Feeding Jejunostomy Tube Placed during Esophagectomy: Is There an Effect on Postoperative Outcomes?

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ABSTRACT

Background: Feeding jejunostomy (FJ) tubes are routinely placed during esophagectomy. However, their effect on immediate postoperative outcomes in this patient population is not clear.

Objectives: To evaluate the effect of FJ tube placement during esophagectomy on postoperative morbidity and mortality.

Methods: The National Surgical Quality Improvement Program database was used to evaluate the effect of FJ tube placement during esophagectomy on 30-day postoperative morbidity and mortality rates. A propensity score-matched cohort was used to compare postoperative outcomes of patients with and without FJ tubes.

Results: An FJ tube was placed in 45% of 2059 patients undergoing esophagectomy. The anastomotic leak rate was 13.5%. Patients with FJ tubes were more likely to have preoperative radiation therapy (59.6% vs 54.9%, $p = 0.041$), transhiatal esophagectomy (21.5% vs 19.2%, $p = 0.012$), a malignant diagnosis (93.2% vs 90.4%), and longer operative time (393 min vs 348 min, $p < 0.001$). In a case-matched cohort, mortality (2% vs 2.4%, $p = 0.618$) and severe morbidity (38.2% vs 34.6%, $p = 0.128$) were comparable between patients with and without FJ tubes. FJ tube placement was associated with higher overall morbidity (46% vs 38.6%, $p = 0.002$), superficial wound infection (6.3% vs 2.9%, $p = 0.001$), and return to the operating room (16.7% vs 12.5%, $p = 0.016$). In a subgroup of patients with anastomotic leak, FJ was associated with shorter hospital stay (20.1 days vs 24.3 days, $p = 0.046$).

Conclusion: These mixed findings support selective rather than routine FJ tube placement during esophagectomy.

INTRODUCTION

Perioperative nutritional support of patients undergoing esophagectomy is important[1,2] to counteract the nutritional deficit associated with esophageal diseases that usually affect swallowing.[3] The optimal route and timing of postoperative nutrition in patients undergoing esophagectomy is unclear,[4] but early enteral feeding might have some advantages.[5] Oral nutrition is desirable postoperatively; however, adequate nutrition using this route is typically delayed to allow healing of the anastomosis. In addition, esophagectomy is often associated with a high risk of postoperative complications that might preclude timely oral feeding[6,7] or may make prolonged adjunct feeding necessary even after discharge. Adjunct nutritional support can be achieved using an enteral or parenteral route. The enteral route is more physiologic and is associated with less septic complications.[1,2] As such, many surgeons routinely secure a feeding tube such as a nasojejunal, nasoduodenal, or jejunostomy tube during esophagectomy. In a prospective study of 205 patients undergoing esophagectomy and concurrent needle catheter jejunostomy, Ryan et al[7] reported the need for prolonged (> 20 days) use of a feeding jejunostomy (FJ) tube in 26% of patients. In another review of 463 patients undergoing esophagectomy with concurrent Witzel jejunostomy, Wani et al[8] reported the need for supplemental jejunostomy tube feeding in more than 50% of patients 2 weeks postoperatively. In addition, patients with an anastomotic leak (11%) needed jejunostomy tube feeding for 38 days on average.

Although a feeding tube can be considered an essential adjunct for nutritional support in some patients after esophagectomy, the tube occasionally can be associated with serious complications, and many patients will not need it for prolonged feeding.[7-12] In a recent review of the literature by Weijs et al,[10] FJ tube-related serious complications that necessitated repeated laparotomy ranged from 0% to 2.9% in 12 series. It has been suggested that the potential of serious (severe) postoperative complications in relation to a prophylactic procedure would argue against the routine use of FJ tubes.[6,9]

With these conflicting stances and limited evidence about routine placement of an FJ tube during esophagectomy, we used a large, robust, multicenter, prospectively collected, national database to assess the effect of FJ tubes on the 30-day postoperative mortality, serious complication, and overall complication rates.

