The management of motility disorders in critical illness

Retief I, RD(SA)
Inge Retief and Associates, Registered Dietitians
Correspondence to: Inge Retief, e-mail: ingeretiefrd@gmail.com

Abstract

Gastric motility disorders in the intensive care unit (ICU) are a reality leading to many complications including inadequate EN delivery. Care should be taken to understand what type of gastric motility disorder is present and therapy should be prescribed early to prevent worsening of clinical outcomes.

© SAJCN

S Afr J Clin Nutr 2011;24(3): S15-S18

Introduction

Hospital malnutrition remains a significant reality especially in the intensive care unit (ICU) patient.[1] Malnutrition has been reported in 20-50% of hospitalised patients and has been shown to increase morbidity, mortality, infection rates, length of hospital stay, institutionalization and healthcare costs.[1,2] Early enteral nutrition (EN) in ICU has been shown to improve clinical outcomes, minimize infection-related complications, preserve gut epithelial cell mass and the function of the gut-associated lymphoid tissue which offers mucosal barrier protection against bacterial translocation and thus offering cost-saving benefits.[3-5] International recommendations state that optimal EN should be initiated within 24 hours of ICU admission.[5] A number of trials have, however, shown that most ICU patients never receive their calculated target calories via EN.[4]

Gastrointestinal tract (GIT) dysmotility is a major obstacle in early, optimal EN delivery,[3] since up to 60% of patients have been reported to experience motility disorders, necessitating the transient cessation of EN infusion.[4] It has been further reported that high gastric residual volumes (GRV's) decrease gastric EN delivery in the ICU and this occurs in 30-51% of patients.[5] Patients with high GRV's are at increased risk of aspiration, have longer ICU stays and higher mortality rates.[5] Symptoms of EN intolerance include elevated GRV's, bloating, nausea, vomiting, abdominal distention, diarrhoea, and patient discomfort.[4]

Normal GIT motility

The primary motor function of the GIT is mixing and propelling food particles at a rate that enhances contact time of nutrients with the mucosa to facilitate absorption of nutrients.[6] GIT motor function is also responsible for peristalsis that cleanses the proximal intestine of residual food and bacteria that leads to stool formation and passing.[3,7] The two major functional zones are the proximal region, comprising of the fundus and antrum, which acts as a reservoir and the distal region, comprising of the antrum and pylorus, which together with the proximal duodenum delivers chyme at a metered rate into the absorptive mucosa of the small intestine at a maximum nutrient delivery rate of 8.4-12.6 kJ/minute.[6]

GI motility is a complex function regulated by the central, autonomic and enteric nervous system (ENS) and modulated by regulatory GI peptides, neurotransmitters and hormones as well as food or chyme presence.[3]

Normal GIT motility is crucial for EN delivery.[7] Disordered gut motility leads to reduced contact time of nutrients with the mucosa and causes small intestinal bacterial overgrowth.[7] This may lead to increased permeability of the mucosa and bacterial translocation, which leads to diarrhoea, dehydration, hypovolemia, the systemic inflammatory response syndrome, sepsis and multiple organ failure, including malnutrition.[3] Of greatest concern is high gastric aspirates which may lead to aspiration pneumonia with increased length of hospital stay, increased hospital readmission, mortality and morbidity.[3] Dysmotility may also affect the absorption and efficacy of medication in the critically ill.[3]

Abnormal GIT motility

Motility disorders are common in critical illness and can be limited to the stomach, small bowel, colon or it can involve the whole GIT.[3] Two major types of GI motility disturbances often described in critically ill patients are postoperative ileus and the motility disorders of critical illness.[3] In addition some patients may also have primary or secondary disorders such as achalasia, gastroparesis or chronic intestinal pseudoobstruction.[3] The aetiology of abnormal GI motility is multifactorial in the critically ill.[3] The most readily recognized motor

dysfunctions that are present in ICU patients who are intolerant to EN are:[6]

- Reduced frequency and amplitude of antral contractions.
- Loss of gastric phase 3 activity.
- Disorganized duodenal phase 3 activity that promotes retrograde flow.
- Disturbed fundic motor activity leading to delayed relaxation in response to nutrient stimulation in the gut which promotes failure of redistribution of gastric content.
- Abnormal duodenal contractility which impairs clearance from the proximal duodenum.
- Heightened feedback from the small intestinal receptors

These dysfunctions may be due to enhanced secretion of cholecystokinin particularly when high fat feeds are used. A potential role for peptide YY has also been identified.[6]

Factors that precipitate abnormal GI motility in critically ill patients include shock, impaired enteric nerve and smooth muscle function, traumatic injuries, inflammation brought on by cytokine activity, surgery, drugs, electrolyte disturbances, ischaemia, hypoxia, hyperglycaemia, dysregulation of gut hormones and neurotransmitters in the ENS, dysfunction of the pacemaker cells of the GI smooth muscles, the primary diagnosis, sepsis, increased intracranial pressure, respiratory failure, cardiac injury and administration of energy dense formulas.[3-6] Medication, such as catecholamines, opioids and sedatives, is also known to influence GIT motility.

