11 Enteral Nutrition

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While there is little argument in the literature of the benefits of early enteral feeding, this practice on the wards is surrounded by controversy as well as mythology. Despite recommendations by A.S.P.E.N. and other nutritional societies, patients remain trapped in battles between starvation and protecting surgical anastomoses, Nil Per Os (n.p.o.) orders and nasogastric (NG) tubes, and "trickle feeds" vs. nocturnal feeds with little data application other than surgeon preference [1, 2]. This chapter will attempt to outline the current concepts for optimizing enteral support and provide the reader with a template to apply current best evidence to his or her surgical practice.

Basic Science of Enteral Feeding

The renaissance for enteral feeding has come with a greater understanding of the innate and adaptive immune systems. The gastrointestinal (GI) tract is the largest immune body in the human system and one of the first lines of defenses we have against environmental pathogens. Gut mucosal defenses mechanisms include: luminal factors such as gastric acid and secretory IgA and IgM, antimicrobial factors which prevent colonization of pathogens, physical barriers such as mucous layers and tight junctions, and mechanical factors such as desquamation and peristalsis that are all vital for maintaining homeostasis [3]. In addition, the adaptive immunity component of the gut includes specialized lymphoid tissue referred to as gut-associated lymphoid tissue (GALT) and mucosal associated lymphoid tissue (MALT). The GALT produces the majority of the immunoglobulins in the human body. Normal stimulation by luminal nutrients is critical for the maintenance of all these physiologic functions [3, 4]. Current evidence demonstrates that lack of nutrient stimulation for as little as 5 days results in decreases in secretory IgA, reduction in GALT tissues, alterations in gut mucosal barriers, and increases in activation of inflammatory cytokines [3]. Furthermore, starvation results in the loss of enteric hepatic circulation and hormonal stimulation that can lead to bacterial overgrowth, cholestasis, and potential for bacteria or endotoxin translocation. The overall impact of not feeding is a profound impact on the patient's immune system.

Nutritional Assessment and Practice Guidelines

The first process in any nutritional support algorithm should begin with a nutritional assessment. History and physical exam are paramount and an

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Table 11.1 Mnemonic "CAN WE FEED?" to facilitate safe initiation of enteral nutrition [5]

*C*ritical Illness Severity
*A*ge
*N*utrition Risk Screening
*W*ait for Resuscitation
*E*nergy Requirements
*F*ormula
*E*nteral Access
*E*fficacy
*D*etermine Tolerance

understanding of the patient's comorbid conditions is valuable when beginning nutrition. This process will allow you to risk stratify patients to determine whether they would benefit from early enteral feeding. Simply asking the question: "Can this patient eat?" is half the battle. Thus, in a patient with a functional GI tract that is continuous and can take nutrition per os, there are few if any contraindications to just beginning a diet. Keeping it simple is the key. We recommend the institution of a practical approach utilizing the CAN WE FEED? mnemonic published by Miller et al. [5]. This is illustrated in Table 11.1. While we understand the original intent of this mnemonic was for intensive care unit (ICU) patients, we think it is a simple straightforward quality process that can be applied to the surgical patient at any level of care. It covers the complete spectrum when addressing the nutritional needs of the patient.

Early Enteral Feeding a Priority

So feed early. The benefits to the surgical patient are numerous. Numerous studies in animals have showed a lack of nutrients to the gut disrupt the gut–blood barrier and intestinal mucosa atrophies leading to the potential for translocation of bacteria [6, 7]. Randomized trials have shown that patients receiving early enteral nutrition have fewer infectious complications and reductions in both ICU and hospital length of stay [8, 9]. Furthermore, a meta-analysis by Peter et al. concluded a clear advantage for early feeding [10]. Whether the patient is immediately postop from major GI surgery, traumatically injured, or has suffered thermal burns early nutrition will be key to a timely and complete recovery with fewer complications. Feeding the gut is the only way to maintain the normal homeostatic pathways throughout the human system. Maintaining a high priority for enteral nutrition maintains stimulation of the small bowel that allows for the release of hormones which maintain normal gallbladder and pancreatic functions. Parenteral nutrition lacks this advantage and can lead to cholestasis and increase risk of infections. Enteral feeds also maintain the normal acid–base balance within the intestinal lumen which is important for the maintenance of normal bacterial flora [4]. One can surely debate what does "early" truly mean in the case enteral feeding. Certainly the literature offers a wide range between 24 and 96 h as a definition for early [8, 11–13]. But the bottom line is—it just makes the most physiologic sense to begin as early as possible.

