NUTRITION

Objectives

- 1. To understand the decision-making process for initiating, maintaining, and terminating Specialized Nutritional Support (SNS) in surgical patients.
- 2. To understand the decision-making process for calculating nutritional requirements, gaining access for SNS, and monitoring for complications during SNS.

Case 1

- A 67-year-old man with obstructing esophageal cancer presents for consideration of surgical therapy. He has lost 25 pounds (15% of normal body weight) over the past 4 months, is unable to swallow anything except liquids, and has near-complete loss of appetite. He has no other past history of significance and takes medications only for hypertension. His appearance is gaunt with obvious loss of body fat and muscle wasting. There is mild peripheral edema. The remainder of the physical exam is unremarkable. Workup suggests that he is a candidate for esophageal resection. His albumin is 2.7g/L and his hemoglobin is 9g/L with microcytic indices. All other determinations are normal.

Case 2

- A previously healthy 27-year-old woman is the restrained driver in a head-on collision. She is diagnosed with intraabdominal injuries and undergoes emergency laparotomy. At operation, a crush injury to the pancreas and duodenum is repaired as is a mesenteric tear and grade II liver laceration. Appropriate external drainage of the injury sites is undertaken. She has lost approximately 1000mL of blood and hasreceived 4000mL of crystalloid solutions intraoperatively. She will be transferred to the intensive care unit (ICU) for initial postoperative care. No other major injuries are noted.

What?

- Carbohydrate
- Lipid
- Protein
- Trace elements
- Vitamins

Who?

- Malnourished (>10% lean body mass)
- Incapable of eating (>10 days)

Why?

- Risks of malnutrition including infection, poor healing and higher mortality
- Malnutrition is exacerbated by physiological stress

When?

- Preoperative?
- Early?
- Late?
- ---after initial resuscitation following injury or surgery

How?

- Parenteral
- Enteral
- Total
- Partial

Issues

- Metabolic response to injury
- Cytokines, inflammation, hormones
- Biology of substrates
- Enteral vs. Parenteral

"Ashen faces, a thready pulse and cold clammy extremities…"

The Ebb Phase

Cuthbertson, Quart. J. Med.25:233,1932

The Ebb Phase

- Hypometabolic
- Hypothermic
- Hypoinsulinemic
- Hypoperfusion
- Hypercortisolism
- Hyperglucagonemia
- Hyperglycemia
- Hypercatecholemia

"The patient warms up,cardiac output increases and the surgical team relaxes..."

The Flow Phase

Cuthbertson. Lancet 1:233, 1942

The Flow Phase

- Hypermetabolic
- Hyperthermic
- Catabolic
- Hyperinsulinism
- Hypercortisolism
- Hyperglucagonemia
- High cardiac output

Nutritional Assessment

- Body weight
- Body mass index
- creatinine height index
- Serum proteins:albumin, prealbumin, transferrin
- Immune competence: lymphocytes, DH
- Nitrogen balance

NUTRITIONAL REQUIREMENTS

PROTEIN

- Most important macronutrient.
- Normal requirement is 1gm\kg\day
- Doubled in stress, burns, trauma or sepsis
- 19-20% of protien intake should be EAA, which should be doubled in stress states.

Carbohydrates

- 1 gm of glucose gives 4 kcal.
- Liver and skeletal muscle store it as glycogen.
- But glycogen stores are exhausted within 24 hrs of fasting.
- Then?
- Gluconeogenesis starts.
- Substrates for gluconeogenesis?

Fats

- 9kcal\gm.
- Body depends on fat for energy in depleted states.
- Hydrolysis of fats depends on hormone sensitive lipase.
- Which hormones increase lipase activity?

NITROGEN

- 1 gm = 6.25 gm of proteins.
- Obligate nitrogen losses are 56-57mg\kg\day
- How?
- 37mg\kg- urine
- 12mg\kg – stools
- 5mg\kg – skin
- 2-3mg\kg – evaporation
- Nitrogen balance= N intake- N losses
- N loss = 24hr urinary nitrogen+ 4gm\day
- +VE N balance= anabolic state
- -VE N balance= ?

BEE

- HARRIS- BENEDICT Equation=
- Males= 66.47+13.75(W)+5.0(H)- 6.76(A) KCAL\Day
- Females= 65.51+ 9.56(W)+1.85(H)- 4.68(A)
- **REE** is the estimation of the pts true energy requirements after taking into account activity factor and injury factor.
- How do we calculate REE?
- REE = BEE *activity factor* injury factor

- ACTIVITY FACTOR:

Bed rest = 1.2

Ambulatory = 1.3

INJURY FACTOR =

Minor surgery = 1.2

Trauma = 1.35

Sepsis = 1.6

Burns = 2.1

- 30 Kcal\kg\d adequately meets the requirement in postsurgical cases.
- During catabolic phase calorie requirement is 1.2- 2.0 times greater than BEE.
- Calorie to nitrogen ratio should be between 100 and 150 to 1 in normal states and in sepsis 100:1.