Identification of GIT motility disorders

Early identification of abnormal GIT motility, by clinical and/or biochemical means, is crucial to prevent complications, unnecessary interruptions of EN, to guide therapy and improve outcome.[3]

Bowel sounds

Traditional physical assessment included auscultation. The presence of bowel sounds is thought to be a key feature of a healthy GIT.[8] This practise continues to be taught in nursing and medical education despite the lack of empirical evidence demonstrating clinical significance.[8] Bowel sounds do not correlate with peristalsis, it can be absent, hypoactive or high pitched during ileus.[3] Baid, reviewed the available literature from 1980 to 2009 regarding bowel sounds, abdominal examination and abdominal physical assessment and found varied and contradictory information regarding normal and abnormal bowel sounds. What was consistent in Baid's review was that the absence of bowel sounds were considered to be abnormal.[8] Fairclough and Silk, as quoted by Baid, stated that auscultation does not contribute to assessment of abdominal disease unless other signs of acute abdomen are present, and that it is done only because of habit and tradition, rather than to diagnose or plan interventions.[8]

Gastric residual volume (GRV)

Measurement of GRV's is the most widely used practise to assess gastric function in ICU patients receiving EN.[3] This practise appears to lack standardization and is affected by patient positioning,

technique, tube location and diameter.[9] Correlation between GRV's and gastric emptying rate has not been adequately demonstrated; however it is still considered to be a likely indicator of retention of gastric content.[3,9] Clinicians agree that large GRV's are abnormal and can lead to aspiration, but no agreement has been reached on the definition of a "large" GRV.[9] Johnson, has cautioned that large GRV's are not always a sign of intolerance to EN and low GRV's are not always proof of no risk of aspiration.[9] McClave, as quoted by Johnson, stated: "No appropriate designated residual volume level to identify aspiration could be derived as a result of poor sensitivity over a wide range of residual volume."[9]

GRV's require accurate measurement, taking time and patience when being performed. Metheny, as quoted by Stambovsky, describes the technique they follow to measure accurate aspirates as the following: a 60 ml syringe is used and 30 ml of air is forced through the syringe prior to each aspiration attempt in order to force the tube's ports away from the mucosal folds. This process is repeated two to three times during each measurement attempt. Slow and gentle withdrawal of the plunger after each air insufflation works best.[10] Regarding GRV cut off, published reports vary from 200 to 500 ml with the lower limit based on assumptions that all GRV's are aspirated.[9] McClave et al, as quoted by Johnson, showed that more than 90% of patients had GRV's of 150 ml or less, thus the question was posed whether all aspirates had been drawn.[9]

Stroud, as quoted by Johnson, showed that GRV's are higher at the start of EN.[9] Johnson stated high GRV's at the beginning of EN should not lead to feeding cessation, except if other signs of intolerance such as bloating, abdominal pain, emesis or nausea appear.[9] Parrish et al, as quoted by Johnson, stated that consistently low GRV's after 48-72 hours of successful EN indicate that testing is no longer necessary.[9] Monitoring of GRV's, alone should, therefore not be used solely to monitor the risk of aspiration. Measures to decrease the latter, such as elevating the head of the patient's bed to 30-45 degrees, using medication to promote motility and postpyloric feeding should also be considered.[9]

Landzinski et al did a study to compare gastric emptying using the paracetamol absorption test (PAT), in patients with low and high GRV's in order to determine if prokinetic therapy improves gastric motility in patients with intolerance. The authors reported that elevated GRV in ICU patients during gastric EN is associated delayed gastric motility. A set protocol for GRV measurement by means of the syringe technique and an 18-Fr large diameter tube was used. Prior to the enrolment of patients correct antral positioning of the gastric tube was determined by auscultating over the stomach after injecting air and confirmed radiographically. The use of GRV's did yield accurate indications of gastric motility delay.[5] The clinical significance of the latter part from inadequate EN feeding, is the findings of Inglis et al, as quoted by Landzinski, who found higher rates of Gram-negative bacilli in both gastric and tracheal aspirates with impaired motility, highlighting the risk for infection.[5]

The evidence regarding GRV assessment is thus not clear but large GRV's at the beginning of EN feeding should mandate further

investigation and therapeutic measures should be taken to prevent aspiration and resultant complications.