How Much to Feed: Full Versus Trophic

The goal of most nutritional plans is to achieve near target caloric goals. This remains a challenge with critically ill patients. Obstacles to achieving goals include issues related to feeding intolerance, ileus, serial surgical interventions, and access. Recent evidence suggests that hypocaloric or trophic feeds (60–70 % goal) may be associated with improved outcomes [14]. Rice et al. randomized over 200 patients with acute respiratory failure to receive either trophic (10 mL/h) or full enteral nutrition for 6 days [15]. This study found no differences in trophic feeds versus full energy nutrition with regards to mortality and ventilator free days. Interestingly, patients who received initial trophic enteral nutrition had fewer episodes of feeding intolerance. The EDEN trial, recently completed, addressed the same topic and found that trophic feeding did not have any impact on ventilator free days or mortality. Furthermore, this study demonstrated no additional benefits or reduction in infectious complications over full enteral nutrition. Moreover, the full nutrition group had more episodes of emesis, higher gastric residual volumes, and increased rates of constipation [16]. It would appear from the current evidence that the recommendation in most population of surgical patients is in support of hypocaloric or trophic feeding that achieves 60–70 % of targets. In fact with trophic feeding there appears to be less enteral nutrition related complications. Caloric deficit has been associated with worse outcomes. Studies from the 1980s and in the twenty-first century seem to replicate that the critical care patient suffers these worse outcomes as the caloric deficit increases, ranging from as low as four to six thousand calories [17, 18]. This would essentially equate to 3 days without any nutrition provision, assuming a 2,000 calorie requirement. These results would support early feeds to be started immediately at goal, to avoid any calorie deficit that could accrue and subsequently place the patient at risk for worse outcomes. However, as reported by *prospective* studies, providing aggressive early goal enteral nutrition has not demonstrated improved outcomes [16]. Therefore, the authors return to the simple statement to start nutrition early, within the first 2 days of the patient's hospital stay. If the enteral route is chosen, start it early at approximately 50 % goal (make the math easy), so that those personnel who are not registered dieticians can provide an order to execute the early enteral nutrition provision.

Early Postoperative Feeding and the Surgical Anastomosis

There is little dispute over the beneficial effects of starting nutrition in the first 24–48 h for a patient admitted to the ICU. However, there are fewer consensuses over the surgical patient with fresh anastomosis or new ostomy. Braga et al. in their study of over 650 major GI procedures demonstrated that early feeding was safe [19]. There was a low complication rate at 1.7 % and early enteral nutrition related mortality was calculated at 0.1 %. Yet still the surgeon remains reluctant to feed the fresh anastomoses. In another study, 53 patients underwent small bowel resection and primary anastomosis, the majority these patients were fed within 48 h postoperatively only one patient required reoperation to treat an anastomotic disruption [20].

The colorectal data is even clearer on early feeding safety [21]. A study by the French Society of Gastrointestinal Surgery demonstrated that only 57 % of the surgeon surveyed abided by evidence-based standards, and when asked specifically about early enteral feeding only 30 % would feed within 48 h. However, the library of literature to come from the Enhance Recovery after Surgery (ERAS) guidelines clearly support nutrition intact *hours* in the colorectal patient. Minimal complications are noted and patients recovery sooner and are discharged earlier [22–25].

The most compelling data for early postoperative feeding in the setting of a surgical anastomosis comes from Han-Geurts and colleagues who compared two groups of postoperative patients. Group one was with the standard approach waiting for bowel function to return. Group two was offered food on postoperative day one. This study demonstrated no significant differences between the groups with regards to complication rates [26]. Another study performed by Zhou et al. addressed the incidence of anastomotic leak rate in early feeding protocols [27]. In this randomized prospective trial, patients were randomized to early feeding or standard NG tube decompression with delayed oral intake until return of bowel function. The compelling observation in this study was that anastomotic leaks occurred at a less frequent rate in the patients that were in the early enteral group. We recommend beginning PO or tube feeding within 24–48 h of anastomotic creation in the setting of restoration of continuity and hemodynamic stability.

Feeding Access

A.S.P.E.N. recommends a hospitalized patient be fed within 7–14 days of admission [11]. Therefore if the patient is unable to receive nutrition during that time frame or it is anticipated the time frame will be extended, some form of nutritional supplementation and access will be necessary.

