Lessons learned from a case report

Managing Feeding Intolerance in Respiratory Failure Patients

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Introduction

Critical illness is often associated with catabolism. Consequently, providing nutritional support to those that cannot eat is essential to prevent malnutrition in the critical care setting.[1] When considering nutrition support in the critical care unit (ICU), certain comorbidities should be taken into careful consideration when formulating an enteral feeding plan. For example, pre-existing liver or renal dysfunction is an important aspect when contemplating nutrition support and can alter the choice of enteral nutrition formulas selected for delivery. The management of critically ill patients with a history of alcohol abuse is complex and nutrition plays a vital part, where malnutrition and other clinical complications may prove detrimental, with adverse effects on mortality.[2]

Although nutrition support is a lifesaving therapy in the intensive care setting, adequate delivery of nutrition is frequently prevented by a myriad of treatment and complications common in this patient group. For example, diarrhoea is a frequently reported complication of enteral feeding, affecting up to 12 to 25 per cent of patients, even in the absence of gastrointestinal dysfunction.[3,4] Patients with acute respiratory failure appear to be particularly at risk, with up to 50 per cent developing diarrhoea during their ICU stay. Smith *et al.*[3] found that up to 63 per cent of patients receiving mechanical ventilation (MV) who had higher feeding infusion rates (>50ml/h) had diarrhoea, and for a longer duration. It has been reported that the motility of the upper gastrointestinal tract in patients receiving MV is severely impaired; contractile activity is completely lost in the stomach and diminished to a lesser degree in the duodenum.[6] Furthermore, the safety of enteral feeding in severe respiratory failure patients, in particular those on extracorporeal membrane oxygenation, has been questioned.[7] Extracorporeal membrane oxygenation (ECMO) has been used increasingly in the past three decades in the support of patients with severe cardiopulmonary failure unresponsive to conventional therapies. Concerns for the negative effects of enteral nutrition in patients receiving ECMO has led to withholding enteral nutrition in this patient group in many ICU centres.[7]

These aspects of nutritional support in the ICU are examined in this brief report, which highlights a case study of an alcoholic female who was transferred for ECMO due to severe hypoxaemia.

Case study

Clinical case

A 47-year-old female patient with a history of heavy smoking, alcohol abuse (1L vodka/day), depression and previous overdose was admitted to the ICU. The patient's presenting complaints were three days of diarrhoea, and abdominal pain on the right side. In addition, there was hypoxaemic respiratory failure with septic shock and acute kidney injury. Her bloods on admission showed raised CRP (358), low Na (129), K (2.7), PO_4 (0.5) and albumin (26) with raised urea and creatinine. A lung CT scan showed extensive emphysematous change with right sided consolidation. Blood culture results showed streptococcal pneumonia. The patient was requiring continuous IV 10% glucose to maintain normal blood glucose levels. Diagnosis was hypoxaemic respiratory failure due to influenza and pneumococcal pneumomia.

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Medical treatment

The patient was oedematous, anuric and, thus, was started on continuous veno-venous hemodiafiltration. The patient had severe hypoxaemia, lactic acidosis and was started on venovenous (VV) ECMO. The application of ECMO involves a venous drainage cannula, reservoir, blood pump, membrane or hollow fibre oxygenator, heat exchanger, and return cannula. This provides partial to complete bypass of the pulmonary circulation and can provide circulatory support in addition to gas exchange. In VV ECMO, the blood is drained from the central venous system and returned after oxygenation back to the central venous circulation. Patient was also started on Pabrinex and refeeding syndrome electrolytes (K, Mg, PO_4) were replaced. Once the patient was haemodynamic stable, a nasogastric tube feed was inserted for enteral feeding. The patient was on ECMO for one week, where breathing improved and patient was put on normal endotracheal tube. After three weeks, a tracheostomy was placed. At the end of four weeks, the patient was only on a continuous positive airway pressure face mask.