Causes of Inadequate Nutrition

- Poor oral intake
- Catabolic states
- Malabsorption
- Increased losses
- Drug and alcoholabuse
- Depression
- Isolation
- Poverty

NUTRITIONAL ASSESMENT

- Components of Nutrition Assessment
- Medical and social history
- Diet history and intake
- Clinical examination
- Anthropometrics
- Biochemical data

Medical and Social History

- Gathered from chart review and patient interview
- *Medical history*: diagnosis, past medical and surgical history, pertinent medications, alcohol and drug use, bowel habits
- *Psychosocial data*: economic status, occupation, education level, living and cooking arrangements, mental status
- *Other:* age, sex, level of physical activity, daily living activities

Dietary History and Intake

- *Appetite and intake*: taste changes, dentition, dysphagia, feeding independence, vitamin/mineral supplements
- *Eating patterns*: daily and weekend, diet restrictions, ethnicity, eating away from home, fad diets
- *Estimation of typical calorie and nutrient intake*: RDAs, Food Guide Pyramid
  - Obtain diet intake from 24-hour recall, food frequency questionnaire, food diary, observation of food intake

Diet Assessment

- Evaluate what and how much person is eating, as well as habits, beliefs and social conditions that may put person at risk
- Usual intake
  - 24 hr recall: retrospective, easy
  - Food logs: prospective, requires motivation
  - Food frequency questionnaire: general idea of how often foods are consumed
- Compare to estimation of needs

Nutritional Questions for the Review of Systems

- General
  - Usual adult weight
  - Current weight
  - Maximum, minimum weights
  - Weight change 1 and 5 years prior
  - Recent changes in weight and time period
  - Recent changes in appetite or food tolerance
  - Presence of weakness, fatigue, fever, chills, night sweats
  - Recent changes in sleep habits, daytime sleepiness
  - Edema and/or abnormal swelling

Nutritional Questions for the Review of Systems

- Alimentary
  - Abdominal pain, nausea, vomiting
  - Changes in bowel pattern (normal or baseline)
  - Diarrhea (consistency, frequency, volume, color, presence of cramps, food particles, fat drops)
  - Difficulty swallowing (solids vs. liquids, intermittent vs. continuous)
  - Early satiety
  - Indigestion or heartburn
  - Food intolerance or preferences
  - Mouth sores (ulcers, tooth decay)
  - Pain in swallowing
  - Sore tongue or gums

Nutritional Questions for the Review of Systems

- Neurologic
  - Confusion or memory loss
  - Difficulty with night vision
  - Gait disturbance
  - Loss of position sense
  - Numbness and/or weakness
- Skin
  - Appearance of a diagnostic rash
  - Breaking of nails
  - Dry skin
  - Hair loss, recent change in texture

Clinical Examination

- Identifies the physical signs of malnutrition
- Signs do not appear unless severe deficiencies exist
- Most signs/symptoms indicate two or more deficiencies
- Examples:
  - Head and Neck: hair loss, bitemporal wasting, conjunctival pallor, xerosis, glossitis, bleeding/sore gums, angular cheliosis, stomatitis, poor dentition, thyromegaly
  - Extremities: edema, muscle wasting, loss of s/c fat
  - Neurologic: evidence of peripheral neuropathy, reflexes, tetany, decreased mental status
  - Skin: ecchymosis, petechie, pallor, pressure ulcers, wound problems/infection

Characteristics of Nutritional Status

Good	Poor
Alert expression	Apathy
Shiny hair	Dull, lifeless hair
Clear complexion	Greasy, blemished complexion
Good color	Poor color

Characteristics of Nutritional Status

Good	Poor
Bright, clear eyes	Dull, red-rimmed eyes
Pink, firm gums and well-developed teeth	Red, puffy, receding gums, and missing or cavity-prone teeth
Firm abdomen	Swollen abdomen
Firm, well-developed muscles	Underdeveloped, flabby muscles

Characteristics of Nutritional Status

Good	Poor
Well-developed bone structure	Bowed legs, "pigeon breast"
Normal weight for height	Over- or underweight
Erect posture	Slumped posture
Emotional stability	Easily irritated, depressed, poor attention span

Characteristics of Nutritional Status

Good	Poor
Good stamina	Easily fatigued
Seldom ill	Frequently ill
Healthy appetite	Excessive or poor appetite
Healthy, normal sleep habits	Insomnia at night, fatigued during the day
Normal elimination	Constipation or diarrhea

Stop and Share

- Identify at least 5 signs of malnutrition present in this child.

Anthropometrics

- Inexpensive, noninvasive, easy to obtain, valuable with other parameters
- Height, weight and weight changes
- Segmental lengths, fat folds and various body circumferences and areas
- Repeated periodically to note changes
- Individuals serve as own standard

Anthropometric Measurements

Height

Weight

Anthropometric Measurements

Head circumference

Triceps skinfold

Disadvantages of Anthropometrics

- Intra and interobserver error
- Changes in composition of patient's tissues
- Inaccurate application of raw data
- Measurements are evaluated by comparing them with predetermined reference limits that allow for classification into risk categories

Anthropometrics

- Ideal body weight
  - Males: 106 lbs + 6 lbs per inch over 5 ft
  - Females: 100 lbs + 5 lbs per inch over 5 ft
  - Add 10% for large-framed and subtract 10% for small-framed
- %IBW = (current wt/IBW) X 100
  - 80-90% mild malnutrition
  - 70-79% moderate malnutrition
  - 60-69% severe malnutrition
  - <60% non-survival

Anthropometrics

- %UBW: usual body weight
  - = (current wt/UBW) X 100
  - 85-95% mild malnutrition
  - 75-84% moderate malnutrition
  - 0-74% severe malnutrition
- % weight change = usual weight – present weight/usual weight X 100
- Significant weight loss
  - >5% in 1 month
  - >10% in 6 months

Body Mass Index = BMI

- Evaluation of body weight independent of height
- BMI = weight (kg)/height^2 (m)
  - >40 obesity III
  - 30-40 obesity II
  - 25-30 overweight
  - 18.5-25 normal
  - 17-18.4 PEM I
  - 16-16.9 PEM II
  - <16 PEM III

