ENTERAL NUTRITION

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INTRODUCTION

The most natural and physiological way of obtaining nutrition is via oral intake through the mouth. Food taken through the mouth is digested and broken up into nutrients and absorbed into the body. For some patients this process is interrupted by illness. The introduction of enteral tubes for feeding becomes necessary for these patients and for some, it maybe permanent.

Advances in the field of clinical nutrition are moving with great speed with different formulations being brought into the market. Today physicians are face with what can bewildering choice of formulations. Increasingly patients are being discharged from the acute hospital with enteral tube feedings to the community. It is important for family physicians to be familiar with the type of formulations and the different enteral tubes. These tubes need to be changed on a regular basis and family physician may be called upon to provide such a service.

Many studies have supported the known fact that if "the gut works" use it adage. The enteral route is always preferable to the parenteral route provided there are no contraindications such as ileus, gastrointestinal ischemia, bilious and persistent vomiting or mechanical obstruction. There are many advantages as it requires less hospital stay, less cost, fewer infections and caloric intake can be varied easily.

ENTERAL TUBES

There are several ways to deliver enteral nutrition, intragastric (nasogastric or gastrostomy) or transpyloric (nasoduodenal, nasojejunal or jejunostomy)[2]. Intragastric feeding is generally preferred as they are more physiological but the transpyloric may be selected if there is increased risk of aspirations, gastrointestinal reflux and in cases the primary disease affecting the stomach. See Figure 1.

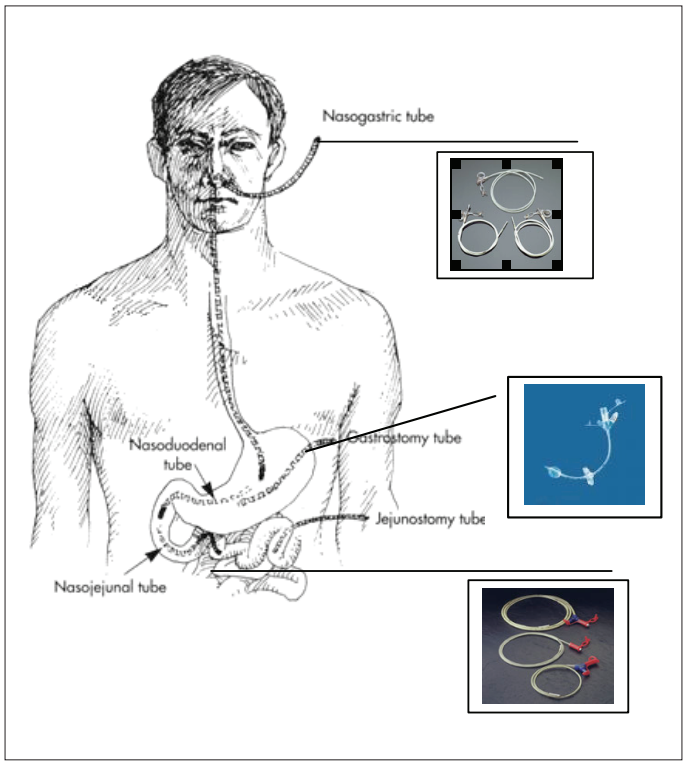
Gastric tubes

The nasogastric tubes are the first means of gaining enteral assess in the majority of patients. Orogatric tubes are use mainly in paediatrics as most infants are obligate nasal breather. However, the transnasal route may not be always possible. Tumours, anatomical anomalies and trauma may impede the passage of the tubes from the nose to the stomach. There is also an increased incidence of bacterial sinusitis in patient with nasoenteric tubes[3]. Extra care should be taken when the tube is place in an unconscious patient as he is unable to cooperate with swallowing. There is risk of tube placement in the trachea in such patients.

Nasogastric tubes

Most patients tolerate intragastric feeding well. Patient with stable condition can be started on bolus feeds and the less stable on continuous feed. Bolus feeding is now the preferred method as it less disruptive to lifestyle and not dependent on a pump device. Feeding method and schedules have to be continuously assessed irrespective of feeding methods. It is more physiological and buffers gastric acid better than post-pyloric feeding. Placement of the nasogastric tubes is relatively safe and can be performed with minimal training at the patient's bedside. However, it is easily dislodged by the patient. It also allows greater flexibility in terms choice of formulas and feeding regime. The stomach is able to tolerate a larger volume and higher osmotic load than the upper small intestine. Other tube feeding method may have to be considered if patient had recurrent aspiration, gastroeosphageal reflux and delay gastric emptying.

