years)	66.2 (SD: 10.1)	63.4 (SD: 8.5)	63.7 (SD: 10.1)	0.469
ASA grade				0.043
1	8 (19.5%)	1 (7.1%)	0 (0%)	
2	25 (61.0%)	8 (57.1%)	24 (68.6%)	
3	8 (19.5%)	5 (35.7%)	9 (25.7%)	
4	0 (0%)	0 (0%)	2 (5.7%)	
ECOG performance status				0.206
0	29 (70.7%)	8 (57.1%)	19 (54.3%)	
1	7 (17.1%)	5 (35.7%)	14 (40.0%)	
2	5 (12.2%)	1 (7.1%)	2 (5.7%)	
Mean BMI (kg/m ²)	26.5 (SD: 3.3)	26.8 (SD: 3.8)	28.3 (SD: 3.6)	0.069
Neoadjuvant CRT	20 (48.8%)	10 (71.4%)	18 (51.4%)	0.171
Abdominal phase				0.001
Laparoscopic	34 (82.9%)	2 (14.3%)	10 (28.6%)	
Converted to open	0 (0%)	1 (7.1%)	1 (2.9%)	
Open	7 (17.1%)	11 (78.6%)	24 (68.6%)	
Adjuvant therapy	14 (34.1%)	7 (50.0%)	16 (45.7%)	0.418

NJT = nasojejunal tube; JT = jejunostomy tube; PT = pharyngostomy tube; SD = standard deviation; ASA = American Society of Anesthesiologists; ECOG = Eastern Cooperative Oncology Group; BMI = body mass index; CRT = chemoradiotherapy

Table 2 30-day morbidity by type of feeding tube

Complications	NJT (n=41)	JT (n=14)	PT (n=35)	p-value
Tube related cellulitis (n=3)	0 (0%)	1 (7.1%)	2 (5.7%)	0.189
Tube haemorrhage (n=1)	0 (0%)	0 (0%)	1 (2.9%)	0.544
Tube occlusion or dislocation (n=1)	0 (0%)	0 (0%)	1 (2.9%)	0.544
Total (n=5)	0 (0%)	1 (7.1%)	4 (11.4%)	0.063
Respiratory complications (n=20)	9 (22.0%)	4 (28.6%)	7 (20.0%)	0.792
Reoperation (n=13)	6 (14.6%)	2 (14.3%)	5 (14.3%)	1.000
Cardiac complications (n=7)	2 (4.9%)	2 (14.3%)	3 (8.6%)	0.435
Chyle leak (n=5)	3 (7.3%)	0 (0%)	2 (5.7%)	0.845
Anastomotic leak (n=4)	3 (7.3%)	1 (7.1%)	0 (0%)	0.267
Haemorrhage (n=3)	1 (2.4%)	0 (0%)	2 (5.7%)	0.756
Gastric conduit necrosis (n=1)	0 (0%)	0 (0%)	1 (2.9%)	0.544
Total (n=53)	24 (58.5%)	9 (64.3%)	20 (57.1%)	0.918

NJT = nasojejunal tube; JT = jejunostomy tube; PT = pharyngostomy tube

Complications

Tube related complications and 30-day morbidity were reported in Table 2. Five patients (5.5%) developed tube related complications. No statistically significant differences were present among the groups for 30-day morbidity but there was a trend towards significance for tube related complications with PT compared with NJT and JT feeding ($p=0.063$).