Frame Size

- Determined using wrist circumference and elbow breadth
- Determines the optimal weight for height to be adjusted to a more accurate estimate
- Wrist circumference: measures the smallest part of the wrist distal to the styloid process of the ulna and radius
- Elbow breadth: measures the distance between the two prominent bones on either side of the elbow

Skinfold Thickness

- Estimates subcutaneous fat stores to estimate total body fat
- Triceps, biceps, subscapular, and suprailiac using calipers are most commonly used
- Disadvantages: total body fluid overload, caliper calibration, inter-individual variability

Body Circumferences and Areas

- Estimates skeletal muscle mass (somatic protein stores and body fat stores
- Midarm or upper arm circumference (MAC): on the upper arm at the midpoint between the tip of the acromial process of the scapula and the olecranon process of the ulna
- Midarm muscle or arm muscle circumference (MAMC): determined from the MAC and triceps skinfold (TSF)
- MAMC = MAC – (3.14 X TSF)
- Total upper arm area: determines upper arm fat stores
- Upper arm muscle mass provides a good indication of lean body mass, used in the calculation of upper arm fat area
- Upper arm fat area: calculation may be a better indicator of changes in fat stores than TSF

Bioelectrical Impedance Analysis (BIA)

- Measures electrical conductivity through water in difference body compartments
- Uses regression equations to determine fat and LBM
- Serial measures can track changes in body composition
  - Obesity treatments

DEXA: dual-energy X-ray absorptiometry

- Whole body scan with 2 x-rays of different intensity
- Computer programs estimate
  - Bone mineral density
  - Lean body mass
  - Fat mass
  - “Best estimate” for body composition of clinically available methods

Biochemical Data

- Used to assess body stores
- Altered by lack of nutrients, medications, metabolic changes during illness or stress
- Interpret results carefully
- Fluid status distorts results
- “Stressed” states (infection, surgery) effects results
- Use reference values established by individual lab

Visceral Proteins

- Produced by the liver
- Affected by protein deficiency, but also renal and hepatic disease, wounds and burns, infections, zinc and energy deficiency, cancer, inflammation, hydration status, and stress

Albumin

- Half life 14-21 days
- Normal value 3.5-5.0 g/DL
- Most widely used indicator of nutritional status
- Acute phase response: levels decrease in response to stress (infection, injury)
- Affected by volume
  - Increases with dehydration, decreases with edema and overhydration

Prealbumin

- Better measure of nutritional status due to shorter half-life, ~2 days
- Normal value: 18-40 mg/DL
- Responds within days to nutritional repletion
- Levels affected by trauma, acute infections, liver and kidney disease; highly sensitive to minor stress and inflammation

Creatinine Height Index

- Estimates LBM
- = $\frac{\text{actual creat excretion (24 hour urine collection)}}{\text{expected creat excretion}}$
- Males: IBW X 23 mg/kg
- Females: IBW X 18 mg/kg
- >80% normal
- 60-80% moderately depleted
- <60% severely depleted
- Accurate 24-hr urine collection is difficult to obtain in acute-care setting

Hematological Indices

- Determine nutritional anemias
- Transferrin: Fe transport protein
- TIBC: total Fe binding capacity
  - Indicates number of free binding cites on transferrin
- Fe deficiency: increased transferrin levels, decreased saturation
- Ferritin: Fe storage protein, increases during inflammation
- Depressed hemoglobin is an indicator of Fe deficiency anemia

Indirect calorimetry/Metabolic Cart

- Measures CO_2 produced and O_2 consumed in critically ill patients on ventilators
- Calculates resting metabolic rate based on gas exchange
- Respiratory quotient calculated
  - Corresponds to oxidation of nutrients
  - CHO: 1:1 ratio of CO_2 produced/O_2 consumed
  - Lipid: 0.7:1 ratio
  - Protein: 0.82:1 ratio
  - Mixed diet: 0.85:1 ratio
  - Overfeeding/lipogenesis: >1.0

Case 1

- 55yo male with Crohn's disease has failed Remicade and needs an ileocolic resection.
  - What are the surgical nutritional issues?

