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Practice Patterns and Utilization of Tube Feedings in Acute Pancreatitis Patients at a Large US Referral Center

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Abstract

Objectives: Clinical trials on tube feedings (TF) have not been sufficiently powered to change practice patterns in acute pancreatitis (AP). We aim to describe the use, duration, and resource utilization of TF in AP patients at an expert United States center.

Methods: Of 423 AP patients prospectively enrolled at the University of Pittsburgh Medical Center from 2004–2014, 139 (33%) received TF. Data on TF was assessed in 100/139 (72%) patients with complete data available.

Results: Patients on TF were more likely to be male, obese, have alcohol etiology, and moderately severe (34 vs. 19%) or severe AP (62 vs. 3%) ($P < 0.05$). Tube feedings were started after a median 5 (interquartile range, 3–8) days from admission and were administered for a median 39 days (interquartile range, 19–58). A nasojejunal route (95%) with an oligomeric formula (92%) was the preferred TF strategy. Feeding tube complications led to at least one endoscopic tube replacement in 42% of patients and to an unexpected healthcare visit in 29% of those discharged on TF (16/55 patients).

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Conclusion: Tube feeding form an important component in the management of patients with moderately severe and severe AP. Further studies should define the optimal utilization of TF and ways to reduce TF-related complications.

Keywords

Acute pancreatitis; tube feedings; enteral nutrition

INTRODUCTION

Management of nutrition is of paramount importance in the treatment of acute pancreatitis (AP). Approximately 80% of AP patients have a mild course and can rapidly transition to oral nutrition.[1] However, a portion of AP patients develop oral intolerance or local and/or systemic complications, requiring alternative routes of nutritional support to avoid malnutrition.[2] Accumulating body of evidence has demonstrated that compared with parenteral nutrition, AP patients who receive enteral nutrition (EN) have lower mortality, fewer infections, and shorter hospital stay.[3,4] Thus, guidelines recommend avoidance of parenteral nutrition unless EN is not feasible or fails to provide the minimum caloric requirements.[5,6]

Several randomized clinical trials (RCTs) have studied different aspects related to the initiation of tube feedings (TF), such as the timing of onset (early [first 48 hours of admission] vs. late),[7] the type of delivery route (nasogastric [NG] vs. nasojejunal [NJ]),[8] and the type of formula (monomeric, oligomeric, polymeric, immune-modulating, etc.)[9]. The impact in major outcomes of each of these aspects has not been clearly demonstrated. Therefore, the only consensus in recent guidelines is that TF should be administered through either a NG or NJ route.[5,6] As a consequence, the administration of TF in AP patients is highly variable among primary care physicians, gastroenterologists, and surgeons.[10] Furthermore, different management aspects of TF such as duration, endoscopic tube replacements, and healthcare visits due to TF complications, have not been studied.

Assessing practice patterns and utilization of TF at expert centers may provide guidance to clinicians in managing AP. With that purpose, we analyzed data in a prospectively enrolled cohort of AP subjects hospitalized over an 11-year period at the University of Pittsburgh Medical Center (UPMC). Our aim was to describe the use, duration, and resource utilization of TF in AP.

MATERIALS AND METHODS

Study Population

Between January 2004 and December 2014, 423 patients with AP were prospectively enrolled in the Severity of Acute Pancreatitis/Pancreatitis-associated Risk of Organ Failure (SAPS/PROOF) study at UPMC. Detailed methodology of this cohort has been previously reported.[11,12] All patients with clinical history or radiologic changes consistent with CP were excluded. Informed consent was obtained from each patient included in the study

cohort. Ethical approval was obtained from the Institutional Review Board at the University of Pittsburgh.

A total of 139 patients received TF during the study period and were eligible for analysis. To accurately report details in the use, duration, and resource utilization of TF, 18 (13%) were excluded due to unavailable electronic medical records during the 2004–2006 period and 21 (15%) were excluded due to incomplete data on TF during the 2007–2014 period. Thus, we were able to obtain complete data on TF utilization in 100/139 (72%) AP patients.

Use of Tube Feedings

The decision of starting TF in an individual patient was made by the treating physician. TF were administered through a NG or NJ route. NG tubes were placed at the bedside. The position was confirmed by fluid aspiration or chest radiograph. NJ nutrition was administered via a 10 or 12 French single lumen NJ tube or a double lumen nasogastric-jejunal (NGJ) tube that includes a 16 French outer stiffer gastric decompression tube and a 9 French inner softer feeding tube. The details of endoscopic insertion of these feeding tubes have been previously described,[13,14] and our practice is to fluoroscopically position the distal tube portion beyond 20 cm from the ligament of Treitz when feasible. After successful tube insertion, a nutritionist was consulted to recommend type of feeding formula, administration rate, and caloric target.

