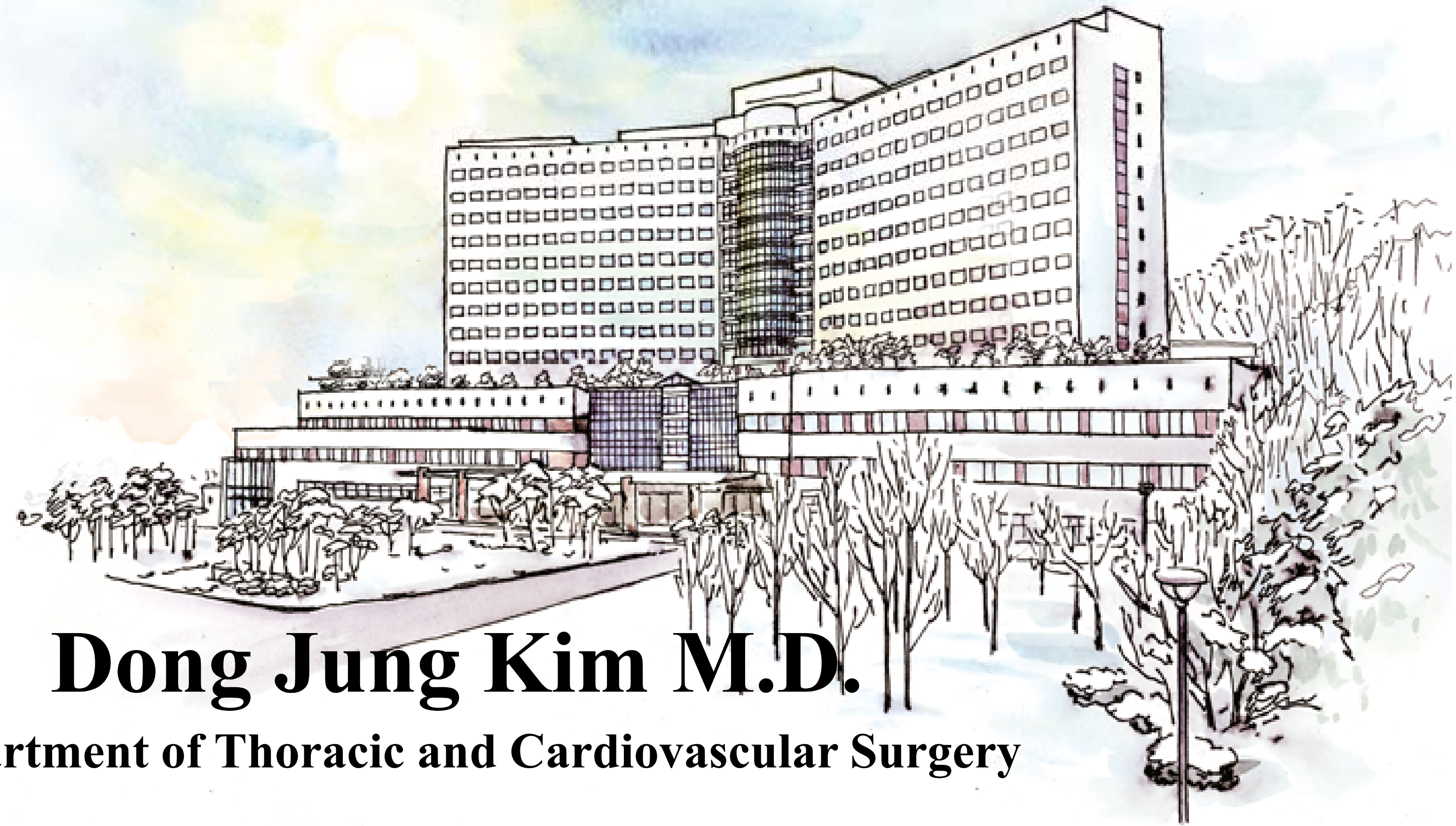
Nutritional support in cardiothoracic surgical patients



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Introduction

- Nutritional support
  - pivotal role in care of surgical & trauma patients admitted to SICU
- Critically ill surgical ICU patients
  - catabolic state driven by a systemic inflammatory response to insult or injury
  - infections, multiple organ dysfunction syndrome (MODS), and prolonged hospitalization

Introduction

- Metabolic response to surgery or trauma
  - shift from sparing of lean body mass to utilization
    - as a gluconeogenic substrate
    - support of immune function and repair of tissue

- Progressive loss of skeletal mass
  - physical unloading of muscle
    - bedrest, inactivity, and immobility

Introduction

- Major goal of nutrition therapy
  - attenuate metabolic response to stress
    - prevent oxidative cellular injury
    - favorably modulate immune responses
  - slow loss of lean body mass
- Early and adequate nutrition therapy
  - improvement in clinical outcome
  - often challenging in surgical ICU patients

Nutrition Assessment

- Determination of which patients will benefit the most from nutritional intervention

- American Society for Parenteral and Enteral Nutrition (ASPEN)
  - deleterious impact of inflammation
  - distinguish between acute & chronic malnutrition