Paracetamol absorption test (PAT)

PAT, also known as the acetaminophen absorption test (AAT), has successfully been used in the ICU setting.[3] The test is based on pharmacokinetics indicating that the drug is not absorbed from the small bowel.[3] Good correlation has been found between stomach emptying time and peak plasma concentrations of paracetamol.[3,5] PAT is an indirect method to measure gastric emptying, but not small bowel motility.[3] Rapid stomach emptying is associated with increased drug absorption from the small intestine and early peak plasma concentrations of paracetamol.[3] PAT results should be obtained from patients with nasogastric or gastric feeding tubes rather than small bowel feeding tubes.[3] First pass metabolism, distribution, elimination and alterations in gut integrity will affect plasma levels of paracetamol.[3] Although PAT is safe, low cost and feasible to perform in the ICU, it does not require multiple blood sampling and personnel assistance. Contraindications for PAT include hypersensitivity to paracetamol, severe hepatic and renal impairment, severe malnutrition as well as long term use of ethanol, rifampin, carbamazepine and phenytoin. Results in patients with upper GI surgery are not accurate as these procedures alter the rate of absorption. Aspiration of gastric content can also alter the absorption kinetics of the drug leading to inaccurate results.[3,4] Heyland et al, as quoted by Landzinski et al, demonstrated by using PAT that critically ill patients, when compared with healthy controls, have delayed gastric emptying.[5]

Gastric scintigraphy, the breath test, ultrasonography and magnetic resonance imaging, gastric motility recording and measurement of small bowel motility are other tests that have been described in the literature. However all of these are not considered routine practice due to such limitations as time, test availability, need for normal organ function other than GIT and cost.[3]

Treatment of GIT dysmotility in critical illness

From the treatment point of view the first and easiest intervention is to correct fluid and electrolyte disorders by means of correct hydration of the correct spaces, as well as decreasing or discontinuing drugs, when possible, that are known to slow down GIT motility.[4] Furthermore, the use of an EN feeding protocol and jejunal feeding to prevent duodeno-gastric reflux is advised.[5,10] Other interventions include:

Blood glucose control with continuous insulin

Hyperglycaemia, even at levels of 7.8 mmol/l has been shown to disrupt antral motor activity.[3] Reduced fundic tone, inhibition of antral pressure waves and stimulation of pyloric pressure waves has been observed with glucose levels above 15 mmol/l.[3] This is due to reduced vagal efferent activity and nitric oxide release from the myoenteric plexus which is only seen with solids and not with liquids.[3] A number of studies showed that blood glucose concentrations are a positive predictor of delayed gastric emptying. By reducing fasting

blood glucose from 10.6 mmol/l to 8.6 mmol/ or post prandial blood glucose from 15.5 mmol/l to 9.4 mmol/l for instance, can increase gastric emptying rate by almost 20%, with accompanying increase in the number of gastric contractions.[4] To date there is no certainty that this magnitude of improvement may be found in ICU or is of documented clinical significance.[4]

Motility agents

The International Nutrition Survey in 2009 showed 66% of individuals with high GRV's receive motility agents.[10] The best hospital settings provided motility agents to patients 100% of the time and the lowest performing sites never gave motility agents.[10] Motility agents have been shown to improve gastric emptying, improve tolerance to EN as well as increase nutritional adequacy and reduce the energy debt of underfeeding.[10]

Metoclopramide, a 5HT4 receptor agonist is the most widely used prokinetic agent in patients with feeding intolerance.[6] This drug stimulates gastric and duodenal motility.[6] Metoclopramide 10 mg IV given 6 hourly may be effective in treating enteral nutrition intolerance.[6] However the effects of the drug rapidly diminish over time such that by day 3 the feeding success in patients with high GRV's is less than 20%.[6] Ukleja recommends that this dose should be halved in renal failure.[3] Metoclopramide is not effective in patients with brain injury.[6] Side effects include dystonic reactions.[3]