We recommend a priority on the initiation of tube feeds as soon as reasonably possible. Many routine elective surgical cases can be fed PO within this time period. Therefore, access may not be relevant. However, in the critically ill surgical, trauma, and burn patient careful thought and priority should be given to these patients, even *prior* to emergent cases. A failure to consider the potential need for postoperative nutritional access can be highly detrimental to the patient and create a conundrum in postoperative care. For example, in the case of the poly trauma patient with severe traumatic brain injury requiring laparotomy or damage control, strong consideration for long-term GI should occur.

Nasogastric or nasojejunal tubes can be easily placed in the operative theater during exploratory laparotomy. These tubes are also placed at bedside with little difficulty but lower success rate for distal access. Our current protocol allows for the placement of these feeding tubes by our nursing staff. We require a kidneys, ureter, bladder (KUB) X-ray to confirm placement. We do not delay tube feeds if we do not achieve a postpyloric position. Several studies have borne out that aspiration risk is not affected by feeding tube position [28]. Mainly, the postpyloric position is desirable because of the small bowel's tolerance to tube feeds vs. the stomach. Only with persistent signs and symptoms of poor gastric emptying or intolerance would we pursue small bowel access.

Other methods of placement of small bowel feeding tubes have been implemented which do not require radiographic confirmation. Recently, the use of electromagnetically guided placement devices (EMPD) has been safely trialed. Powers et al. demonstrated a 97.2 % success rate using EMPD and a nurse driven protocol [29]. Only 8 % of the 904 feeding tubes placed in this study required X-ray confirmation. In another study by the same authors they verified the agreement between EMPD and radiographs achieving a 99.5 % agreement rate [30]. The clear advantages to a protocol using EMPD are patient safety related to misplacement of the feeding tube, reduction in radiation exposure, possible earlier initiation of tube feeds, and cost reduction related to multiple radiographs. Though blind, endoscopic, and fluoroscopic placements of small bore small bowel feeding access have been described, the least invasive and logistically easiest method appears to be using the EMPD. However, all techniques should be in the surgeon's armamentarium to facilitate efficient enteral access.

There is currently no standard recommendation for optimal timing for placement of surgical feeding access. Patient selection for placement of a surgical access should consider patient's prognosis, current critical issues, the complications involved and tube insertion and care, and the length of time feeding access will be required. As previously discussed, the nasoenteric tube is adequate for those patients requiring short-term feeding access. However, the complications of nasoenteric tube mandate a risk and benefit analysis for the consideration for enterostomy. The risks include sinusitis, septic necrosis, patient discomfort, epistaxis, and misplacement/migration of tube into the lung resulting in pneumothorax or pulmonary aspiration. While there is no consensus on the placement of surgical feeding tubes most will agree if access is needed for greater than 4 weeks enterostomy should be performed. These feeding tubes come with their own challenges. However, are necessary in many patients for optimal outcomes. The complications of enterostomy tubes include infection, pressure necrosis, skin breakdown, granulation tissue, tube occlusions, and tube displacement.

The basic types of surgical place feeding tubes are the gastrostomy and jejunostomy. There are several variations from these positions which can include extensions from the gastrostomy into the jejunum and options for endoscopic, open and laparoscopic placement of these tubes. When considering what type of feeding tube to place one must include factors such as anatomy, previous surgeries, and prognosis. Also environmental factors may impact placement such as patient location and availability of skilled practitioners with the ability to place feeding access with quality and efficiency. It is these authors preference when placing surgical feeding tubes to utilize the gastrojejunostomy, open or percutaneous techniques. The gastrojejunostomy tube offers several unique advantages over gastrostomy and jejunostomy alone. The gastrojejunostomy allows for access to both the stomach and proximal small bowel via only one defect in the intestinal tract; more tolerant small bowel feeds while simultaneously decompressing the stomach. Given the high incidence of gastric dysmotility or gastroparesis in the critically ill patient this tube seems well adapted to use in these scenarios.