FIGURE 1: Enteral Tubes



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Gastrostomy tube

The practice of placement of a percutaneous endoscopic gastrostomy (PEG) has become more common in patient requiring long term enteral feeding. Such a feeding method tethered the gastric wall to the anterior abdominal wall exposing it to infections and excoriations. There is a possibility of fistula formation after the tube is removed. The main advantages are the tubes have a larger bore, it lasts longer and has less risk of occlusion.

Post pyloric tubes

The placement of a feeding tube beyond the pylorus is necessary in patients who are intolerant of intragastric feeding or often due to a combination of the following factors:

- Pulmonary aspiration
- Severe gastrointestional reflux and esophagitis
- Post surgery/multiple trauma
- Gastric and anteroduodenal dysmolity
- Patients on paralytic agents

Compared to nasogastric tubes post-pyloric tubes (nasodoudenal and nasojejunal) are harder to place and are usually place under direct vision endoscopically[5]. The ideal placement is into the distal duodenum or jejunum, beyond the ligament of Treitz[4]. An adequately sited post-pyloric tube that is verified radiologically virtually eliminates aspiration and is less likely to be dislodged even with persistent coughing and vomiting. However, the tubes used are of smaller bore compared to the nasogastric tubes. The risk of intestinal perforation and tube occlusion are higher.

Placement of a jejunostomy endoscopically or surgically may be required in patients with significant delay in gastric emptying and antroduodenal motility. Such tubes can be used for feeding immediately however, there is risk of infection at the percutaneous site and formation of fistula after removal.

CARE OF THE TUBES

Proper care of the tubes are necessary to prolong its lifespan and prevent occlusion. The tubes require changing 2-8 weekly and 6 monthly for nasogastric tube and gastrostomy respectively. Family physician need to be aware that medications prescribed need to be crushed and diluted before they can be fed through the enteral tubes. Certain medications such as enteric coated tablets, cytotoxic drugs, sublingual formulation and sustained released tablets, cannot be crushed and will have to be substituted. Enteric coated tablets are designed to prevent drug dissolution in the stomach and promote absorption in the small intestine. Crushing sustained release preparation will result in higher than normal expected peak dose initially and sub-therapeutic drug concentration later. Tables 1 and 2 describes the proper technique of feeding of formulas and medications.

COMPLICATIONS OF ENTERAL FEEDING

Patients should be monitor regularly for possible complications that may occur with enteral tube feedings. Potential problems can be physical, gastrointestinal or metabolic. Table 3 illustrates the possible causes and suggested remedies for the problems.

Patient who are severely malnourished and those who have lost a large amount of weight rapidly are at risk of refeeding syndrome during the first 2 to 3 weeks of refeeding. The syndrome is mainly defined by primarily by manifestation of hypophosphatemia, cardiovascular collapse, rhabdomyolysis, seizures and delirium. However the rapid changes in metabolism and electrolyte movement during this anabolic state leads to other cardiovascular and neurological manifestations. Wernicke's encephalopathy, manifesting as delirium can occur with refeeding in Thiamine deficient patients. Thus in addition to monitoring of vital signs, monitoring of electrolytes including potassium and phosphate daily, looking for signs of oedema, congestive heart failure and mental state changes are important during refeeding. Patients with any electrolytes and mineral abnormalities should be repleted.

ENTERAL FORMULAE

When selecting an enteral formula for a patient both the formula characteristics and the patient specific conditions and comorbidities should be considered. Formula variables include: digestibility/availability of the nutrients, nutritional adequacy, viscosity, osmolarity, ease of use and cost. Patient variables include: nutritional status and requirements, electrolyte balance, digestive and absorptive capacity, disease state, renal function, medical or drug therapy, and possible routes for administration. Adult enteral products fall into one of the following categories: general use, high nitrogen, high nitrogen and calorie, fibre

TABLE 1: Feeding Process

1. Ensure patient is sitting upright or propped up at least 30 degrees.
2. Ensure proper hand hygiene before preparation of the formula
3. Flushed tube with 20-30ml of warm water
4. Slowly pour in the enteral formula, allowing for feeds to drain in before pouring in further feeds

