ROUTE OF EARLY NUTRITION SUPPORT IN CRITICALLY ILL PATIENTS

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CASE PRESENTATION

83 y/o wheelchair bound female, presented to KCHC with RLE pain
PMH- Venous insufficiency, HTN, OA, esophageal stricture, B/L cataract
PSH- None
Allergy- PCN
Medications- Ibuprofen, multivitamins

Vitals

BP 121/71  HR 114  RR 28  T 101  SaO2 91%
CASE PRESENTATION

- Initially admitted with RLE cellulitis, UTI and AKI-> IV clindamycin and Bactrim (WBC 32, bands 11%)
- HD# 1, coffee ground emesis, abrupt onset epigastric pain, made NPO and started on PPI
- HD# 2, patient acutely decompensated, AMS, respiratory distress, abdominal pain -> intubated -> MICU, heparin drip empirically for possible PE, pressors, (Vanc., Aztreonam, flagyl), surgery consult-> rigid abdomen, CT A/P showed pneumoperitonemem with free fluid.
CASE PRESENTATION

- **CBC** 21/9.6/32.1/258 bands 60%
- **BMP** 134/4.7/98/1/35/2.89/67
- **LFT** 3.3/1.7/228/75/95/0.6
- **ABG before intubation** 7.2/37.2/54.5/15/82/-10.5
- **ABG after intubation** 7.24/38.1/56/16.2/98.2/-10.1
- **Lactate** 3.6  **D-Dimer** 8.27  **BNP** 203  **UCX** >100,000 GNR
CASE PRESENTATION

- Assessment-> perforated viscus, septic shock, multi-organ failure -> transferred to SICU for resuscitation
- OR-> 2L bilious fluid, diffuse peritonitis, pelvic abscess, 1 cm perforated duodenal ulcer, s/p abdominal washout, graham patch and feeding witzel jejunostomy, subhepatic and pelvic JP drains
- POD# 0 intubated, on pressors, new onset Afib. with RVR-> Bicarb. And Cardizem drip
- TTE- EF 55-60%, diastolic dysfunction, mild MR & TR  Troponin 0.023
- POD# 2 off pressors, tube feeds started @ 20cc/hr, Abdominal Cx +ve for yeast-> caspofungin
CASE PRESENTATION

- POD# 4 off sedation non-responsive to pain, AKI and shock liver resolving (BUN/Cr 29/1.6  FENa 0.3%).
- POD# 5 tube feeds increased to goal, head CT negative
- POD# 6 still intubated, non-responsive to pain, fever, WBC 35, right foot dorsal ulceration with mummified 2nd toe, midline abdominal wound not healing, fascia is necrotic but intact
- POD# 7 panscan negative, C-diff negative, s/p evacuation of abscess from J tube site, palliative care called for unfavorable prognosis, not accepted by organ donation.
CASE PRESENTATION

• **POD# 10** arousable to pain, WBC 24, s/p precut. tracheostomy. Peri-jej. Abscess cx- Enterococcus faecalis, latex negative staph.

• **POD#11** Abdominal JPs discontinued, s/p right foot wound debridement

• **POD# 12** perfuse diarrhea-> hyperchloremic metabolic acidosis with compensatory respiratory alkalosis -> free water via j-tube, IV sodium bicarb Q12hrs and imodium
CASE PRESENTATION

• POD# 14 Afebrile, WBC 12, high output diarrhea-> rectal tube (2L/24hr), C-diff neg, NA 148, Cl 123, HCO3 14, Cr. 1.4 ABG 7.42/27.4/175/18/-6.2 FiO2 40% TV 450 RR 24 (over breathing in 40s), IV D5W started

• POD# 16 Diarrhea worsened (4L/24hr), Alb. 1.6, Cr. 1.3, tube feeds changed to semi elemental, Imodium, loperamide

• POD# 17 diarrhea improved (1L/24 hr), Cr. 1.0, Na 141, ABG 7.45/32/165/100/23.5/-1.3. D5W stopped, antibiotic stopped
CASE PRESENTATION

- **POD# 20** Diarrhea worsened, tube feed held for bowel rest, TPN started
- **POD# 21** low grade temp with slowly rising **WBC 15**
- **POD# 23** Rectal tube 130/24hr
- **POD# 24** fever 101, s/p panculture, antibiotics restarted (vanc. Flagyl, Aztreonam)
- **POD# 25** tube feed restarted, midline wound non-healing with no granulation tissue
- **POD# 26** fulminant acholic diarrhea, tube feeds held
CASE PRESENTATION