Gastric Dysmotility/Gastroparesis

Gastric dysmotility or gastroparesis as a common occurrence in the postsurgical patient. The main cause of gastric dysmotility is related to the disruption of hormonal balances and catecholamines that are present in this patient population [31]. This can be a vexing issue for any protocol with a priority for early enteral feeding. A tincture of time might be the best medicine in these cases to allow for catecholamine and inflammatory cytokines to dissipate. However, in our experience the best approach is a highly protocolized pathway to combat this entity. The small bowel is much more tolerant to early enteral feeding than the stomach. However, the majority of patients receives and tolerates gastric feeds, especially if started at less than goal as described earlier. Our protocol dictates that if the gastric residual volume exceeds 500 cc, tube feeds are stopped for 2 h and then restarted. If there are subsequent issues with high gastric residuals, we start the patient on intravenous metaclopramide and erythromycin. Over the next 24–72 h if this process is not successful we consider the use of small bowel access via the previously described techniques (Table 11.2). The evidence for the use of erythromycin as a promotility agent is based on the work by Boivin et al. [32, 33]. Erythromycin was given intravenously (IV) every 8 h and found to result in less interruption of tube feeds for high gastric residuals. Subsequently, more enteral formula was administered. This has been further substantiated in a randomized placebo controlled trial which again showed patients given erythromycin achieved a higher rate of goal tube feeds versus placebo. These authors state that there are potential side effects to erythromycin mainly the risk of torsades de pointes and the potential for multidrug-resistant organisms [32, 34, 35]. However, there is little evidence to suggest that erythromycin has a substantial impact on the gut flora. We recommend a trial of prokinetic agents for 72 h when intolerance to gastric feeds is encountered.

Table 11.2 Protocol for the initiation and access of enteral nutrition

Enteral Nutrition (EN)
• Initiation of EN – Start Formula at 50 % of goal (~25–30 mL/h) within 24–48 h of admission – Advance as tolerated to goal by day 5 with improvement of SIRS or critical illness – If not at 60 % of goal after 7 days, consider PN supplementation (refer to protocol)
• Withhold EN if hemodynamically unstable (rising lactate, pressors)
• EN Access – Placement ▪ Begin with blind bedside nasogastric feeding tube ▪ Consider bedside electromagnetic, endoscopic, fluoroscopic, or intraoperative placement ▪ OGT and NGT placement confirmed by physical exam and X-ray ▪ Small bore feeding tube placement confirmed by KUB or electromagnetic placement – Gastric access ▪ Short-term: OGT, NGT, small bore feeding tube ▪ Long-term (>30 days): PEG (initiate TF 6 h post PEG placement) – Postpyloric access ▪ Short term: If placement unsuccessful after two attempts consider endoscopic placement of PEG/J (long term) ▪ Indications Gastroparesis with persistent high (500 mL) Gastric Residual Volume (GRV) despite prokinetic agents or recurrent emesis Severe active pancreatitis (endoscopic placement for jejunal feeds) Open abdomen
Abdominal Trauma Index (ATI) > 15