Nutritional Support

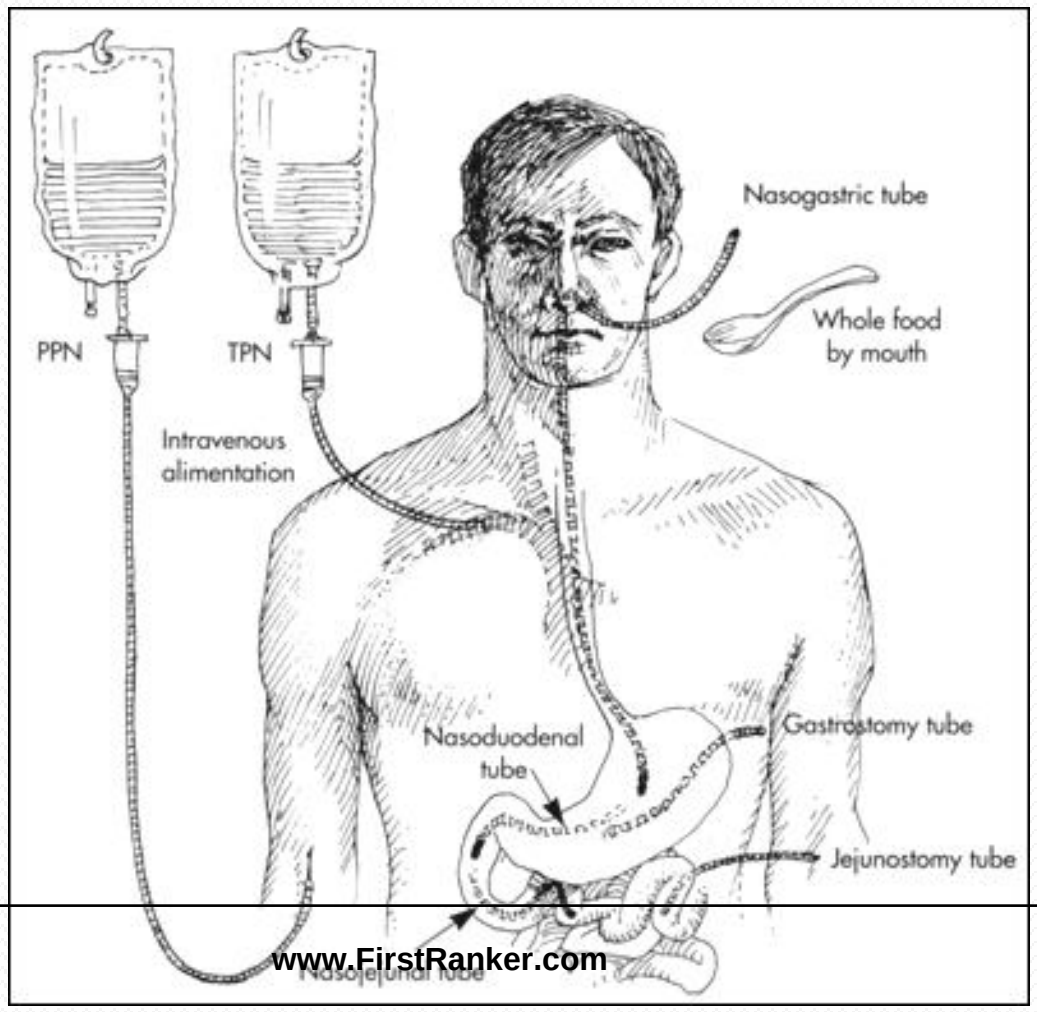
Fundamental goal of nutritional support:

1. To meet the energy requirement for metabolic processes
2. To maintain a normal core body temperature
3. For tissue repair

Conditions That Require Specialized Nutrition Support

- Enteral
  - —Impaired ingestion
  - —Inability to consume adequate nutrition orally
  - —Impaired digestion, absorption, metabolism
  - —Severe wasting or depressed growth
- Parenteral
  - —Gastrointestinal incompetency
  - —Hypermetabolic state with poor enteral tolerance or accessibility

ENTERAL NUTRITION



Enteral Nutrition

- Nutrition delivered via the gut
- Includes oral feedings and tube feedings

Enteral Tube Feeding

- Nutritional support via tube placement through the nose, esophagus, stomach, or intestines (duodenum or jejunum)
  - —Must have functioning GI tract
  - —IF THE GUT WORKS, USE IT!
  - —Exhaust all oral diet methods first.

Oral Supplements

- Between meals
- Added to foods
- Added into liquids for medication pass by nursing
- Enhances otherwise poor intake
- May be needed by children or teens to support growth

Diagram of enteral tube placement.

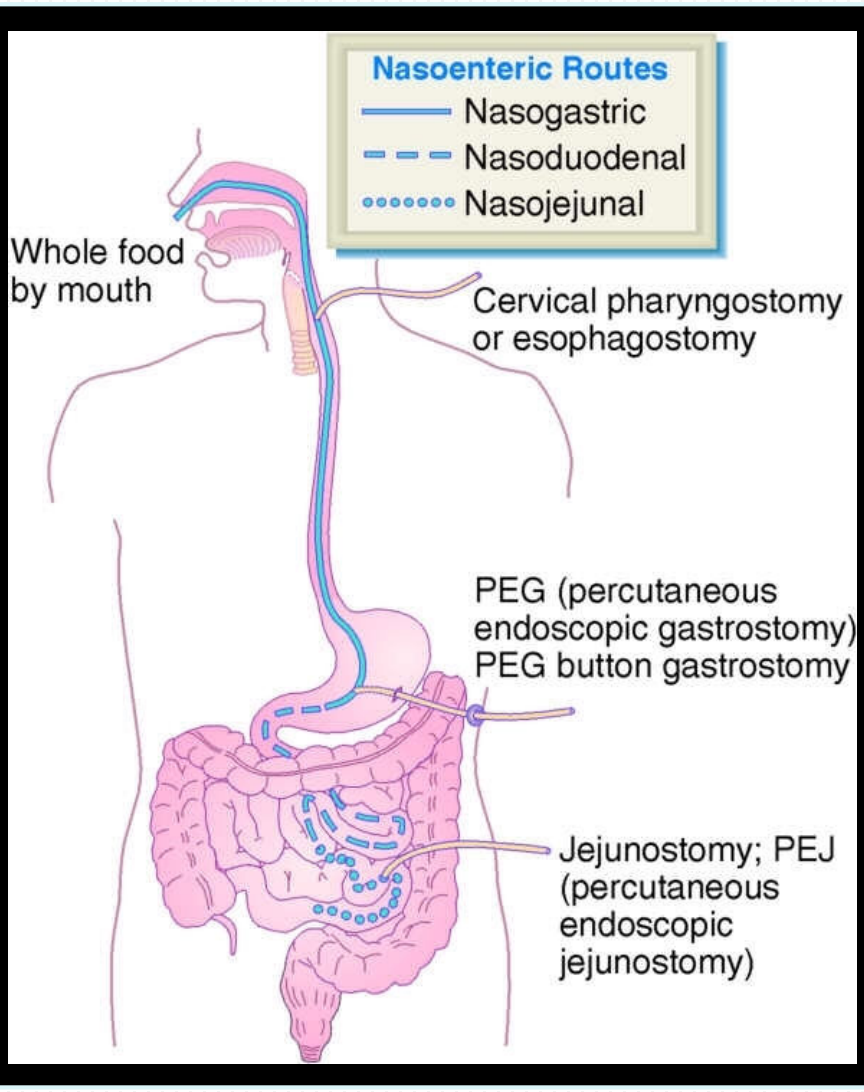


Fig. 22-2. p. 468.