- POD# 27 hypotensive responsive to albumin 25% and fluid challenges
- POD# 28 febrile, WBC 13, LUE thrombophlebitis, right forefoot dry to wet gangrene, eschar unroofed with purulent drainage. LUE Doppler-negative
- POD# 32 Albumin 1.3, persistent diarrhea, bicarb. drip, levophed started, WBC 14
- POD# 35 progressed to ARDS.
- POD# 37 patient made DNR and family decided withdrawal of care
- POD# 38 pressors held. terminal extubation. Fentanyl, Ativan, Hydromorphone for painless passing
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OBJECTIVES

• Introduction
• Malnutrition consequences
• Nutritional goals
• Nutritional assessment
• Enteral nutrition
• Parenteral nutrition
• Early nutritional support
INTRODUCTION

• Nutrients are crucial for human life, growth & well-being.
• Macronutrients (carbohydrates, lipids, proteins & water) are needed for energy, cell multiplication and repair.
• Micronutrients (trace elements & vitamins) are essential for metabolic processes.
INTRODUCTION

- **Marasmus** - severe starvation (wasting), inadequate protein and calories
- **Kwashiorkor** - Severe protein deficiency due to catabolic protein loss, decrease in albumin, edema caused by prolonged malnutrition/stress.

- Marasmus represents an adaptive response to starvation, whereas kwashiorkor represents a maladaptive response to starvation.
- In Marasmus the body utilizes all fat stores before using muscles.
- Kwash have greater risk of morbidity & mortality compared to Marasmus.
INTRODUCTION

- **Malnutrition** in hospitalized surgical patients is well documented with rates up to 50%
- **Stress**
  - Fever: each 1 degree Celsius over normal, increases BMR 5-8%
  - Surgery BMR increased by 10%
  - Sepsis, RF, Trauma: 30-50%
  - Burn: 50-100%
CONSEQUENCES OF MALNUTRITION

• Increased susceptibility to infection (immune cell dysfunction)
• Overgrowth of bacteria in the GIT-> Bacterial translocation
• Abnormal nutrient losses through the stool
• Poor wound healing
• Increased frequency of decubitus ulcers
• increased days on mechanical ventilation and LOS in the ICU, and inpatient death
NUTRITIONAL GOALS

• Meet metabolic needs of the patient
• Nitrogen balance
• Preserve or recover visceral proteins
• Reduce morbidity
• Reduce mortality
• Shorten hospital stay
NUTRITIONAL REQUIREMENT

- **Harris-Benedict equation (BMR)** gender, weight, height, age -> resting, fasting state
- **Resting Energy Expenditure (REE)** O2, CO2 consump. -> resting, not fasting state
- **Indirect calometri- RQ** ratio of CO2 produced to O2 consumed
NUTRITIONAL REQUIREMENT

- **Daily calorie requirement** 25 kcal/kg/day
- **Mild stress** 25-30 kcal/kg/day
- **Moderate stress** 30 kcal/kg/day
- **Severe stress** 30-35 kcal/kg/day
- **Burn** 35-45 kcal/kg/day
- **20% protein**  30% fat  50% CHO
NUTRITIONAL REQUIREMENT

- Nitrogen balance (protein/6.25) – (24 hr urine N + 4g)
- Protein requirement in healthy adult 0.8g/kg/day
- Protein requirement in acutely ill patient 1.2g/kg/day
- Protein requirement for ICU patient 2.5g/kg/day
NUTRITIONAL STATUS ASSESSMENT

- Insufficient energy intake
- Weight loss
- Loss of muscle mass
- Loss of subcutaneous fat
- Localized or generalized edema
- Diminished functional status
NUTRITIONAL STATUS ASSESSMENT

- **Serum Albumin** half life (18-20 days). <2.2 negative catabolic intake.
- **Serum Transferrin** (8-9 days)
- **Serum prealbumin** (2-3 days)
- **Ritinol Binding Protein** (12 hours)
- **Immunocompetence** $\text{TLC} = \%\text{lymp} \times \text{WBC} \times 100$. $n$ 1200-1800 cells/mm³
- **Urinary Creatinine Excretion**
INDICATIONS FOR NUTRITIONAL SUPPORT

• Premorbid status
• Poor nutritional status, <50% total energy needs, Alb.<3g/dl
• Weight loss
• Critically ill patients (sepsis, trauma, burn, major surgery, etc)
• Patient expected unable to eat > 7 days
ENTERAL NUTRITION ACCESS

• **Gastric** sump tubes, dobhoff feeding tubes, PEG, open gastrostomy

• **post-pyloric** feeding tubes, PEJ, open witzel jejunostomy
  (gastroparesis, sepsis, sign GER, pancreatitis, aspiration, proximal enteric fistula)
ENTERAL NUTRITION ADVANTAGE