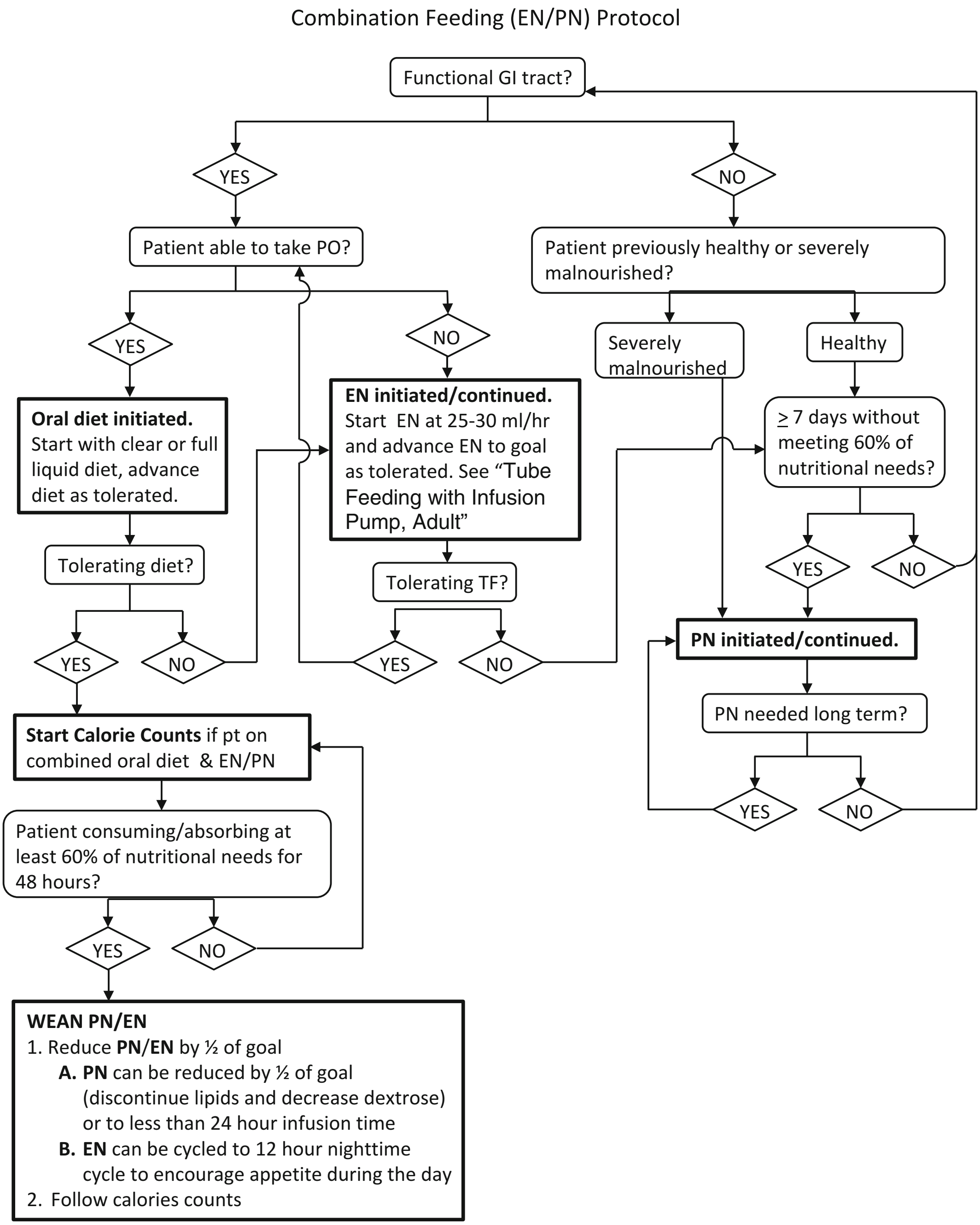

Fig. 11.1 Nutrition protocol for use of Enteral Nutrition (EN) and Parenteral Nutrition (PN) in critically ill patients

Regardless of the reasons for unsuccessful use of enteral nutrition, at some point, parenteral nutrition (PN) should be entertained. Though the battle to continue to the use of enteral nutrition should continue, PN can be started. The risks and benefits of PN are outside of the scope of this chapter. However, Fig. 11.1 shows how we incorporate both forms of nutritional support in the care of the critically ill and injured.

Enteral Nutrition and Disease States

Various disease states warrant special consideration when comes to the employment of enteral nutrition. This may be one of the most controversial and misunderstood areas as it applies to the actual application of evidence in the enteral nutrition paradigm. This is likely due to a lack of complete understanding of the innate and acquired immune systems and there interdependence on enteral nutrition. Moreover, the impact that catabolic stress plays in the mortality of a surgical patient. We will discuss pancreatitis, enteroatomospheric fistulas, and sepsis as they relate to enteral nutrition. Descriptions of enteral nutrition with trauma and burn pathology are described elsewhere.

Acute Pancreatitis

The cornerstone of nutritional support of acute pancreatitis for decades has been fluids and fasting. It was not till the recognition the extreme catabolic stress of fasting places on the human organism has led to a greater understanding and priority for the initiation of enteral feeding. The dated belief that parenteral nutrition is superior for the support of acute pancreatitis lacks evidence [36]. Though intuitively the concept of avoiding food may subsequently stimulate pancreatic secretion thus aggravating pancreatic inflammation seems physiologically sound. However, the evidence is that enteral nutrition is associated with fewer complications, reduction and length of hospital stay, as well as better outcomes [37]. In a systematic review of the literature, Gramlich and others demonstrated significant decreases in infectious complications when enteral nutrition was employed over parenteral nutrition. While there was no difference in mortality in this review there were significant cost benefit associated with enteral nutrition [38]. In the recent work, Yi performed a meta-analysis of eight randomized control trials demonstrated a clear superiority of total enteral nutrition versus TPN. This meta-analysis showed that enteral nutritional support leads to decreases in mortality, fewer complications, reduction in organ failure, and additional surgical intervention [37]. This and other studies have lead major societies such as American College of Gastroenterology and A.S.P.E.N. to recommend that oral feedings be initiated immediately if there are no contraindications [36]. A patient with severe pancreatitis, the standard of care remains enteral nutrition. With regards to TPN, it is important to note that there was a study of TPN versus no nutritional therapy in the management of acute pancreatitis. Noteworthy in this study was the fact that early TPN patients did worse than those who received only IV fluids and no nutritional support. Patients receiving TPN in this study had longer hospitalizations and a greater incidence of catheter-related sepsis. It is our practice to begin oral intake as soon as nausea and emesis are no longer present. In more severe cases, we place nasojejunal feed tubes and initiate enteral feeds when resuscitation is completed and hemodynamics are no longer labile.