METHODS

The American College of Surgeons National Surgical Quality Improvement Program (NSQIP) is a nationwide validated clinical database that provides preoperative to 30-day postoperative information on surgical patients. The Current Procedural Terminology (CPT) codes were used to identify patients undergoing elective esophagectomy (43101, 43107, 43108, 43112, 43113, 43117, 43118, 43121, 43122, 43123, and 43124) in the NSQIP database between 2016 and 2017. Placement of an FJ tube during the index procedure was identified using CPT codes (44015, 44300, 44186, 44201, 44372, and 49441) for additional procedures.

The 30-day postoperative mortality, serious morbidity, and the overall morbidity rates were the primary outcome measures. Serious morbidity was defined as the development of 1 or more of the following: Organ/space infection, deep wound infection, wound dehiscence, pneumonia, unplanned intubation, failure to wean off the ventilator after 48 hours, pulmonary embolism, renal failure, stroke, cardiac arrest, myocardial

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infarction, postoperative bleeding, deep venous thrombosis, *Clostridium difficile* infection, anastomotic leak, sepsis, septic shock, and return to the operating room. Overall morbidity included serious morbidity (as described earlier) in addition to superficial wound infection, urinary tract infection, and superficial thrombophlebitis. The length of hospital stay and the incidence of individual complications were considered secondary outcomes. Patients undergoing emergency procedures or those with an unknown underlying diagnosis were excluded.

Analysis variables included patients' demographics (age, sex, and race), body mass index, functional status, American Society of Anesthesiologists class, and tobacco smoking. The following preoperative comorbidities were analyzed: Infection including systemic inflammatory response syndrome; sepsis; septic shock or preoperative wound infection; preoperative pulmonary disease including pneumonia, chronic obstructive pulmonary disease, or dyspnea; preoperative congestive heart failure; hypertension; stroke; diabetes; bleeding disorder; disseminated cancer; radiation therapy in the past 90 days; chemotherapy in the past 30 days; preoperative weight loss above 10% in the past 6 months; and corticosteroid use. Also evaluated were results of the following preoperative laboratory tests: Serum creatinine, albumin, white blood cell count, and hematocrit. Intraoperative details analyzed included complex reconstruction (intestinal vs gastric conduit), procedure approach (transthoracic, transhiatal, or thoracoabdominal), intraoperative transfusion, operative time, surgical approach (open vs minimally invasive), and diagnosis (benign vs malignant).

Baseline characteristics of patients with and without FJ tube placement were compared using χ^2 test for categorical variables and Student *t*-test for continuous variables. To account for the baseline differences between patients with and without FJ tube placement, a 1-to-1 propensity score-matched cohort was identified. A logistic regression model was used to estimate the likelihood of placing an FJ tube intraoperatively, and a propensity score (ranging from 0 to 1) was calculated for each patient using the coefficients of factors associated with placing an FJ tube from the logistic regression model. Patients with and without FJ tubes were matched on propensity score using a nonreplacement 1-to-1 match with a caliper of 0.005. Comparisons of baseline characteristics and primary and secondary outcomes of the matched cohort were then performed using χ^2 test for categorical variables and Student *t*-test or Mann-Whitney test (Wilcoxon rank sum test) depending on the distribution of the continuous variables. A sensitivity analysis was conducted to identify the effect of intraoperative FJ tube placement on postoperative outcomes in patients with a postoperative leak. Statistical analysis was conducted using Stata version 11.2 (StataCorp, College Station, TX).

RESULTS

Of the 2059 patients included in the study, 921 (44.7%) patients had an FJ tube placed, and 1138 (55.3%) did not. An anastomotic leak occurred in 278 (13.5%) of the patients. There were significant differences between the 2 groups as shown in Table 1. Patients with jejunostomy were more likely

Table 1. Baseline characteristics by status of jejunostomy tube placement before case matching (N = 2059)[a]