Length of stay

The median LOS for the entire cohort was 11 days (range: 2–75 days). In terms of the individual groups, it was 12 days (range: 6–75 days) for NJT patients, 11 days (range: 8–48 days) for JT patients and 11 days (range: 2–50 days) for PT patients. The differences were not statistically significant (Kruskal–Wallis test, $p=0.989$). This was also the case when subgroup analysis was conducted according to the

Table 3 Summary of studies on enteral nutrition following oesophagectomy

Study	Design	n	Feeding adjunct	Tube infection / cellulitis	Tube leak	Tube obstruction	Tube dislocation	Respiratory complications	Reoperation	Chyle leak	Anastomotic leak
Mercer, 1996 ⁹	Prospective	32	JT	-	1 (3.1%)	1 (3.1%)	2 (6.3%)	-	-	-	2 (6.3%)
Yagi, 1999 ¹⁰	Retrospective	78	JT	3 (3.8%)	-	-	-	10 (12.8%)	-	-	6 (7.7%)
Page, 2002 ⁶	RCT	20	NJT	1 (5.0%)	-	-	7 (35.0%)	4 (20.0%)	-	0 (0%)	-
Han-Geurts, 2004 ¹¹	Retrospective	1,166	JT	-	-	-	1 (0.1%)	-	13 (1.1%)	-	-
Gabor, 2005 ¹²	Prospective	44	NJT	1 (2.3%)	-	-	9 (20.5%)	4 (9.1%)	-	-	21 (47.7%)
Sica, 2005 ¹³	Retrospective	262	JT	2 (0.8%)	1 (0.4%)	0 (0%)	2 (0.8%)	67 (25.5%)	4 (1.5%)	4 (1.5%)	28 (10.7%)
Ryan, 2006 ⁵	Prospective	205	JT	3 (1.4%)	3 (1.4%)	6 (2.9%)	5 (2.5%)	43 (21.0%)	3 (1.4%)	-	-
Han-Geurts, 2007 ⁷	RCT	79 71	JT NJT	13 (16.5%) 0 (0%)	3 (3.8%) 0 (0%)	5 (6.3%) 2 (2.8%)	9 (11.4%) 18 (25.4%)	28 (35.4%) 31 (43.7%)	1 (1.3%) 0 (0%)	0 (0%) 2 (4.2%)	5 (6.3%) 8 (11.3%)
Gupta, 2009 ¹⁴	Prospective	204	JT	-	-	13 (6.4%)	-	-	-	-	22 (10.8%)
Wani, 2010 ⁸	Retrospective	463	JT	7 (1.5%)	-	34 (7.3%)	-	-	7 (1.5%)	-	52 (11.2%)
Llaguna, 2011 ¹⁵	Prospective	73	JT	2 (2.7%)	5 (6.8%)	2 (2.7%)	7 (9.6%)	19 (26.0%)	7 (9.6%)	1 (1.4%)	6 (8.2%)
Fenton, 2011 ¹⁶	Retrospective	143	JT	18 (12.8%)	2 (1.4%)	5 (3.6%)	1 (0.7%)	-	1 (0.7%)	-	16 (11.2%)
Couper, 2011 ¹⁷	Retrospective	48	JT	1 (2.1%)	-	-	4 (8.3%)	10 (21%)	0 (0%)	1 (2.1%)	5 (10.4%)
Rino, 2011 ¹⁸	Prospective	16	JT	2 (12.5%)	4 (25.0%)	0 (0%)	0 (0%)	-	-	-	-
Srinathan, 2013 ¹⁹	Retrospective	103	JT	3 (2.9%)	-	7 (6.7%)	2 (1.9%)	-	3 (2.9%)	-	27 (26.2%)
Torres Júnior, 2014 ³	RCT	21 21	JT NJT	-	4 (19.0%) 0 (0%)	4 (19.0%) 4 (19.0%)	2 (9.5%) 4 (19.0%)	-	-	-	-

JT = jejunostomy tube; NJT = nasojejunal tube; RCT = randomised controlled trial

approach used for the abdominal part of the operation (Kruskal–Wallis test, $p=0.624$ and $p=0.429$ for open and laparoscopic respectively).

Discussion

Early EN following oesophagectomy is a key element in supporting a patient's recovery and reducing postoperative complications. Table 3 summarises studies on EN after oesophagectomy.^{5,5–19} Although the use of EN is not without its disadvantages, the benefits outweigh the risks.