TABLE 2: Feeding Medications

1. Verify tube placement
2. Check tube for patency and flushed with 30ml of water. Use a syringe no smaller than 30ml to avoid excessive pressure and potential tube rupture.
3. Prepare the medications by diluting liquid medications with 30ml of water or crushing tablets into a fine paste and mix with water
4. Connect syringe to tube and gently push in medications
5. Flushed tube with 30ml of water and administer next medications
6. Flushed

TABLE 3: Complications of Enteral Feeding

Complications	Possible causes	Suggested management
A. Physical		
Malposition	Inadvertent insertion into trachea/bronchi	- Air insufflation & auscultation of epigastrium - Aspiration of gastric contents and test with litmus paper - Chest radiograph
Blockage	- Crushed medications - Inadequate flushing - Precipitation of protein in feed - High viscosity formulas - Small bore tubes	- Flushed tubes 4-6 hourly before and after feed - Ensure proper drug administration - Bolus feeding
Dislodgement of tubes	- Uncooperative patient - Inadequate inflation of balloon	- patient may need to be restrained
Local discomfort/ Peristomal infection	- Trauma during insertion - Poor cleaning technique - Excoriation - immunocompromised host	- proper insertion & cleaning technique - Appropriate size tube - Gauze cushioning - Bactroban ointment and stoma powder to wound - Silver dressing and antibiotics if required
B. Gastrointestinal		
Nausea, bloating and cramps	- delay gastric emptying - volume overload - specific nutrient intolerance	- position patient on the right side to facilitate passage of gastric content through pylorus - Change formula or administer prokinetics - decrease the volume of each feed
Diarrhoea	- fat malabsorption - medications - feed contamination - Osmotic overload - Decreased bulk	- Change formula to high fibre or add bulking agents - remove offending medications: antibiotics or antacids if possible - Change to low fat formula - adhere to clean standard when preparing feed and while feeding
Constipation	- Dehydration and fecal impaction - lack of dietary fibre in feed - intestinal obstruction	- Increased free water and remove impaction - Change to a formula with fibre such as Jevity - Stop feeding if obstruction is suspected
C. Metabolic		
- Vitamin, mineral, trace elements, essential fatty acid deficiencies - Hyperglycaemia - Hyperkaelemia - Hypophosphatemia - Hypomagnesaemia - Hypozincaemia - Overhydration/ dehydration	- Refeeding syndrome - Fluid overload/high osmolar feeds - Insulin deficiency	- monitor urea electrolytes and creatinine. Replace if electrolytes are abnormal - Use diuretics if overloaded - Change formulas - Monitor glucose and give insulin if required - Reduce K intake or use reduce K formula
D. Psychosocial issues		
Depression, withdrawal, non compliance	- altered body image - loss of oral gratification	- encourage sosialisation at mealtimes - provide emotional support and medications if necessary - provide ice chips, sugar free gum or candies and oral hygiene

TABLE 4: Types of Enteral Formulae

Type	Description	Calorie	Protein (g/L)	Osmolarity (mosm/kg H20)	Flavour
A. Standard patients with Low/Normal Caloric Requirement					
 Ensure powder	Low saturated fats, quality protein. Lactose free, gluten free	1.0	37.2	555	vanilla
 Ensure Liquid	Same as ensure powder	1.0	37.3	555	Vanilla Chocolate Strawberry
 Ensure Life	Omega 3,6,9 Prebiotic fibre,inulin Vitamin D Less sweet	1.0			Vanilla Chocolate Strawberry
 Isocal	No fibre	1.0	34	270	Nil
B. Standard patients with high calorie requirement					
 Ensure Plus	Less saturated fats, quality protein, lactose and gluten free	1.5	54.9	690	Vanilla Chocolate Raspberry Strawberry Banana Blackcurrant
 Resource Support	High calories, high protein Lactose Free	1.5	86.2	800	Vanilla
 Resource 2.0	High protein and calorie	2.0	84	790	Vanilla Chocolate
C. Diabetic Patients					
 Glucerna Liquid	Reduced carbohydrate Low cholesterol MUFA Lactose and Gluten free Not for use in galactosemia	1.0	41.8	355	Vanilla
 Glucerna SR	Low glycaemic index Low cholesterol MUFA Lactose and gluten free Not for use in galactosaemia	1.0	41.8	355	Vanilla Chocolate