Any discussion of the nutritional support of acute pancreatitis should include the concept of pharmaconutrition. Glutamine by far is one of the most interesting and most studied pharmaconutrients in the arena of surgical metabolism. Glutamine provides energy for enterocytes, lymphocytes, macrophages, and neutrophils, and may be an important component of the mucosal physiology. Numerous randomized control trials have demonstrated benefit for glutamine supplementation in the surgically critical patient and trauma victim. A meta-analysis published in 2013 favored glutamine supplementation in acute pancreatitis, but in the eight randomized control trials reviewed, only intravenous glutamine showed benefit. However, a recent large prospective study with septic shock patients did not show benefit [39]. Therefore, the enthusiasm with glutamine has waned.

Enterocutaneous Fistula

One of the most challenging problems in surgery remains the enterocutaneous fistula (ECF).

Despite the many advances and techniques available, ECF are challenging even to the seasoned surgeon. The vexing issue is the complex interplay of multiple parallel and sometimes competing processes involved in the care of these patients. A balanced approach is essential to control sepsis, minimizing fistula output, keeping electrolytes and fluid balance, and all the while striving to provide nutrition so that the fistula can heal. Traditionally, a fasting state is employed and pharmacotherapies targeted to reduce GI secretions have been the standard. The impact on mortality with these approaches has been variable. In the early 1960s, with the advent of TPN, mortality improved for the patient with ECF. Yet still it was recognized that without the pleothropic effects of enteral feeding further efforts to reduce mortality would be inhibited.

Recently, the Penn Trauma Group outlined in a review a clear systematic approach to the metabolic and nutritional treatment of ECF. Clinically, we employ a similar approach in our treatment of ECF. Schwab and coauthors recommend a three staged approach. This process is outlined in Fig. 11.2.

Phase I entails the diagnosis, resuscitation, and institution of TPN. The goal of this phase is to reduce the inflammatory and catabolic state that will create road blocks to the healing process. Phase II defines anatomy, provides adequate drainage, and involves a complete nutritional assessment, as well as consideration of appropriate feeding access. This is critical. It determines how much bowel is present that will allow for adequate absorption of nutrients. An assessment for feeding access is performed during this phase. If necessary, balloon catheters are placed within distal areas of the fistula so that proximal fistula effluent can be for refed. Nutritional assessment and active monitoring to achieve a positive nitrogen balance is key. A standard recommendation of achieving 20–30 kcal/kilo/day of nonprotein calories and 1.5–2.5 g/kg/day of protein are reasonable initial goals. A high degree of priority should be placed on nutritional monitoring which should include weight, prealbumin, albumin, and C-reactive protein. If your patient is on TPN during the initial phases—an emphasis on discontinuation of TPN should be placed to favor the early enteral process. Various groups have demonstrated that many ECF patients are able to transition to full enteral nutrition [40].

There should be a strong consideration for immunomodulating adjuncts in the treatment plan for ECF. Though studies remain controversial, many of these studies are under powered for mortality and therefore the benefits of formulas which contained elements such as glutamine, arginine, omega-3 fatty acids, and vitamin C have shown minimal impact. However, there is minimal risk to these adjuncts therefore we recommend the employment of immuno nutrition when feasible.

In addition, agents which potentially impact fistula output may benefit and impact early closure. Antimotility agents such as loperamide and opium compounds can be employed safely. Proton pump inhibitors, octreotide, and somatostatin have shown variable results but reduce secretions which can be advantageous if fistula outputs are liters per day. Bulking agents can be considered such as dietary fiber. We have employed a myriad of these modalities in combination and recommend a very in the individualized approach when dealing with ECF.