Nutrition treatment

On admission the patient weight was 60kg, her height 1.71m and her body mass index (BMI, calculated as weight in kg divided by the square of height in m.) was 20kg/m^2. Clinical examination revealed general malnutrition, triceps and chest subcutaneous fat loss, ascites and, as per subjective global assessment,[8] moderately malnourished. The patient's nutritional requirements were calculated based on 20-25kg/kg BW and 1.2g protein/kg BW for the first week and then increased to 25-30kcal/kg and up to 1.5g protein/kg, as the patient improved, in line with ESPEN[9] recommendations. The patient was started on a standard iso-osmolar non-fibre feed, as per local ICU feeding protocol, at 25ml/hour with gastric residual volume (GRV) checked every four hours for the first one to two days of feeding, where GRV >250ml are considered high. The patient had persistently high GRV for the first day, where prokinetics were introduced to improve gastric motility. After three days on prokinetics, GRV were still high and feed remained at the low rate of 25ml/hour. Prokinetics agents have shown to improve gastric motility and promote feed absorption. However, the effects of the drug rapidly diminish after three days, where feeding success in patients with raised GRV and prokinetic is <20 per cent.[10] On day four, an nasojejunal (NJ) tube was inserted and feed was again challenged at 25ml/hour. Although tolerance seemed improved, the patient developed diarrhoea.

Diarrhoea, as per local protocol, was defined as type 7 stools >3 times/day or a liquid stool output of >750ml/day. Patient stool output was >1000mls/day, bowels opening 6 times/day, and a Flexi-Seal[R] FMS (ConvaTec UK) was inserted, as per diarrhoea management protocol, to prevent development of pressure sores. Stool sample was sent for culture and Clostridium Difficile infection was excluded. A fibre feed was introduced as the addition of fibre has been shown to improve motility, absorb excess fluid, and may assist with glucose control.[11] After a couple of days, stool output was still high around 800-900mls/day. It was now day seven and the patient had an ongoing poor nutrition since admission. The next step on the diarrhoea management protocol was to try peptide feeds. Patient was then started on Peptamen HN (Nestle), starting at a low rate of 25ml/hour. This feed nutrient composition is small-peptides (Whey protein) and mostly (70%) medium-chain triglycerides (MCT) with a nutrition content of 1.3 cals/ml and 6.6g protein in 100mls. Small peptides have been shown to be more efficiently absorbed than either intact protein or individual amino acids. Furthermore, enteral formulas containing whey protein have shown positive nutritional and clinical outcomes when compared to casein-containing formula.[12] See **Table One**.

Recently, Wiersdma, *et al.*[13] demonstrated that faecal weight >350ml/day was associated with significant negative energy balance (loss of 627kcal/day vs. neutral balance; P = 0.01). In the second week, diarrhoea was resolved despite feed infusion rate increment to 54ml/hour, and the Flexi-Seal[R] tube was removed. Rectal tubes have been associated with complications, including discomfort, local ulceration, infection, and perforation of rectum.[14] Improved feed tolerance resulted in the patient receiving near-target caloric goal, average 80 per cent, during these two weeks. Recently, a large prospective multi-institutional study of 352 ICUs from 33 countries, with a total of 7,872 mechanically ventilated patients, showed that achieving 80-90 per cent of prescribed calories are associated with the better clinical outcomes.[15] At day nine, the patient pulled the NJ tube out and a nasogastric (NG) tube was inserted; feeding regimen remained the same. Consequently, despite continuing MV and its associated gastric hypomotility, feeding tolerance was still optimal. Clearly, the peptide formula, whey protein and 70 per cent MCT, was responsible for improved feed tolerance and not the jejunal feeding route.

At the end of the third week, a tracheostomy was placed, and sedation stopped to start mobilising patient. Nutritional requirements were increased to 1800 kcals and 90g proteins to promote anabolism. The patient remained on feed but the infusion rate was increased to 58ml/hour; this provided 1392mls, 1800 kcals and 92g proteins. The patient was on this regimen for two weeks; bowel motions remained regular with adequate stool frequency and consistency. Decannulation was performed at the end of week four, where the feeding regimen was changed to 75ml over 16 hours providing an 8-hour break during the day to facilitate oral intake. Despite the increased infusion rate, tolerance remained