Erythromycin, a macrolide antibiotic was first established as a potential gastrokinetic agent in the early 1990's.[6] Erythromycin at 200 mg IV 12 hourly can be used prophylactically in high risk patients or reactively when high GRV's are seen.[6] However as in the case of Metoclopramide prolonged administration has been associated with reduced efficacy. Only 30% of patients by day 7 of treatment were still tolerant to EN.[6] IV erythromycin needs to be diluted depending on dosage and its use may therefore be of limited value in fluid restricted patients.[6] Efficacy and side effects of erythromycin are inversely proportionate to dosage and exact dosage for enteral nutrition tolerance has not been adequately described.[4] Side effects include increases in clinical effects of many drugs including cyclosporine, tacrolimus, methadone and fentanyl.[3]

It is also important to note that neither of these drugs have been approved by the FDA for use in ICU to reverse EN intolerance.[4] This off-label use is extrapolated from their established efficacy in treating diabetic gastroparesis.[4] The two drugs can be used alone or in combination to achieve maximal effects.[6,10] The mechanism of the claimed synergistic effect is unclear but may reflect the blockade of alternative compensatory pathways.[6] Discontinuation is needed if no treatment effect is found.[10]

Landzinski et al's study to evaluate prokinetic usage after gastric dysmotility, confirmed that patients with elevated GRV's definitely had impaired gastric emptying compared with patients with minimal GRV's. Secondly initiating prokinetic therapy in patients with elevated GRV's accelerated gastric motility to the extent that gastric emptying function resembled that of patients tolerating EN. Their findings on beneficial effect was overall in favour of erythromycin.[5] Landzinski's

findings extended the findings of other similar trials including that of Cohen et al, as quoted by Landzinski who reported that initiating prokinetic therapy led to the initiation of EN in 88% of their patients.[5] In the case of Landzinski EN initiation was achieved in 100% of their patients, but difference in the extent of EN initiation may have been due to study design.[5] According to Landzinski, the optimal role of prokinetic agents in patients experiencing EN intolerance remains to be determined.[5]

Complementary and alternative medicines

Mullin and Clarke did a recent review of complementary and alternative medicine and their role in the treatment of motility disorders. They stated that western based herbs such as peppermint oil, caraway oil, ginger and STW5 (Iberogast) as well as Chinese herbs like TWK, electroacupuncture as well as neutraceuticals like melatonin and hypnosis in the form of music therapy can modulate GI motility.[7] The safety or efficacy of such treatments have not been shown, especially in critically ill patient and are not advocated. The authors warn that practitioners need to become more aware of these treatments because of their potential adverse effects. Cinnamon, for instance, at a dose of more than 6 g per day may lead to delayed gastric emptying, an effect that may be potentially useful in the management of patients with the dumping syndrome.[7] The use of such alternative therapies may therefore be associated with unplanned treatment effects and are not recommended until their effects are well documented.

Future treatments

Cholecystokinin antagonists may be a possible futuristic approach as cholecystokinin levels are increased in patients with enteral feeding intolerance.[6] Agonists and other hormones such as ghrelin may also be investigated to promote gastric motility and positively influence metabolism via growth hormone secretion.[6]

References

1. Norman et al. Prognostic impact of disease-related malnutrition. Clinical Nutrition 2008; 27: 5-15

2. National alliance for infusion therapy and the American society for parenteral and enteral nutrition public policy committee and board of directors. Disease-related malnutrition and enteral nutrition therapy: A significan problem with a cost-effective solution. Nutr Clin Pract 2010; 25 no 5: 548-554

3. Ukleja, A. Altered GI motility in critically ill patients: Current understanding of pathophysiology, clinical impact and diagnostic approach. Nutr in Clin Pract 2010; 25, no 1: 16-25

4. Chan, L. A "gutsy move": Tackling enteral feeding intolerance in critically ill patients. Nutr in Clin Pract 2010; 25, no 1: 10-12

5. Landzinski et al. Gastric motility function in critically ill patients tolerant vs intolerant to gastric nutrition. JPEN 2007; 32, no 1: 45-50

6. Fraser RJL & Bryant L. Current and future therapeutic prokinetic therapy to improve enteral feed intolerance in the ICU patient. Nutr Clin Pract 2010; 25, no 1: 26-31

7. Mullin GE & Clarke JO. Role of complementary and alternative medicine in managing gastrointestinal motility disorders. Nutr Clin Pract 2010; 25, no 1: 85-87

8. Baid, H. A critical review of auscultating bowel sounds. British Journal of Nursing 2009;18, no 18: 1125 – 1129

9. Johnson, A. Assessing gastric residual volumes. Critical Care Nurse 2009; 29, no 5: 72-73

10. Stambovsky, M. Care and patience needed for accurate measure of gastric residual volumes. Amer Journ of Crit Care 2009; 10: 10