Demographic and clinical characteristics	No jejunostomy (n = 1138, 55.3%)	Jejunostomy (n = 921, 44.7%)	p value[b]
Age, mean (SD), y	63.1 (11.1)	63.6 (10.1)	0.322
Female sex	222 (19.5)	191 (20.7)	0.488
ASA class ≥ 3	916 (80.5)	768 (83.7)	0.064
Dependent functional status	10 (0.9)	7 (0.8)	0.768
BMI, mean (SD), kg/m^2	27.4 (5.8)	27.7 (5.9)	0.320
Tobacco smoking	298 (26.2)	227 (24.6)	0.426
Weight loss	245 (21.5)	199 (21.6)	0.966
Corticosteroid use	26 (2.3)	27 (2.9)	0.357
Preoperative comorbidities			
Infection[c]	27 (2.4)	17 (1.9)	0.411
Pulmonary disease[d]	101 (8.9)	73 (7.9)	0.441
Heart failure	6 (0.5)	5 (0.5)	0.961
Hypertension	512 (45.0)	465 (50.5)	**0.013**
Diabetes	199 (17.5)	188 (20.4)	0.091
Bleeding disorder	34 (3.0)	41 (4.5)	0.078
Disseminated cancer	37 (3.3)	17 (1.9)	**0.047**
Radiation therapy in past 90 d	614 (54.9)	544 (59.4)	**0.041**
Chemotherapy in past 30 d	733 (65.3)	593 (64.7)	0.780
Preoperative laboratory tests			
Creatinine, mean (SD), mg/dL	0.86 (0.3)	0.90 (0.38)	0.017
Albumin, mean (SD), g/dL	3.8 (0.46)	3.7 (0.45)	0.248
White blood cell count, mean (SD), 10^9/L	6.2 (2.4)	6.3 (2.3)	0.717
Hematocrit, mean (SD), %	37.5 (4.9)	37.5 (4.5)	0.875
Complex reconstruction (intestinal conduit)	37 (3.3)	25 (2.7)	0.478
Procedure type			
Transthoracic	804 (70.7)	598 (64.9)	**0.012**
Transhiatal	218 (19.2)	198 (21.5)	
Thoracoabdominal	116 (10.2)	125 (13.6)	
Malignant disease	1,029 (90.4)	858 (93.2)	**0.026**
Minimally invasive surgical approach	624 (54.8)	531 (57.6)	0.200
Intraoperative transfusion, ≥ 2 units	7 (0.6)	2 (0.2)	< 0.174
Operative time, mean (SD), min	348.8(129.0)	393.1(127.4)	**< 0.001**
Hospital length of stay, mean (SD), d	12.6 (10.7)	12.2 (9.1)	0.396

[a] Data are shown as number (percent) unless indicated otherwise.
[b] Boldface indicates statistically significant.
[c] Includes preoperative wound infection, systemic inflammatory response syndrome, sepsis, or septic shock.
[d] Includes preoperative pneumonia, chronic obstructive pulmonary disease, or dyspnea.
ASA = American Society of Anesthesiologists; BMI = body mass index; SD = standard deviation.

to have hypertension, preoperative radiation therapy, higher creatinine levels, transhiatal esophagectomy, malignant diagnosis, and longer operative time.

For the entire cohort (N = 2059), mortality (2.0% vs 3.54%, p = 0.369) and major morbidity (38.2% vs 35.4%, p = 0.189) were not different between patients with and without FJ tubes, but overall morbidity (46.3% vs 39.7%, p = 0.002) was significantly higher in patients with FJ tubes. Table 2 shows the propensity score-matched cohort with comparable preoperative and intraoperative characteristics between the 2 groups to minimize the confounding effect of those differences on the primary and secondary outcomes. Table 3 summarizes the postoperative outcomes of the 2 patient groups in the propensity score-matched cohort. Neither 30-day postoperative mortality (2% vs 2.4%, p = 0.618) nor serious morbidity (38.2% vs 34.6%, p = 0.128) varied significantly between the patients with and without FJ tubes. Overall morbidity was still higher in patients with FJ tubes after case matching (46% vs 38.6%, p = 0.002). A review of specific complications in the propensity score-matched cohort revealed a greater incidence of superficial wound infection (6.3% vs 2.9%, p = 0.001) in the FJ tube group and a greater chance of return to the operating room (16.7% vs 12.5%, p = 0.016). Hospital length of stay was not different between the 2 groups, but operative time was longer in patients with FJ tubes (mean = 394 min vs 351 min, p < 0.001). Table 4 shows the outcomes of 226 patients with a leak in the case-matched cohort. About 51% of those patients had intraoperative placement of an FJ tube. In this subgroup with leaks, FJ tube placement was associated with increased superficial wound infection rate (12% vs 3.6%, p = 0.019) and shorter hospital stay (20.1 days vs 24.3 days, p = 0.046). Mortality and readmission rates were not significantly different.