Table One: Patient NJ Feed Prescription and Stool Output for Two Weeks

Kcals & Protein	Day	Stool Output (ml/d)	Stool Frequency (units/d)	Feed Volume Prescribed	% of Calories Prescribed
20-25 kcal/kg	1	500ml	3	42ml/hr	83
1.2 g protein/kg	2	450ml	3	42ml/hr	88
	3	300ml	3	42ml/hr	85
Requirements	4	250ml	2	42ml/hr	80
1200-1500kcal	5	250ml	2	42ml/hr	76
72g proteins	6	250ml	2	42ml/hr	77
	7	200ml	1	42ml/hr	72
		314ml	2.2		80%
25-30kcal/kg	1	150ml	1	54ml/hr	77
1.2-1.5g protein/kg	2	Type 5	1	54ml/hr	71
	3	Type 5	1	54ml/hr	68
Requirements	4	0	0	54ml/hr	65
1500-1800 kcal	5	Type 5	2	54ml/hr	89
72-90g proteins	6	Type 5	1	54ml/hr	85
	7	0	0	54ml/hr	82
					77%

Day 2 onwards on week 2 – Flexi-seal was removed. The introduction of Peptamen HN feed halved stool output within 24hrs and faecal volume was <350ml/day by the 3rd day.

adequate with regular bowel motions. Following two days of overnight feeding, oral intake was providing up to 50 per cent of requirements and feeding was stopped. The patient was discharged eating and drinking to a ward in another hospital after 33 days on ICU with a weight of 57kg.

Discussion

This study highlights the benefits of using a peptide formula, whey protein and 70% MCT, in the management of feeding intolerance in a patient receiving MV. A key finding is that within 24 hours of initiating the peptide formula, stool output had halved and frequency reduced by the fourth day. This is a significant clinical result, as among clinical complications, diarrhoea is the most distressing to patients and nursing staff. Many factors have been implicated in the aetiology of diarrhoea; however, the cause is largely unknown and probably multifactorial.[5] Recently, luminal excess of bile acids has been offered as a possible cause for diarrhoea.[16] This was confirmed by animal studies showing that prolonged starvation causes gut atrophy, including the terminal ileum.[17] In human studies, Hernandez, *et al.*[18] performed duodenal biopsies in 15 critically ill patients after four days of fasting and confirmed the presence of mucosal atrophy. Similarly, in a DeMeo, *et al.*[16] study, 18 of 19 ICU patients developed diarrhoea when enteral feeding was started after five days of fasting. In this case report, that can be an explanation for the success of peptide feed in an alcoholic patient. In alcoholic liver disease, a study showed that 48 per cent of daily caloric intake was derived from alcohol in this patient group.[19] In this case report, the high MCT formula content can explain the success of this nutrition approach. The MCT fat can be absorbed directly across the small intestine in the absence of bile salts and lipase, hence, believed to be beneficial in feeding malabsorptions.[20] Therefore, a peptide formula with a high MCT content and whey protein can be successful in patients who would otherwise require parenteral nutrition because of feeding intolerance.

Another significant result was that patient only lost five per cent body weight, despite 33 days on ICU, compared to admission weight. A stool output reduction <350ml/day within two days of introducing the peptide feed was instrumental in maintaining adequate energy balance and minimising catabolism. It can be concluded that suboptimal management of enteral nutrition could be the most common cause of feeding intolerance, therefore, education of nutrition staff can have the potential to reduce the misuse of parenteral nutrition. Additionally, the Society of Critical Care Medicine, and the American Society for Parenteral and Enteral Nutrition, recommend the use of peptide semi-elemental formula for patients with persistent diarrhoea (Grade E).[21]

Conclusion

The evidence supporting peptide feed in diarrhoea are not conclusive. It must also be noted that, overall, there is not enough data on the use of peptide feeds. With the luxury of increasing availability of different enteral nutrition formulas, differing in their protein and fat content and ranging from monomeric to polymeric preparations, comes a complexity in the decision-making process with regards to nutrition support in critical illness. Dietitians must try different formulations, where a polymeric formula has failed, before considering the parenteral route. This case illustrates the potential merits of critical reasoning, despite scarce evidence, to the nutrition management of feeding intolerance in the critical care setting.

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