• Provides nutrition when oral intake is inadequate
• Intake easily and accurately monitored
• Cost effective
• Reduces risks associated with disease state
• Preserve gut integrity
• Preserve immunologic function of the gut
ENTERAL FEEDING DISADVANTAGE

- Access problem (tube obstruction/ dislodgement)
- Aspiration
- Difficulty meeting the goal
- Diarrhea
- Metabolic
- Overhydration
ENTERAL NUTRITION FORMULAS

- Osmolality
- Caloric density
- Amount of protein per calori, as well as electrolyte, vitamin and mineral
- Intact or predigested
- Fiber is present or absent,
- Disease specific nutrients or not
ENTERAL NUTRITION FORMULAS

• **Standard formula** patients who can digest and absorb nutrients. Isotonic, 1 kcal/ml, lactose free, intact proteins about 40g/1000kcal, non-protein calorie to nitrogen ratio 130, mixture of simple and complex CHO, long chain FA, vit. And minerals.

• **Concentrated (calorie-dense) formula** Critically ill patients frequently require volume restriction. Composition is similar to standard, except hyperosmolar, caloric density1.2, 1.5 or 2.0 kcal/ml. less likely to be tolerated if delivered rapidly beyond pylorus
ENTERAL NUTRITION FORMULAS

- **Predigested (elemental) formula** for patients with compromised digestive or absorptive functions. Protein is hydrolyzed to short chain peptides, less complex CHO, less fat (mainly medium chain triglycerides). Failure to tolerate standard formula, short gut, Thoracic duct leak, digestive defects. No differences in mortality and infectious complication.

- **Disease specific formula** for Trauma, glycemic, renal, pulmonary, hepatic formulas (fluid and electrolyte restriction)
ENTERAL NUTRITION

- low fat/high carbohydrate enteral nutrition had a significant reduction in the incidence of pneumonia.
- Early nutrition in the course of surgical critical illness has been shown to decrease the rate of nosocomial pneumonia.
- Most guidelines suggest high-protein enteral nutrition (1.2 to 2 g per kg of ideal body weight per day) in patients with critical illness based upon observational studies that report improved mortality.
- Formula provide only an average of 20 ml/kg water.
- Fibers should be avoided when patient is on pressors.
ENTERAL NUTRITION

- Continuous versus bolus - no evidence that either is superior to the other.
- Amount and rate - daily amount is tailored to the nutritional and fluid needs of each patient. Calorie goal
- Initial rate - 10-30 ml/hr and then incrementally increase to target 20 ml q8hr
- Measurement of gastric residuals correlates poorly with aspiration risk and is associated with a decrease in calorie delivery.
- Monitoring - Aspiration, diarrhea, electrolyte imbalance, hyperglycemia, refeeding synd.
HISTORY OF TPN

Dr. Stanley J. Dudrick, the father of intravenous hyper-alimentation (IVH)

Born in Pennsylvania, 1935, MD degree form UPenn. 1961

IVH developed in 1960s, surgical resident in UPenn.

Was able to maintain nutrition for beagle puppies and subsequently newborn babies

Completed the work necessary to make this nutritional technique safe and successful

TPN one of four most signif. accomplishment in modern surgery (Asepsis, Antibiotics, Anesthesia)

TPN one of three most important advancements in surgery during past century (open heart surgery, organ transplantation)
PARENTERAL NUTRITION

- Approximately 40,000 people use TPN in the US
- Require 10-16 hrs. to be administered
- 5 year survival is approximately 20%
- Step-up approach when full enteral support is CI or fails to reach caloric targets
- Hypertonic nutrients intravenously, in elemental or pre-digested form (AA, dextrose, lipid emulsion, electrolytes, vitamins and minerals)
- Fat is also provided in a three-in-one solution or "piggy-backed."
INDICATIONS FOR PARENTERAL NUTRITION

• Preoperative If patient is malnourished and EN not feasible
• Malnourished patient in which EN is not feasible
• Adequately nourished and EN not possible for >7 days
• Hyper metabolic state with poor enteral tolerance (failure to reach caloric targets)
INDICATIONS FOR PARENTERAL NUTRITION (CONT.)

- **Nonfunctional GI tract** due to impaired absorptive capacity (bowel obstruction, short gut syndrome, prolonged diarrhea, high output fistulas, very severe BID)
- **Congenital GI anomalies**
- **Necrotizing enterocolitis**
- **Necrotizing pancreatitis**
- **Extensive burns**
- **Severe TBI**
TPN COMPLICATIONS

• Pneumothorax
• Arterial puncture
• Venous thrombosis/ PE from chronic IV access
• Catheter related sepsis 15% mortality per infection, 85% staph., 15% yeast, 5% GNR
• Fatty liver infiltration and liver failure dt using linoleic acid as a major source of calories
• hepatobiliary dysfunctions include steatosis, steatohepatitis
TPN COMPLICATIONS (CONT.)