D. Renal patients					
	Dialysis Patients High protein Calorically dense Low Phosphate/K/Calcium	2.0	69.9	635	Vanilla
Nepro	High folate/B6/FOS				
	Non dialysis patients Lowprotein Calorically dense Low phosphate/Na/High	2.0	30 (6% of calories)	600	Vanilla
Suplena	folate/B6/MUFA				
E. Respiratory patients					
	Ventilator, COPD, Cystic fibrosis High calorie, low carbohydrate 20% fat as MCT	1.5	62.6	475	Vanilla Chocolate
Pulmocare	Antioxidants				
F. Patient with Gastrointestinal symptoms					
	High Fibre Isotonic Lactose and gluten free	1.0	44.3	310	Nil
Jevity					
		1.2	55.5	450	
Jevity 1.2					
G. SIRS/ARDS					
	Calorically dense, Low carbohydrate Eicosapentaenoic acid Gamma-linoleic acid Antioxidant 25% fat as MCT	1.5	62.4	493	Nil
Oxepa	Modulate inflammation				
H. High protein					
	For Cancer patients EPA (omega 3) FOS High level of quality protein Low fat	1.25	69.9	635	Vanilla
Prosure	Vitamins, Minerals				
	Protein supplement High quality concentrated protein	30 cal/scoop	6g/scoop		Nil
Propass					

TABLE 5: Nutritional Requirements

Calories

Mifflin-St Jeor Formula:

Men

10 x weight (kg) + 6.25 x height (cm) - 5 x age (y) + 5

Women

10 x weight (kg) + 6.25 x height (cm) - 5 x age (y) – 161

Harris Benedict Formula:

Men

66.5 + (13.75 X weight in kg) + (5.003 X height in cm) - (6.775 X age in years)

Women

655.1 + (9.563 X weight in kg) + (1.85 X height in cm) - (4.676 X age in years)

Protein

Min protein requirement: Ideal BW x 1g/kg

Fluids

- Estimation by Caloric intake
  Children: 1.5 ml/cal
  Adults: 1.0 ml/cal
- Estimation by BW
  Adults: 30 ml/kg BW/day

Caloric Breakdown

Carbohydrate	55%
Fat	30%
Protein	15%

enriched semi-elemental, fat modified and specialty. If in doubt consider referral to a dietician for further advice. Most formulas currently available are isotonic and are well tolerated at full strength when delivered into the small intestine. The different types of enteral formulas available are illustrated in Table 4.

ESTIMATING NUTRITIONAL REQUIREMENTS

Most hospitalized patients will require 30kcal/kg/day. In most intent and purposes, the ideal body weight of the patient can be used for nutritional purposes. The energy requirement can be calculated using the Mifflin St. Jeor formula or the Harris benedict formula (Table 5). Patient's needs may vary greatly with his metabolic state. The average patient receiving nutritional intervention requires 0.8 – 2.0g protein/kg usual body weight. The goals are to minimize protein breakdown, preserve lean body mass, promote protein synthesis and optimize immune response.

A healthy adult ingest approximately 1ml free water/kcal of energy or 30 -35 ml/kg/day. However, wide variations in fluid intake are normally well tolerated without producing hypo or hypernatremia. Patients with liver disease, renal disease, cardiovascular, pulmonary disease and closed head injury may require fluid restriction, whereas, patients with diarrhoea, hypovolemia, burns and insensible loss may require additional fluid.

Nutritional repletion therapy increased electrolyte requirements and the needs need to be adjusted based on laboratory results and current clinical status of the patients. Other nutrients such as vitamins are essential in human metabolism. A minimum of 2-4% kcal as linoleic is required daily to prevent essential fatty acid deficiency. Fortunately all the enteral formulas are designed to provide at least the recommended daily allowance of each nutrient.

SUMMARY

Adequate nutrition plays an important role in maintaining health. Malnutrition contributes significantly to morbidity and mortality. It increases health care cost by prolonging hospital stay, increased probability of medical complication from impact immune system and wound healing. Malnutrition frequently accompanies acute and chronic disease as well as trauma.

The oral route is always the preferred route for providing nutrient intake. For patients who are unable to ingest adequate nutrients normally and safely by mouth but who has at least a partially functioning gastrointestinal tract, the introduction of enteral tubes for feeding becomes necessary for these patients and for some, it maybe permanent.

A good understanding of the types of tubes available, care of tubes, prevention and management of complications, enteral formulae, enteral nutritional requirements, and the calculation of these requirements is a pre-requisite in the care of patients requiring enteral nutrition

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