Early EN was compared with delayed nutrition by Wang *et al*, and was found to be associated with a short LOS, fewer incidences of pneumonia and better nutrition outcomes.²⁰ The authors advocated starting enteral feeding within 48 hours of oesophagectomy. EN was compared with PN in a randomised controlled trial (RCT) by Takesue *et al*.²¹ They presented the data of 47 patients who had undergone a thoracic oesophagectomy. EN was found to have a positive impact on weight loss and decreased the incidence of pneumonia. A systematic review by Weijs *et al* including 17 studies on early oral feeding as well as NJT and JT feeding showed that early oral feeding was associated with a shorter LOS.² NJT and JT patients had similar postoperative complication rates. However, nutritional outcomes and patient satisfaction were not reported.

Page *et al* compared NJT feeding following oesophagectomy with intravenous fluids.⁶ The incidence of NJT dislocation was 35% and cellulitis occurred in 20% of NJT patients. In the only RCT that investigated NJT versus JT feeding after oesophagectomy, Han-Geurts *et al* recruited 150 patients; 71 received NJT and 79 received JT feeding.⁷ The incidence of tube obstruction was 3% in the NJT group and 6% in the JT group. Tube dislocation was more prevalent among NJT patients (25%) than among JT patients (11%). There was no tube leak in the NJT group but three patients (4%) developed tube leak in the JT group and one of these subsequently required a laparotomy. Cellulitis was not reported in the NJT group. Conversely, 16% of JT patients experienced cellulitis and wound infection.

In a RCT by Torres Júnior *et al*, 21 patients received NJT feeding while 21 received JT feeding.³ Both routes were associated with a similar number of complications and a similar LOS. Nevertheless, the JT route allowed EN for longer periods. The trial also included patients who underwent gastrectomy and pancreaticoduodenectomy. In a previous study from our unit on PT feeding after oesophagectomy, an incidence of 10% was reported for cellulitis and 1.5% for granuloma formation at the site of PT insertion.²² A retrospective review by Kent *et al* examining 38 patients who underwent PT insertion for different indications revealed that the most common associated complication was tube dislocation or migration (24%).²³ The authors concluded that PT feeding is a valid technique for the management of complications following oesophagectomy and that it was more tolerable than a NJT.

Our study demonstrated that early EN can be administered using three different routes with similar results. The

NJT route was the most commonly used technique, especially among laparoscopic cases (82.9%). PT was the second most common technique for feeding and it was usually inserted during open oesophagectomy (68.6%). JT was the least common route for feeding and it was mainly inserted using an open technique (78.6%). The incidence of tube related complications in this study was 5.5% while that for 30-day morbidity was 58.9% (Table 2). The most prevalent tube related complication was cellulitis with an incidence of 3.3% across the entire cohort. NJT patients did not experience any tube related complications although the difference between the groups was not statistically significant (Table 2). The three different routes for EN did not appear to have an impact on LOS.

In our series, NJT and JT feeding did not lead to obstruction, dislocation or haemorrhage, and only one patient developed cellulitis in the JT group. PT feeding was associated with cellulitis, tube dislocation and haemorrhage. NJT obstruction was avoided in our cohort by four-hourly flushes of water through the feeding port. Tube dislocation may be prevented by stitching the NJT with a loose silk suture. If dislocation does occur, a new NJT can be inserted using an endoscope.

Study limitations

Our study has its own limitations as it was a retrospective analysis of a single centre practice. The group sizes were not balanced (fewer JT patients than NJT and PT patients) and the groups were heterogeneous in the types of surgery (laparoscopic vs open). Tube related complications occurred only in five patients, possibly owing to the sample size available. Finally, data on patient satisfaction with the different EN routes were not recorded during the hospital stay. A large prospective RCT is recommended to address these issues, and should focus on long-term nutritional outcomes and patients' experiences with the three EN routes following oesophagectomy.

Conclusions

NJT feeding is a feasible, effective technique that is not associated with major adverse events and it can be used safely for early EN following oesophagectomy. A multicentre prospective trial is advocated to verify these findings.

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