• **Acute cholecystitis** bile stasis (6% patients on TPN longer than 3 weeks and 100% patients on TPN longer than 13 weeks develop biliary sludge.)

• **Hunger**

• **Refeeding syndrome** (hypokalemia, hypophosphatemia, hypomagnesemia, hypoglycemia)

• **Hypoglycemia** from abrupt cessation of TPN
EARLY PARENTERAL NUTRITION IN CRITICALLY ILL PATIENTS WITH SHORT-TERM RELATIVE CONTRAINDICATIONS TO EARLY ENTERAL NUTRITION: A RANDOMIZED CONTROLLED TRIAL
GORDON S DOIG, FIONA SIMPSON, ELIZABETH A SWEETMAN, SIMON R FINFER, D JAMIE COOPER, PHILIPPA T HEIGHES, ANDREW R DAVIES, MICHAEL O'LEARY, TOM SOLANO, SANDRA PEAKE

- Multicenter, randomized controlled single blinded trial 2006-2011
- ICUs of 31 community and tertiary hospitals in Australia and New Zealand
- 1372 patient randomized (686 standard care, 686 early PN)
- Main outcomes: 60 days mortality, quality of life, infections and body composition.

- Early PN to critically ill adults with relative contraindications to early EN, compared with standard care, did not result in a difference in day-60 mortality.
- The early PN strategy resulted in significantly fewer days of invasive ventilation but not significantly shorter ICU or hospital stays.
TRIAL OF THE ROUTE OF EARLY NUTRITIONAL SUPPORT IN CRITICALLY ILL ADULTS.

HARVEY SE1, PARROTT F, HARRISON DA, BEAR DE, SEGARAN E, BEALE R, BELLINGAN G, LEONARD R, MYTHEN MG, ROWAN KM; CALORIES TRIAL INVESTIGATORS.

- open, randomized, multicenter, controlled, parallel group, unplanned admission to 33 different English ICU
- 1191 parenteral/ 1197 Enteral, nutritional support initiated with 36 hrs, f/up 1ry & 2ry outcomes
- 30 days Mortality-> 33.1% parenteral group, 34.2% enteral group. RR in parenteral group, 0.97;95% CI, P 0.57
- Hypoglycemia-> 3.7% parenteral, 6.2% enteral. P=0.006
- Vomiting-> 8.4% parenteral, 16.2 enteral. P<0.00.
- Infectious comp.-> no difference 0.22 vs. 0.21; P=0.72
- 90 days mortality-> 37.3% parenteral vs 39.1% enteral, P=0.40
- Calorie intake was similar in the 2 groups, target intake not achieved in most pts.
ASPEN GUIDELINES

- **based on if they have CI for enteral nutrition and if they are adequately nourished or malnourished**
  - If no CI to enteral feeds-> early (within 24 hr) enteral nutrition grade 1B
  - If Hemodynamically unstable-> early enteral nutrition is CI grade 2C
  - If adequately nourished with CI for enteral nutrition-> recommend no initiating early parenteral feeding before one to two weeks. Grade 1A
  - If malnourished with CI for enteral nutrition up to 1 week-> recommend no initiating early parenteral feeding before one to two weeks. Grade 2C
  - If malnourished with CI for enteral nutrition more than 1 week-> recommend parenteral nutrition before one to two weeks. Grade 2C
  - Obese patients BMI>30kg/m2, same as adequately nourished critically ill patients
• PN is indicated in severely undernourished patients who cannot be adequately orally or enterally fed (grade A)

• Patients who require post-operative artificial nutrition, enteral feeding or a combination of enteral and supplementary parenteral feeding is the first choice (grade A)

• Parenteral Nutrition is beneficial in undernourished patients if enteral nutrition is not feasible for at least 7 days

• Most patients preoperative carbohydrate loading using the oral route is recommended

• Protein intake of 1.5 g/kg ideal body weight is effective to limit nitrogen losses in the perioperative period (grade B)
SUMMARY

- Hypoalbuminemia associated with mortality and post-op complications
- Nutrition is a powerful determine of patient outcome
- EN should be the first choice for nutritional support in the critically ill.
- Gastric feeding is superior to post-pyloric feeding
- Early EN is contraindicated in hemodynamically unstable patients.
SUMMARY

• routine checking of gastric residual volumes is unnecessary in asymptomatic patients
• TPN is not recommended before 1-2 weeks in adequately nourished patients who have CI for EN
• PN is recommended for malnourished patient who have contraindications to enteral nutrition expected to be more than one week
• parenteral nutrition support are at risk for infection, adverse metabolic effects, and complications related to venous access
REFERENCES