Table 2. Baseline characteristics by status of jejunostomy tube in a matched cohort[a]

Demographic and clinical characteristics	No jejunostomy (n = 841, 50%)	Jejunostomy (n = 841, 50%)	p value
Age, mean (SD), y	63.3 (10.8)	63.3 (10.1)	0.994
Female sex	170 (20.2)	166 (19.7)	0.807
ASA class ≥ 3	692 (82.3)	694 (82.5)	0.898
Dependent functional status	8 (0.95)	7 (0.83)	0.795
BMI, mean (SD), kg/m^2	27.5 (5.9)	27.7 (6.0)	0.475
Tobacco smoking	218 (25.9)	213 (25.3)	0.780
Weight loss	187 (22.2)	187 (22.2)	> 0.999
Steroid use	21 (2.5)	22 (2.6)	0.877
Preoperative comorbidities			
Infection[b]	19 (2.3)	16 (1.9)	0.608
Pulmonary disease[c]	74 (8.8)	73 (8.7)	0.931
Heart failure	6 (0.71)	4 (0.48)	0.526
Hypertension	402 (47.8)	411 (48.9)	0.661
Diabetes	160 (19.0)	156 (18.6)	0.803
Bleeding disorder	30 (3.6)	30 (3.6)	> 0.999
Disseminated cancer	21 (2.5)	17 (2.0)	0.512
Radiation therapy in past 90 days	492 (58.5)	492 (58.5)	> 0.999
Chemotherapy in past 30 days	535 (63.6)	543 (64.6)	0.684
Preoperative laboratory tests			
Creatinine, mean (SD), mg/dL	0.87 (0.34)	0.89 (0.36)	0.157
Albumin, mean (SD), g/dL	3.8 (0.45)	3.8 (0.44)	0.840
White blood cell count, mean (SD), 10^9/L	6.2 (2.3)	6.3 (2.3)	0.278
Hematocrit, mean (SD), %	37.5 (5.0)	37.7 (4.4)	0.345
Complex reconstruction (intestinal conduit)	28 (3.3)	23 (2.7)	0.477
Procedure type			
Transthoracic	567 (67.4)	563 (66.9)	0.872
Transhiatal	179 (21.3)	187 (22.2)	
Thoracoabdominal	95 (11.3)	91 (10.8)	
Malignant disease	767 (91.2)	780 (92.8)	0.243
Minimally invasive surgical approach	492 (58.5)	490 (58.3)	0.921
Intraoperative transfusion, ≥ 2 units	2 (0.24)	2 (0.24)	> 0.999

[a] Data are shown as number (percent) unless indicated otherwise.
[b] Includes preoperative wound infection, systemic inflammatory response syndrome, sepsis, or septic shock.
[c] Includes preoperative pneumonia, chronic obstructive pulmonary disease, or dyspnea.
ASA = American Society of Anesthesiologists; BMI = body mass index; SD = standard deviation..

DISCUSSION

FJ tube placement for enteral feeding is the most common adjunct feeding procedure to accompany esophagectomy, and it is thought to benefit the patient by providing early enteral nutrition, which is superior to parenteral nutrition.[1-3] However, FJ tubes can be associated with few but severe complications,[7-12] and not all patients will use an FJ tube, which puts into question the justification of routinely placing an FJ tube during esophagectomy.[6,9,13] In our analysis of 2059 patients undergoing esophagectomy, we demonstrate that there is higher overall morbidity, return to the operating room, and superficial wound infection with FJ tube placement, but no significant difference in immediate postoperative mortality, serious morbidity, and hospital length of stay. We also demonstrate that esophagectomy can be associated with a high rate of serious postoperative complications (including a leak rate of 13%) that potentially could delay optimal oral nutrition. In patients with leaks, FJ tube placement was associated with significantly shorter hospital stay despite higher rate of superficial wound infection and return to the operating room.