Sepsis

With regards to enteral feeding in the setting of the septic patient, we recommend strict adherence to the Surviving Sepsis Campaign National Guidelines [41, 42]. These guidelines clearly favor enteral feeding over the use of TPN. The institution of enteral feeding should begin within 48 h and one should avoid long-term fasting due to the high catabolic state in sepsis. The data regarding timing of enteral feeding in the setting of pressors is largely inferred. However, the risk for intestinal ischemia is real for a very small group of patients, less than 1 % [43]. Therefore, hypocaloric tube feeds with the goal of achieving 50 % of daily goals in the initial phases are warranted. Enteral feeding should not begin until fluid resuscitation is completed and pressor requirements are stable or decreasing. We do not advise

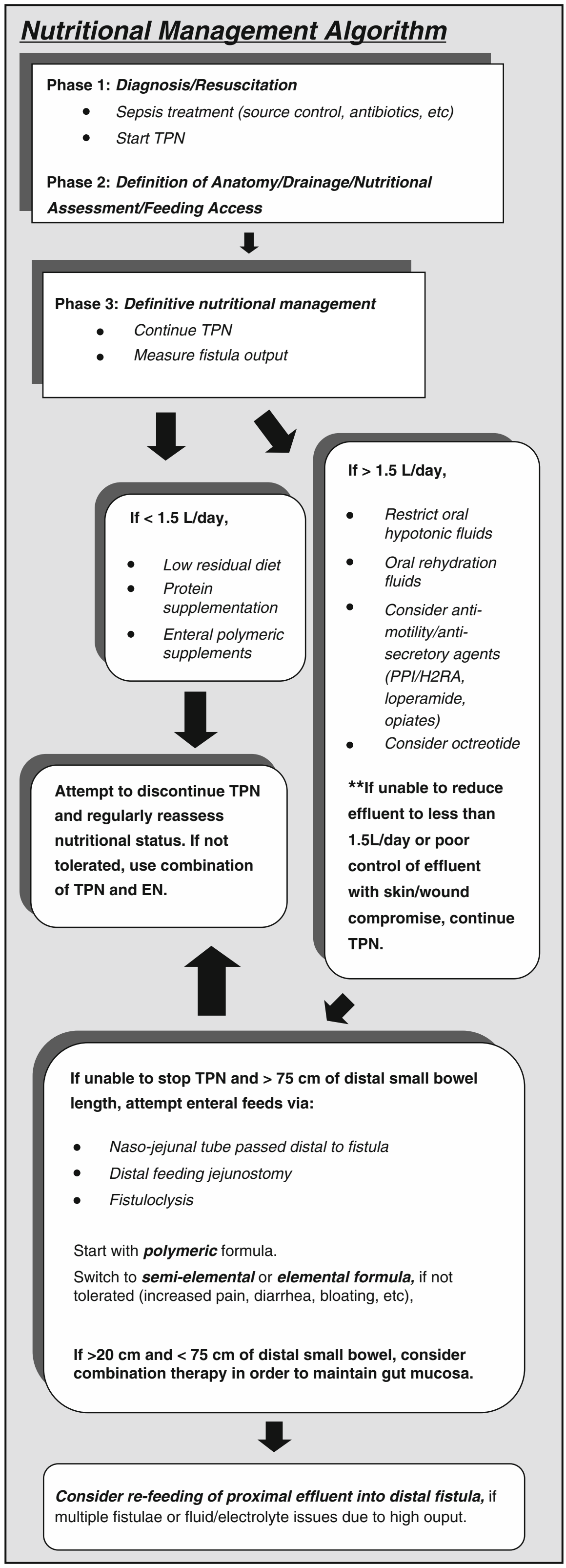

Fig. 11.2 Nutritional management of enterocutaneous fistula. From [40]; with permission

aggressive targets to goal feeding until the patient is clinically improving. Certainly, the institution of enteral feeds in sepsis is very individualized, and in those patients who improve quickly advancement to goal can be performed safely.

Complications of Enteral Nutrition

Those patients who suffer complications associated with enteral nutrition are the same who stand to benefit the most. Unfortunately, "intolerance" to enteral nutrition is poorly defined as gastroparesis, high gastric residual volumes, small bowel ileus, bowel sounds, adequate bowel movements and diarrhea have no agreed upon definitions in the intensive care patient. As well, many of these entities are not associated with documented associations with clinical outcomes such as frank aspiration and pneumonia. However, enteral nutrition is often held and the propagation of malnutrition due to feed withholding is continued. Nonetheless, we will attempt to describe some of the complications commonly associated with enteral nutrition.