Indications for Enteral Nutrition

- Malnourished patient expected to be unable to eat >5-7 days
- Normally nourished patient expected to be unable to eat >7-9 days
- Adaptive phase of short bowel syndrome
- Increased needs that cannot be met through oral intake (burns, trauma)
- Inadequate oral intake resulting in deterioration of nutritional status or delayed recovery from illness

ASPEN. The science and practice of nutrition support. A case-Based Core curriculum. 2001; 143

Contraindications for EN

- Severe acute pancreatitis
- High output proximal fistula
- Inability to gain access
- Intractable vomiting or diarrhea
- Aggressive therapy not warranted

ASPEN. The science and practice of nutrition support. A case-based core curriculum. 2001;

Contraindications for EN

- Inadequate resuscitation or hypotension; hemodynamic instability
- Ileus
- Intestinal obstruction
- Severe G.I. Bleed
- Expected need less than 5-7 days if malnourished or 7-9 days if normally nourished

- **Severe diarrhea**
- **Protracted Vomiting**
- **Intestinal dysmotility**

} **Are Not Contraindications**

Do Not Feed a Necrotic Bowel !!

- **INSTEAD FEED EARLY TO PREVENT A NECROTIC BOWEL**

Advantages - Enteral vs PN

- Preserves gut integrity
- Possibly decreases bacterial translocation
- Preserves immunological function of gut
- Reduces costs
- Fewer infectious complications in critically ill patients
- Safer and more cost effective in many settings

ASPEN. The science and practice of nutrition support. A case-based core curriculum. 2001; 147

ADA EAL, Critical Illness, accessed 8-07

Advantages—Enteral Nutrition

- Intake easily/accurately monitored
- Provides nutrition when oral is not possible or adequate
- Supplies readily available
- Reduces risks associated with disease state

Disadvantages—Enteral Nutrition

- GI, metabolic, and mechanical complications—tube migration; increased risk of bacterial contamination; tube obstruction; pneumothorax
- Costs more than oral diets (not necessarily)
- Less “palatable/normal”: patient/family resistance
- Labor-intensive assessment, administration, tube patency and site care, monitoring

Enteral Formulas

- Liquid diets intended for oral use or for tube feeding
- Ready-to-use or powdered form
- Designed to meet variety of medical and nutrition needs
- Can be used alone or given with foods

Enteral Formulas

- Determine best choice by medical and nutrition assessment
- Meet specific nutrition needs

Enteral Formula Categories

- Polymeric
- Monomeric
- Fiber-containing
- Disease-specific
- Rehydration
- Modular

Route For Feeding Access

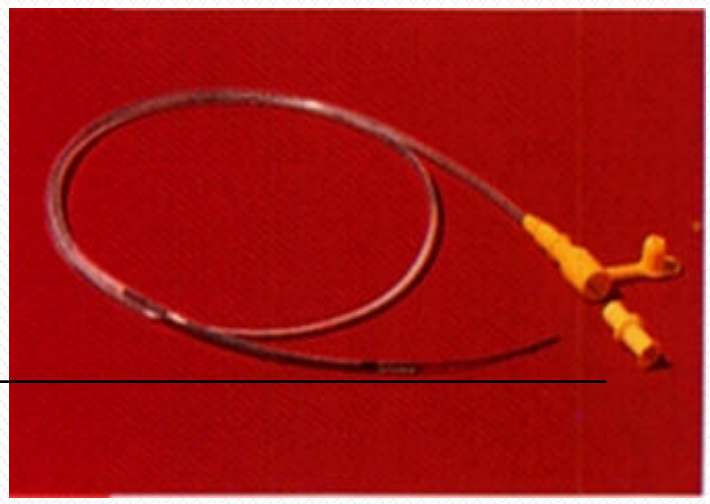
- Short Term access (for 4-6wk)---

Use **Nasal Access** :naso-gastric/jejunal tubes

- **Nasogastric tubes:**

➢ Allow use of hypertonic feeds
higher feeding rates
bolus/Intermittent feeding

➢ Fine bore 8-10 F NG tubes



Access Techniques…..cont

Nasojejunal NJ tubes

- Indicated—gastric reflux
  --delayed gastric emptying
  --unconcious patient
- Fine bore 6-10 F
- Insertion same as NG, but once reached stomach, patient is turned onto the right side advance tube 10cm
- To assist postpyloric placement of NJ tube :
- 10mg Metoclopramide iv 10 min 200mg Erythromycin iv 30min prior placement