Data was collected prospectively during the hospital admission. The type of feeding tube used was recorded as NG, NJ, or NGJ. The type of feeding formula was classified as monomeric (elemental), oligomeric (semi-elemental), polymeric, or other. The timing of TF initiation was calculated using the initial date of hospital admission and the date of feeding tube placement. The indication for TF was categorized based on the Revised Atlanta Classification (RAC).[15] In patients with mild AP, an additional indication for enteral feedings was searched. The first type of tolerated nutrition was also recorded as oral, enteral or parenteral.

We recorded whether AP survivors were discharged on TF or a different route of nutrition. In patients discharged with TF, data on subsequent emergency room (ER) visits, or hospitalizations due to TF complications was obtained by retrospective review of medical records. The need for additional endoscopic feeding tube replacement and complications that led to repeated endoscopies were recorded. The total duration of TF, reasons for termination and the type of nutrition used afterwards were also recorded retrospectively.

Statistics

Descriptive data on clinical profile of AP was presented as proportions for categorical data, and median with interquartile range (IQR) for continuous data. Data was initially analyzed for the whole cohort, and then stratified based upon TF utilization. Bivariate comparisons were performed using Chi-square for categorical data and Mann-Whitney U test for continuous data.

Data on timing of TF, type of feeding tube, type of formula, complications, resource utilization and duration of TF, were presented as proportions for categorical data and median

with interquartile range (IQR) for continuous data. Bivariate comparisons between the duration and reason of termination of TF were performed with the Mann-Whitney U test. Statistical significance was defined as $P < 0.05$. Data analysis was performed with Stata/IC version 12.1 (StataCorp, College Station, Texas).

RESULTS

Cohort Characteristics

Among 423 AP patients in the study cohort, 139 (33%) received TF. The distribution of baseline socio-demographic and clinical characteristics based on TF utilization is shown in Table 1. Compared with patients who did not receive TF, those who received TF were more likely to be male ($P = 0.001$), obese ($P = 0.03$), and transferred from another hospital ($P < 0.001$). TF were more likely to be administered in AP patients with alcoholic etiology ($P < 0.001$), during a sentinel attack ($P = 0.03$), and with moderately severe (34 vs. 19%, $P < 0.001$) or severe disease (62 vs. 3%, $P < 0.001$). ICU admission ($P < 0.001$), multisystem organ failure (OF) ($P < 0.001$), need for pancreatic interventions ($P < 0.001$), and mortality ($P < 0.001$) were more likely in patients who received TF vs. those who did not. Patients on TF required significantly longer hospital stay than those without TF (log-rank, $P < 0.001$).

Socio-demographic and clinical characteristics were similar between those on TF with complete and incomplete data, except by higher rates of transfer and multisystem organ failure in those with complete data (Supplemental Table 1). Cross sectional imaging was obtained in 96/100 patients. Pancreatic necrosis was present in 87 patients (91%). Infected necrosis was diagnosed in 20/87 (23%) patients and walled-off necrosis (WON) developed in 70/87 (80%) patients. The median diameter of WON was 12 cm (IQR, 8–15).

Initiation of Tube Feedings

Descriptive data on the initiation of TF is shown in Table 2. TF were started in 98% of patients due to moderately severe or severe AP. Only 2% of patients received TF in the setting of mild AP and oral intolerance.

TF was the first route of tolerated nutrition in 87% of patients. A total of 9% of patients received total parenteral nutrition (TPN) as their first route of nutrition and then transitioned to TF after 7 days (IQR, 4–8). Oral nutrition was the first route of tolerated nutrition in 4% of patients, but transition to TF was needed after 11 days (IQR, 3–25) due to development of pancreatic necrosis in all these patients.

TF were started at a median of 5 days (IQR, 3–8) of admission. The majority of patients had endoscopic NGJ (51%) or NJ (44%) tube placement. Only 5% underwent bedside NG tube placement, but all transitioned to NJ or NGJ tubes later during the admission due to the need for prolonged TF (median 42 days; IQR 32–45). An oligomeric (semi-elemental) feeding formula was used in 92% of patients, whereas 5% received a monomeric formula, 2% a polymeric formula and 1% other type of formula.