Aspiration

The risk of aspiration and subsequent pneumonia is very much a concern with the patient receiving enteral feeds. Particularly when one considers the route of enteral feeding nasogastric versus nasojejunal one would intuitively think that there would be a higher risk for aspiration and subsequent pneumonias from those patients admitted to the nasogastric route. Despite several well-designed studies which attempted to demonstrate a higher risk of aspiration events in those patients fed via the nasogastric route, studies have failed to consistently demonstrate worse outcomes in gastric feed patients. Therefore, we recommend that you start enteral feeding regardless of the position of the nasal feeding apparatus. We do recommend priority be given to the nasojejunal position when placing a small bore feeding tube intraoperatively, or via endoscopic, fluoroscopic or EMPD based on the better tolerance of enteral feeds distal to the duodenum. Certainly prevention is the best medicine when dealing with ventilator-associated pneumonia. Therefore, the immune modulating benefits of early enteral feeding should be given high priority as part of any prevention strategy. The focused on the use of VAP bundles have proven highly effective to decrease the incidence of pneumonia in the ICU population. Unfortunately, those bundles do not mention early feeding.

Diarrhea

Diarrhea is common in those patients receiving enteral nutrition. While it would be easy to assume that enteral formulations are the root of most diarrhea, this is usually the least likely culprit. Diarrhea is multifactorial. When addressing the patient who has diarrhea, we perform a careful evaluation of the patient's history and physical exam, current medications, and risk factors for infection. A systematic review of all medications, antibiotic history, and nutritional plan is essential. Medications are implicated more often than not in patients receiving enteral nutrition. One of the most common findings in our population is related to bowel regimen medications. These medications are necessary for the postoperative and critically ill patients receiving narcotics, but can be culprits for diarrhea. In addition, many medications specifically elixirs contain sorbitol which can be potent inducer of loose stool.

Any assessment of loose stool in the surgical patient must include a consideration of infectious diarrhea. There should be high suspicion for *C. difficile* in patients receiving antibiotics. One must also consider other bacteria as potential pathogens in the postsurgical patient. Once infectious and medications have been ruled out one can consider changing the enteral formulation. Lactose and excessive fat or carbohydrate formulations usually are responsible for enteral induced diarrhea. However, most formulations used commonly in practice today are designed to avoid these common inducers.

There are several options for addressing diarrhea. The simple addition of dietary fiber in most cases will suffice. Several studies have employed this strategy with success [44]. Other agents can be useful in slowing GI motility. It is crucial that enteral nutrition is not discontinued for diarrhea unless bowel ischemia or fluid/electrolyte imbalances are encountered. Careful scrutiny of medications and infections causes yield the majority of causes without interruption or alteration in the nutritional plan.

Formulas

There are multiple commercially available formulations for enteral feeding. Most formulas are similar in nature with regards to content containing about 1.0–2.0 cal/mL. Formulations are all fairly similar in the protein, carbohydrate, and fat ratios. Generally, protein content ranges from 16 to 20 %, carbohydrates 40–53 %, and fat 29–40 %. These formulations are iso-osmolar with few exceptions which include Isosource, Jevity, Osmolite, and Nutren. Numerous studies have also advocated an immunomodulating formula (containing glutamine, arginine, nucleotides, antioxidants, and omega-3 fat content) with some improved outcomes noted [45–47]. Typically though, the hospital purchasing contract drives the potential formulas available to the practitioner. The decision to choose a particular formula over the other may also include consideration of the nutritional status of the patient, electrolyte balance, absorptive capacity, disease state, and renal function. Though detailed knowledge of these formulas is often obtained by the institutions' registered dieticians, we again refer to have one or two well-known formulas known to the surgical staff. This will allow an easy prescription to be provided in the early phase of patient care associated with "early enteral nutrition provision."

Conclusion

Enteral nutrition is the preferred method of feeding and should be started early, within 24–48 h. Though this statement is mundane and stated in every nutrition text, it is probably the most important nutrition act we can perform with the greatest impact to patient care. Nuances of enteral nutrition concerning route, how much, and actual formulations used are important. However, a lack of this knowledge should not be an obstacle in accomplishing the early provision of enteral nutrition via the properly placed NGT/OGT at ~25 cc/h for almost every ICU patient who has completed a well-executed resuscitation.

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