An FJ tube was used in 45% of esophagectomy procedures in our study, which reflects the lack of agreement among surgeons regarding placement of an FJ tube during esophagectomy. Because our data were collected from more than 250 hospitals, to our knowledge, this is the largest study that reports the rate of using FJ tubes in the context of esophagectomy from a nationwide, multicenter database. Although underreporting of the rate owing to coding errors cannot be excluded, the NSQIP database does have audit measures to ensure interrater reliability, with almost 0% variation.[14] An FJ tube also can be placed in the perioperative period, particularly in patients undergoing neoadjuvant chemoradiotherapy,[15] which will further affect the rate reported in our study. However, in our study, a subset analysis of patients without neoadjuvant chemoradiation therapy and no prior operation before esophagectomy, the jejunostomy tube placement rate was 45% among 694 esophagectomy procedures, which is comparable to the rate reported for the overall cohort.

We found a higher rate of overall morbidity, superficial wound infection, and return to the operating room in the FJ tube group. We do not have a direct confirmation that those events were all attributed to FJ tubes, but after case matching, it appears likely that FJ tube placement is contributing to this observation. Superficial wound infection at the FJ tube site as well as catheter-related complications requiring a repeated operation have been reported in the literature. In a review of 12 studies where an FJ tube was placed during esophagectomy, Weijs et al[10] found that FJ tubes were associated with wound infection rates of 0.4% to 16%, reoperation rates ranged from 0% to 2.9%, and mortality rates from 0% to 0.5%. Only 2 of the 12 studies reported patient mortality associated with FJ tube placement. Serious complications that are related to the jejunostomy catheter, including bowel obstruction, intraperitoneal leak with peritonitis, intraabdominal abscess, abscess at the jejunostomy tube site, wound infection, and wound dehiscence were reported.[8,10-12,16-19] Other more common, but less serious complications such as tube dislodgement, leakage around the catheter, catheter blockage, nausea, bloating, or diarrhea were also reported.[10-19]

There are conflicting results of reports in the literature regarding the effect of FJ tube placement on hospital length of stay.[4] Our study findings show comparable length of hospital stay between patients with and without FJ tubes; however, in a subgroup of patients with an anastomotic leak, we found that those with FJ tubes had a 4-day shorter length of hospital stay on average. This subgroup analysis is important because most surgeons place an FJ tube as a "safety valve" in the event of an anastomotic leak. One strength of our study is the large sample size that allows such analysis, whereas most prior studies were limited to small-number, single-center experiences.[8,10,12,17-19] It is possible that FJ tube placement allows early enteral nutrition or prevents interruption of feeding in patients with leaks, leading to a shorter hospital stay.

This study has several limitations. Selection bias is inherent to the retrospective study design. There is a chance that some patients had FJ tubes placed preoperatively, which would result in case misclassification; however, we accounted for that by using a propensity score-matched cohort with balanced preoperative characteristics. Our data do not capture other feeding methods that might have been used in the group without jejunostomy; therefore, we cannot make conclusive comments on comparative efficacy of those other methods of feeding. We were successful in creating a cohort with balanced preoperative and intraoperative characteristics between the 2 groups. However, propensity score matching cannot account for other factors unmeasured by our database that can be different between the groups and affect the postoperative morbidity (eg, tumor stage or

Table 3. Comparison of postoperative outcomes by jejunostomy tube status in propensity score-matched cohort[a]