Among 86 patients who survived the hospital admission, 55 (64%) were discharged home on TF, 35% on oral diet, and 1% on TPN.

Resource Utilization Related to Feeding Tube Complications

At least one repeated endoscopy was required in 42% of patients for feeding tube replacement. Among these 42 patients, a median of 2 additional endoscopies was required (IQR, 1–3). The median time from initial tube insertion to the first repeated endoscopy was at 25 days (IQR, 10–32). The most common feeding tube complications that led to endoscopic tube replacement were dislodgement (20%) and clogging (15%) (Table 3).

Among the 55 patients discharged home on TF, 16/55 (29%) required at least one ER visit and 11/55 (20%) required at least one hospital admission for the management of tube related complications.

Duration of Tube Feedings

The median duration of TF was 39 days (IQR, 19–58). In 70% of patients, TF were discontinued as planned by the treating physician at a median of 42 days (IQR, 21–60) and transitioned to oral diet. Among these patients, the duration of TF was longer in those who underwent pancreatic intervention (62 days; IQR, 41–103) compared to those who did not (36 days; IQR, 18–55) ($P = 0.01$). Pancreatic intervention was performed at a median time of 59 days from initial admission (IQR, 30–78).

TF were terminated earlier in 11% of patients that tolerated oral diet immediately after a tube related complication (26 days; IQR, 12–46; $P = 0.07$) and in 8% of patients who required TPN (28 days; IQR, 11–50; $P = 0.36$). TPN was administered for a median of 16.5 days (IQR, 11–56) and subsequently transitioned to either oral nutrition or TF (Table 4).

A timeline of the sequence of events from initial AP admission, TF initiation, tube replacement, and TF discontinuation, is presented in Figure 1.

DISCUSSION

In this large single center prospective cohort of patients with AP, TF were started in 33% of patients at an average of 5 days from hospital admission and administered for a median duration of 39 days. TF were administered through a NJ route and using an oligomeric formula in the vast majority of patients. Feeding tube complications led to at least one endoscopic feeding tube replacement in 42% of patients and to an unexpected healthcare visit in 29%.

Gut arousal in AP is important to maintain the gut protective function, reduce bacterial overgrowth, and prevent bacterial translocation.[16] Two RCTs have demonstrated that early nutrition (<48h) in mild AP was associated with shorter hospital stay compared with delayed nutrition.[17,18] In patients with moderately severe or severe AP, evaluating the impact of early vs. delayed nutrition has been challenging as establishing local complications or persistent OF require at least 48–72 hours from disease onset. Thus, all RCTs assessing the timing of nutrition in severe AP phenotypes have used moderately accurate scoring systems to predict severity.[19–22] A Dutch multicenter RCT of 208 patients with predicted severe AP comparing early NJ feedings within 48 hours of presentation with an on demand approach started at 72 hours demonstrated similar risk of infection and death.[21] Most recently, a single center RCT

of 214 patients with predicted severe AP showed similar findings.[22] However, early TF may be associated with higher risk of complications as recently demonstrated in a RCT of 1,000 critically ill patients on mechanical ventilation.[23] In that study, early full TF was associated with higher risk of vomiting, elevated residual gastric volumes, constipation and hyperglycemia; and was not superior to permissive underfeeding. As the timing to feed AP patients with severe phenotypes is not precisely defined, our practice has been to use an on demand approach by carefully assessing oral tolerance and severity based on the RAC at 72 hours. Using this approach, ~70% of patients (133/195) with truly moderately severe or severe AP received TF at a median time of 5 days of onset of pancreatitis. In contrast, only ~3% of patients (6/228) with mild AP received TF due to prolonged oral intolerance.

Optimal duration of TF in AP has not been defined. A previous retrospective study of 31 patients with necrotizing pancreatitis and gastric outlet obstruction (GOO) revealed that the median duration of NJ feedings was 25 days.[14] In another retrospective study of 33 AP patients the mean duration of NJ feedings was 105 days.[24] Given the lack of additional data, our approach has been to empirically continue TF for at least 4 weeks in patients with moderately severe or severe AP. After that period of time, we repeat cross sectional imaging and assess symptoms in the outpatient setting to decide further management. Alternatively, frequent oral challenges could be attempted earlier and TF stopped once the oral route reassures optimal nutrition needs.[22] When pancreatic intervention is needed, then TF are prolonged until oral tolerance is recovered post-intervention.