Access Techniques…..cont

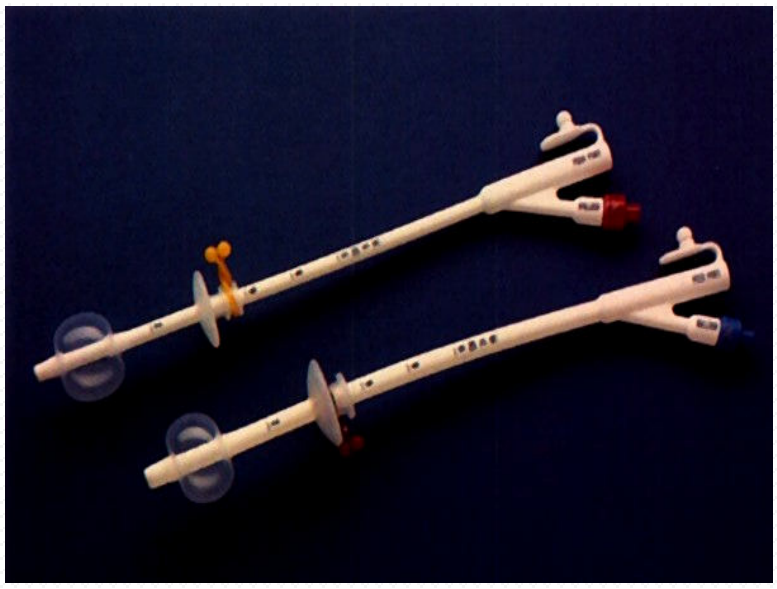
- Long Term access > 4-6wk----Feeding Ostomies (Enterostomies)
- Percutaneous Endoscopic Enterostomy
- Surgical Enterostomy

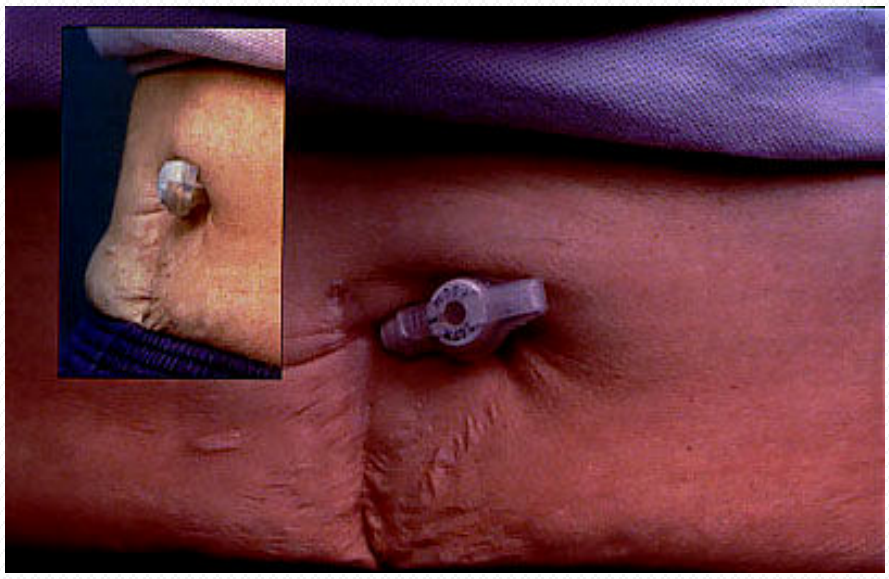
Percutaneous Endoscopic Enterostomy

1- Percutaneous Endoscopic Gastrostomy

PEG: ***Method of choice***

Considered in pat. with normal gastric emptying





Percutaneous Endoscopic Gastrostomy

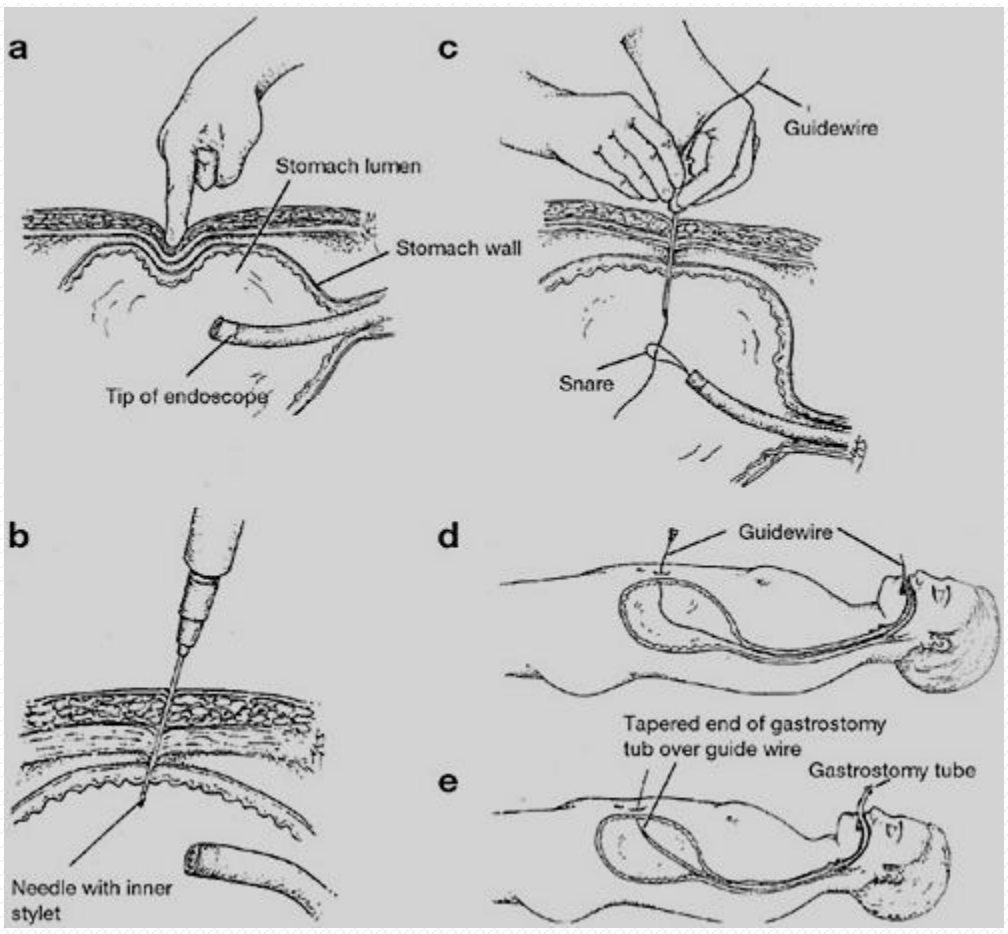
Contraindications:

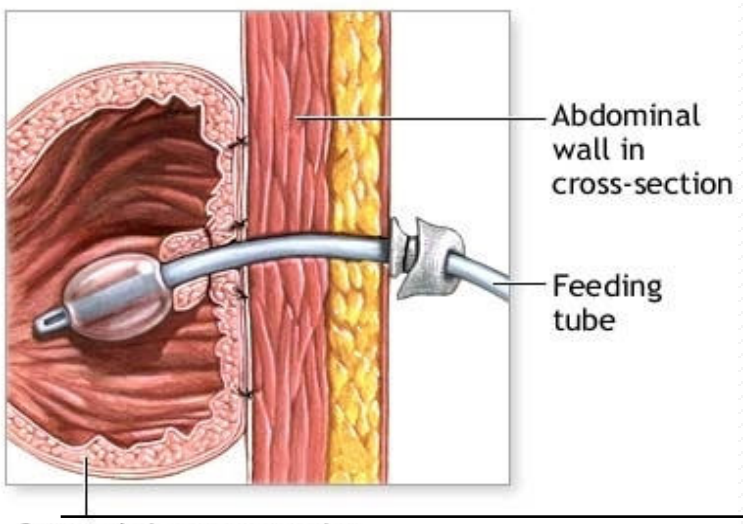
Gastric cancer

Gastric ulcer

Ascitis

Coagulation disorders





(*Source:* Kudsk KA, Jacobs DO. Nutrition. In: Surgery: Basic Science and Clinical Medicine. Norton JA, et al., eds. New York: Springer-Verlag, 2001(2) Part 7, Section 91:136)

Feeding Ostomies (Enterostomies)

Percutaneous Endoscopic Jejunostomy

2- PEJ

- New—
- Technically difficult
- Indicated if postpyloric feeding is needed
- Allows concomittent jejunal feeding and gastric decompression

Administration of EN

- **Bolus**
- **Continuous**
- **Intermittent**
- **Cyclic**

Bolus Feedings

Administer 200-400 ml of enteral formula into the stomach over 5 to 20 minutes, usually by gravity with a large-bore syringe

Indications:

-Recommended for gastric feedings

-Requires intact gag reflex

-Normal gastric function

Continuous Feedings

- Administration into the GIT via pump or gravity, usually over 8 to 24 hours per day

Indications:

- Promote tolerance
- Compromised gastric function
- Feeding into small bowel
- Intolerance to other feeding techniques

Intermittent Feedings

- Administration of 200-300 ml over 30-60 minutes q 4-6 hours

Indications:

- Intolerance to bolus administration
- Initiation of support without pump

Open vs Closed System

Open System

- Product is decanted into a feeding bag
- Allows modulars such as protein and fiber to be added to feeding formulas
- Less waste in unstable patients (maybe)
- Shortens hang time
- Increases nursing time
- Increased risk of contamination

Closed System or Ready to Hang

- Containers sterile until spiked for hanging
- Can be used for continuous or bolus delivery
- No flexibility in formula additives
- Less nursing time
- Increases safe hang time
- Less risk of contamination
- More expensive than canned formula

Closed vs Open System

Open System

- Hang time 8 hours for decanted formula; 4 hours for formula mixtures
- Feeding bag and tubing should be rinsed each time formula replenished
- Contaminated feedings are associated with pt morbidity

Closed System

- Hang time 24-48 hours based on mfr recommendations
- Y port can be used to deliver additional fluid and modulars
- May result in less formula waste as open system formula should be discarded p 8 hours

Closed vs Open System

- In a survey of nurses at MetroHealth, only 28% were aware of the 8 hour hang time for open system formulas written into nursing policy
- 55% recommended adding new formula to old, in violation of existing nursing protocol
- 66% could state the 24 hang time for closed system formulas
- The cost of wasted formula is minimal compared to the cost of nursing time and risk of illness in patients

Luther H, Barco K, Chima CS, Yowler CJ. Comparative study of two systems of delivering supplemental protein in burn hardized tube feedings. *J Burn Care Rehabil* 2003;24:167-172.

What are the major problems associated with tube feeding?

1- Aspiration----Most Important

- Prevalence range from 2% - 95%
- **Several issues should be considered**:

1-Tube Size and Position

Large bore vs small bore

Gastric vs Jejunal

2-Body Position Supine vs Semi recumbent

3-Underlying Disease Gastroparesis/ Atony

4-Feeding Regimen

Intermittent or Continuous vs Bolus

To Limit the Risk of Aspiration

- 1- Raise head of bed 30-40° during feeding and 1 hr after
- 2-Use intermittent / continuous feeding regimens rather than------ bolus method
- 3-Check gastric residual regularly
- 4-Consider jejunal access--------

  -recurrent tube feeding aspiration

  -high risk of gastric motility dysfunction

2-Diarrhea----Most Common

- Incidence 2.3% - 68%
- Critically ill are more prone
- Multiple aetiologies:
- **1-Medications:**

Antibiotics-----overgrowth of C.difficile / Candida

Sorbitol base liquids---Theophylline

Meds containing Magnesium

- **2-Altered bacterial flora**

H2-blockers/ PPI---permit bacterial overgrowth

Bacteria colonize---Gastric pH exceeds 4

2-Diarrhea----Most Common

- **3-Formula Composition**

➢ Osmolality & Rate

incidence of diarrhea in critically ill

↑ mechanically vent patients----receiving hyperosmolar feeds at high infusion rates