Outcome	No jejunostomy (n = 841)	Jejunostomy (n = 841)	p value[b]
Morbidity			
All morbidity	325 (38.6)	387 (46.0)	**0.002**
Serious morbidity	291 (34.6)	321 (38.2)	0.128
Mortality	20 (2.4)	17 (2.0)	0.618
Wound complications			
Organ/space infection[c]	78 (9.3)	81 (9.6)	0.803
Deep wound infection[c]	8 (0.9)	7 (0.8)	0.795
Superficial wound infection	24 (2.9)	53 (6.3)	**0.001**
Wound dehiscence[c]	7 (0.8)	6 (0.7)	0.781
Pulmonary complications			
Pneumonia[c]	103 (12.3)	115 (13.7)	0.384
Unplanned intubation[c]	95 (11.3)	91 (10.8)	0.756
Pulmonary embolism[c]	14 (1.7)	20 (2.4)	0.299
Failure to wean off ventilator > 48 h	84 (10.0)	81 (9.6)	0.806
Urinary complications			
Renal failure[c]	18 (2.1)	10 (1.2)	0.127
Urinary tract infection	17 (2.0)	20 (2.4)	0.618
Other complications			
Stroke[c]	2 (0.24)	1 (0.12)	0.563
Postoperative bleeding[c]	109 (12.9)	97 (11.5)	0.372
Cardiac arrest[c]	15 (1.8)	7 (0.8)	0.086
Postoperative myocardial infarction[c]	9 (1.1)	8 (0.9)	0.807
Deep venous thrombosis	25 (2.9)	24 (2.8)	0.885
Sepsis[c]	44 (5.2)	43 (5.1)	0.912
Septic shock[c]	47 (5.6)	43 (5.1)	0.665
Anastomotic leak[c]	110 (13.1)	116 (13.8)	0.668
Clostridium difficile infection[c]	15 (1.8)	15 (1.8)	> 0.999
Return to OR[c]	105 (12.5)	140 (16.7)	**0.016**
Operative time, mean (SD), min	351 (127)	394 (127)	**< 0.001**
Length of hospital stay, mean (SD), d	12.5 (10.8)	12.2 (9.2)	0.539
Readmission	84 (10)	89 (10.6)	0.688

[a] Data are shown as number (percent) unless indicated otherwise.
[b] Boldface indicates statistically significant.
[c] Serious complications.
OR = operating room; SD = standard deviation.

Table 4. Postoperative outcomes of patient with anastomotic leak by feeding jejunostomy tube status[a]

Outcome	No jejunostomy (n = 110)	Jejunostomy (n = 116)	p value[b]
Mortality	7 (6.4)	10 (8.6)	0.520
Organ/space infection	57 (51.9)	68 (58.6)	0.304
Deep wound infection	3 (2.7)	2 (1.7)	0.608
Superficial wound infection	4 (3.6)	14 (12)	**0.019**
Wound dehiscence	1 (0.9)	4 (3.5)	0.195
Sepsis	24 (21.8)	23 (19.8)	0.712
Septic shock	21 (19.1)	24 (20.7)	0.765
Return to operating room	55 (50)	70 (60.3)	0.118
Readmission	28 (25.5)	24 (20.7)	0.395
Length of hospital stay, mean (SD), d	24.3 (17.7)	20.1 (13.8)	**0.046**

[a] Data are shown as number (percent) unless indicated otherwise.
[b] Boldface indicates statistically significant.
SD = standard deviation.

intraoperative adverse events). As such, this analysis cannot substitute for the results of a randomized clinical trial. Finally, our data do not capture the effect of feeding tubes on long-term outcome (beyond 30 days) and whether the catheter obviates the need for total parenteral nutrition in patient experiencing serious postoperative complications.

Despite these limitations, our findings about FJ tube placement during esophagectomy are derived from a large, national, multicenter database and provide important new information suggesting that selective placement of an FJ tube during esophagectomy is warranted.

CONCLUSION

Our study results demonstrate that FJ tube placement during esophagectomy was associated with a higher rate of overall morbidity (particularly superficial wound infection), but it was also associated with a shorter hospital stay in patients with a postoperative anastomotic leak. These findings suggest that surgeons should avoid routine FJ tube placement and selectively use FJ tubes in patients at high risk of an anastomotic leak. ❖

Disclosure Statement

The author(s) have no conflicts of interest to disclose.

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Author contributions

Mohammed H Al-Temimi, MD, MPH, takes primary responsibility for study conception, design, acquisition of data, data analysis, and interpretation. Mohammed H Al-Temimi, MD, MPH, wrote the initial draft of the manuscript and the critical revision. Anya M Dyurgerova, DO, assisted in drafting the manuscript. Michael Kidon, DO, participated in drafting the manuscript. Samir Johna, MD, assisted in data acquisition, analysis, and interpretation, and assisted in critical revision of the manuscript.

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