Three RCTs with total of 157 patients with predicted severe AP have demonstrated similar outcomes by using NG or NJ feedings.[25–27] However, the use of NG feedings may be problematic for several reasons. First, the risk of aspiration pneumonia was not the primary outcome in these studies and may have been underestimated. In critically ill patients, post-pyloric feedings is associated with 30% lower rate of pneumonia compared with NG feedings.[28] Second, the position of the NJ tube tip was not precisely reported in these studies and pancreatic stimulation may have not been completely avoided. A study of 36 healthy volunteers demonstrated that only TF administered beyond 20 cm from the ligament of Treitz successfully avoided pancreatic stimulation.[29] Third, patients with large fluid collections, GOO, and ileus, may have poor tolerance to NG feedings and may benefit of jejunal feedings. Finally, NJ tubes are softer, smaller and more pliable than NG tubes, which likely makes them more comfortable for prolonged outpatient feedings.[2] For the above reasons, our practice has been to use NJ feedings whenever possible.

The use of TF in our cohort carried a risk of 42% for endoscopic tube replacement due to complications at a median of 25 days. Similarly, in a small retrospective study of 31 patients with necrotizing pancreatitis on TF, 40% needed repeated endoscopy at a median of 25 days. [14] We also demonstrated that among AP patients receiving TF in the outpatient setting, up to 29% required an ED visit and 20% required a hospitalization for TF complications. These results emphasize that this group of patients requires close follow-up with a specialized team that is available to address and manage these TF complications, which may reduce the burden of ER visits and hospitalizations. Novel technologies, such as bedside insertion of a self-propelling NJ tube, may be cost-effective in such patients to reduce costs and risks related to repeated endoscopy and sedation.[30]

Our study has several limitations. First, it is a single referral center study and our results may not be representative of all patients with AP. However, our results may be representative of patients with moderately severe or severe AP initiated on TF at large referral centers. Second, while the majority of data was collected prospectively, details in the management of outpatient TF were collected retrospectively. This may have led to information bias and underestimation of the risk of complications, repeated endoscopies, and healthcare visits. Third, the exclusion of 28% of patients with incomplete TF data could have introduced selection bias. Though, demographic and clinical characteristics were similar between those with incomplete and complete data with the exception of different rates of transfer and multisystem organ failure. Fourth, we described TF utilization in an 11-year period and published RCTs or guideline recommendations may have changed the nutrition management of AP patients during that period of time.[5,6] However, our practice patterns have remained relatively stable with utilization of delayed jejunal feedings and oligomeric formula in >90% of AP patients that require TF. Finally, our study does not allow determining the adequate onset, route of administration, type of formula, and duration of TF. Large multicenter RCTs are needed to answer these questions. Instead, this is a post-hoc analysis of the management of TF in patients with moderately severe and severe AP.

We conclude that a delayed onset feeding strategy (5 days into the disease), administered through a nasojejunal route and using an oligomeric formula was the preferred strategy in this prospective cohort of AP patients who received TF at a tertiary referral center. Almost half required at least one endoscopic tube replacement and almost a third had an unexpected healthcare visit due to a feeding tube complication. The total duration of TF was 6 weeks, but patients who underwent pancreatic intervention required significantly longer duration of TF. In the lack of sufficiently powered RCTs and high quality evidence in guideline recommendations, our center experience aims to provide guidance to clinicians who manage patients with moderately severe and severe AP. Future RCTs are needed to precisely define the optimal utilization of TF in AP patients with different severity profiles. New methods to reduce feeding tube complications in this patient population are also needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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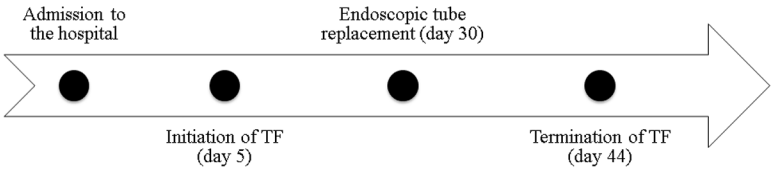

FIGURE 1.
Timing of TF in AP patients in our institution.

TABLE 1.