2-Diarrhea----Most Common

- **4-Hypoalbuminemia**

---Reduces osmotic pr & causes intestinal mucosal oedema

Critically ill with s.Alb < 2.6g/dl dia~~rrhe~~a with standard EN

- **5-Formula Contamination**

Altered Drug absorption & Metabolism

- Phenytoin

Binds to NG tubing at pH of enteral formulation----less drug delivery

- Warfarin

Resistance 2ndry to Vit K in Enteral feedings

Stop enteral feeding 2 hrs before and 2 hrs after

Metabolic Complications

- Less frequent compared to TPN
- **Hyperglycemia**: 2ndry to High CHO load in specific formula esp critically ill / elderly--------insulin resistance
- **Electrolyte imbalance**:

Use of high osmolar formulation esp: Pat on fluid restriction/ renal concentrating difficulties are at risk of -----Dehydration & Hypernatremia

Mechanical

- Feeding tube obstruction
- Feeding tube dislodged
- Nasal irritation
- Skin irritation/excoriation at ostomy site

Refeeding Syndrome

- At risk: when refeeding those with marginal body nutrient stores, stressed, depleted patients, those who have been unfed for 7-10 days, persons with anorexia nervosa, chronic alcoholism, weight loss
- Symptoms: Hypokalemia, hypophosphatemia and hypomagnesemia; cardiac arrhythmias, heart failure; acute respiratory failure

Refeeding Syndrome

- Correct electrolyte abnormalities (via oral, enteral, parenteral route) before initiating nutrition support
- Administer volume and energy slowly
- Monitor pulse rate, intake and output, and electrolyte levels
- Provide appropriate vitamin supplementation
- Avoid overfeeding

Monitoring of Patients on EN

- Electrolytes
- BUN/Cr
- Albumin/prealbumin
- Ca^{++}, PO_4, Mg^{++}
- Weight
- Input/output
- Vital signs
- Stool frequency/consistency
- Abdominal examination

Routes of Parenteral Nutrition

- Central access
  - —TPN both long- and short-term placement
- Peripheral or PPN
  - —New catheters allow longer support via this method limited to 800 to 900 mOsm/kg due to thrombophlebitis

<2000 kcal required or <10 days

Advantages—Parenteral Nutrition

- Provides nutrients when less than 2 to 3 feet of small intestine remains
- Allows nutrition support when GI intolerance prevents oral or enteral support

Indications for Total Parenteral Nutrition

- GI non functioning
- NPO >5 days
- GI fistula
- Acute pancreatitis
- Short bowel syndrome
- Malnutrition with >10% to 15 % weight loss
- Nutritional needs not met; patient refuses food

Contraindications

- GI tract works
- Terminally ill
- Only needed briefly (<14 days)

Administration

- Start slowly
  (1 L 1st day; 2 L 2nd day)
- Stop slowly
  (reduce rate by half every 1 to 2 hrs
  or switch to dextrose IV)
- Cyclic give 12 to 18 hours per day

Monitor

- Weight
  (daily)
- Blood
  Daily
  - Electrolytes (Na^+, K^+, Cl^-)
  - Glucose
  - Acid-base status

  3 times/week
  - BUN
  - $Ca^{+,}$ P
  - Plasma transaminases

Monitor—cont'd

- Blood
  Twice/week
    Ammonia
    Mg
    Plasma transaminases
  Weekly
    Hgb
    Prothrombin time
    Zn
    Cu
    Triglycerides

Monitor—cont'd

- Urine:
  Glucose and ketones (4-6/day)
  Specific gravity or osmolarity (2-4/day)
  Urinary urea nitrogen (weekly)

- Other:
  Volume infusate (daily)
  Oral intake (daily) if applicable
  Urinary output (daily)
  Activity, temperature, respiration (daily)
  WBC and differential (as needed)
  Cultures (as needed)

Problems

- PPN
  Site irritation
- TPN
  1. Catheter sepsis
  2. Placement problems
  3. Metabolic

Q. A young man weighting 65 kg was admitted to the hospital with severe burns in a severe catabolic state. An individual in this state requires 40 kcal per kg body weight per day and 2 gms of protein/kg body weight/day. This young man was given a solution containing 20% glucose and 4.25% protein. If 3000 ml of solution is infused per day -

- The patient would not be getting sufficient protein
- The calories supplied would be inadequate
- Both protein and calories would be adequate
- Too much protein is being infused

Q. One is not the indication of total parenteral nutrition -

- Acute pancreatitis
- Enterocolic fistula
- Chronic liver disease
- Faecal fistula

Q. TPN is indicated in all except -

- Short bowel syndrome
- Burn
- Sepsis
- Enterocutaneous fistula

Q. A patient on total parenteral nutrition for 20 days presents with weakness, vertigo and convulsions. Diagnosis is :

- Hypomagnesemia
- Hyperammonemia
- Hypercalcemia
- Hyperkalemia

Q. Ramesh met and accident with a car and has been in ‘deep coma’ for the last 15 days. The most suitable route for the administration of protein and calories is by :

- Jejunostomy tube feeding
- Gagstrostomy tube feeding
- Nasogastric tube feeding
- Central venous hyperalimetation

Q. A patient undergoes a prolonged and complicated pancreatic surgery for chronic pancreatitis. Most preferred route for supplementary nutrition in this patient would be :

- Total Parentral Nutrition
- Feeding Gastrostomy
- Feeding Jejunostomy
- Oral feeding