Socio-demographic and Clinical Characteristics of AP Patients Based on TF Utilization

Variables	Patients With TF (n = 139)	Patients Without TF (n = 284)	*P*
Age, median (IQR), y	53 (36–67)	50 (36–67)	0.65
Sex, male, n (%)	86 (61.9)	125 (44.0)	0.001
Race, n (%)			0.19
White	130 (93.5)	250 (88.0)	
Black	8 (5.8)	32 (11.3)	
Hispanic	1 (0.7)	2 (0.7)	
BMI category, n (%)			0.03
Underweight	1 (0.7	8 (2.8)	
Normal	18 (13.0)	66 (23.2)	
Overweight	46 (33.1)	97 (34.2)	
Obese	74 (53.2)	113 (39.8)	
Transferred, n (%)	117 (84.1)	104 (36.6)	<0.001
Etiology, n (%)			<0.001
Biliary	56 (40.3)	121 (42.6)	
Alcoholic	27 (19.4)	24 (8.5)	
Idiopathic	25 (18.0)	46 (16.2)	
Hypertriglyceridemic	15 (10.8)	17 (6.0)	
Post-ERCP	6 (4.3)	52 (18.3)	
Other	10 (7.2)	24 (8.4)	
History of AP, n (%)			0.03
Sentinel AP attack	106 (76.3)	187 (65.8)	
Recurrent AP attack	33 (23.7)	97 (34.2)	
Severity by RAC, n (%)			<0.001
Mild	6 (4.3)	222 (78.1)	
Moderately severe	47 (33.8)	53 (18.7)	
Severe	86 (61.9)	9 (3.2)	
ICU admission, n (%)	99 (71.2)	28 (9.8)	<0.001
Multisystem organ failure, n (%)	50 (36.0)	4 (1.4)	<0.001
Pancreatic interventions, n (%)	63 (45.3)	13 (4.6)	<0.001
Mortality secondary to AP, n (%)	14 (10.1)	2 (0.7)	<0.001
Total LOS, median (IQR), d	21.5 (14–37)	6 (4–8)	<0.001

BMI indicates body mass index; ERCP, endoscopic retrospective cholangiopancreatography; RAC, revised Atlanta classification; ICU, intensive care unit; LOS: length of stay.

TABLE 2.

Initiation of TF in AP Patients

Variables	Patients With TF (n = 100)
Indication of TF, %	
Moderate or severe AP	98
Mild AP with oral intolerance	2
First route of tolerated nutrition, %	
TF	87
Parenteral *	9
Oral *	4
Days from admission to TF initiation, median (IQR)	5.5 (4–8)
Type of first tube insertion, %	
Endoscopic nasogastric jejunal	51
Endoscopic nasojejunal	44
Bedside nasogastric †	5
Nutrition Formula, %	
Monomeric	5
Oligomeric	92
Polymeric	2
Other	1
Type of nutrition at discharge, % (n = 86) ‡	
TF	64
Oral	35
Parenteral	1

* Subsequently switched to TF.

† All of these patients required subsequent endoscopic NJ or NGJ placement.

‡ After excluding patients who died during the hospital stay.

TABLE 3.

Resource Utilization due to TF Complications in AP Patients

Variables	Patients With TF (n = 100)
Need for endoscopic tube replacement, %	42
Timing of endoscopic replacement, median (IQR), d *	25 (10–32)
Complications that led to tube replacement, %	
Dislodgement	20
Clogging	15
Coiling	4
Kinking	3
No. of endoscopies in patients that required endoscopic tube replacement, median (IQR)	2 (1–3)
Need for ER visit due to tube complication, % †	29
Need for hospitalization due to tube complication, % †	20

* Timing calculated from TF initiation.

† Percentage obtained among patients discharged from the hospital on TF (n = 55).

TABLE 4.

Reasons for Discontinuation and Duration of TF in AP Patients

Reasons for TF Termination, (n = 100)	Patients With TF, %	Duration of TF, Median (IQR), d	*P*
Physician driven onset of oral diet	70	42 (21–60)	0.01*
TF without bridge for pancreatic intervention	59	36 (18–55)	
TF as a bridge for pancreatic intervention	11	62 (41–103)	
Oral trial after a tube related complication	11	26 (12–46)	0.07†
Transition to parenteral nutrition	8	28 (11–50)	0.36†
Death	11	38 (13–82)	0.81†
Total cohort	100	39 (19–58)	--

*Duration of TF compared between those who had physician driven onset of oral diet with and without pancreatic intervention.

†Duration of TF compared with physician driven onset of oral diet.