(J Acad Nutr Diet. 2012;112(5):730–8)

ASPEN

- "Severely malnourished"
  - will obtain the greatest benefit from early nutrition intervention
- Key components
  - energy intake
  - degree of recent weight loss or gain
  - body fat, muscle mass
  - presence or absence of fluid accumulation

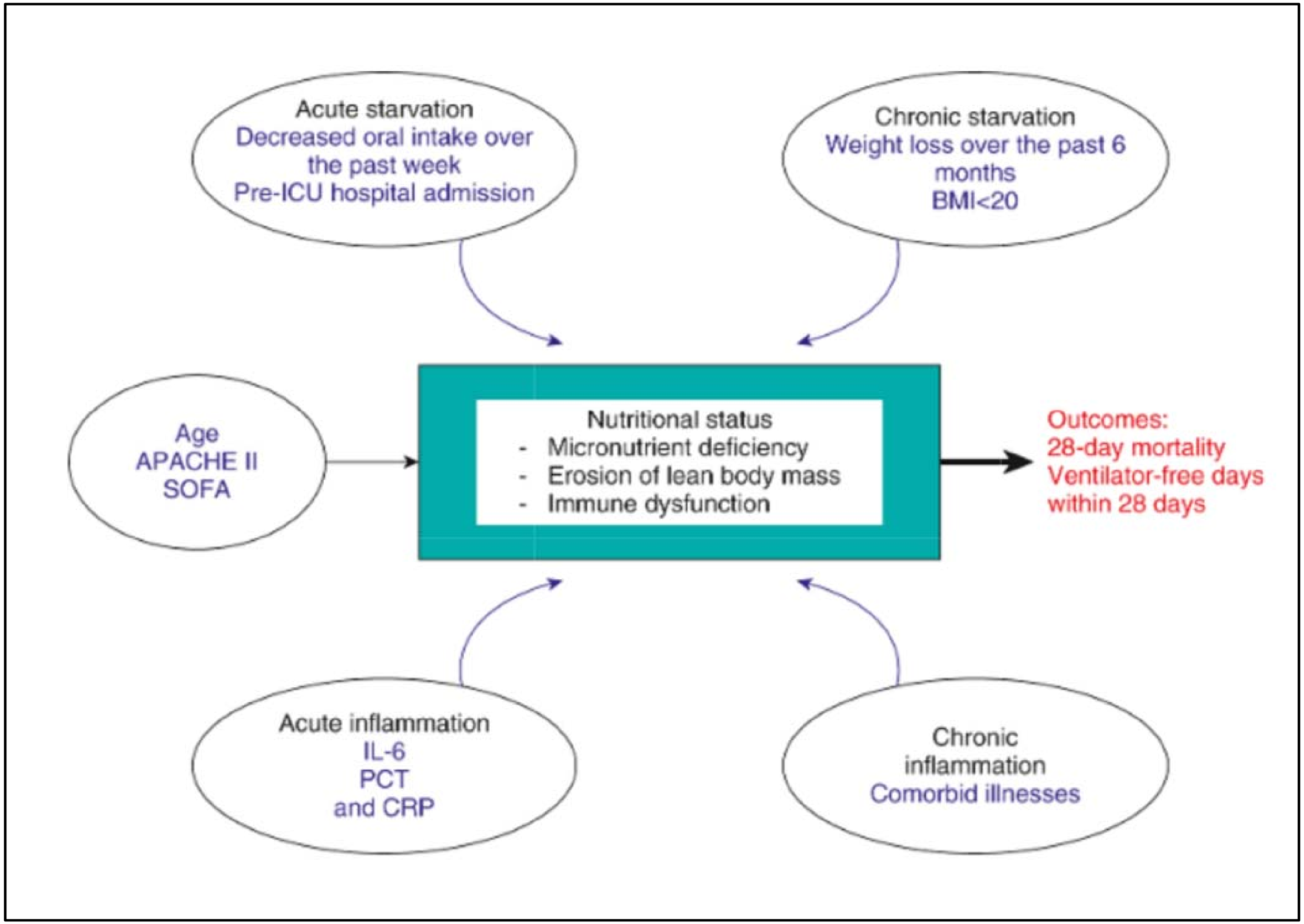
ASPEN severe malnutrition
Meet at least two of the following: Energy intake: ≤50 % of need for 5 days or more Weight loss: >2 % in 1 week, >5 % in 1 month, >7.5 % in 3 months Moderate fat loss, muscle wasting, and/or peripheral edema

Nutrition Assessment

- Nutritional assessment instruments
  - MNA, SGA, SNAQ, NRS-2002, MUST scores
  - have not been developed for ICU patients and rarely have been specifically validated

- NUTRIC score
  - starvation, inflammation, nutritional status, and outcomes
  - Low score (0~4)
    - low malnutrition risk
  - High score (5~9)
    - identify patients who are the most benefit from nutrition therapy

NUTRIC score



NUTRIC score

The NUTRIC Score is designed to quantify the risk of critically ill patients developing adverse events that may be modified by aggressive nutrition therapy. The score, of 1-9, is based on five variables that are explained below.

VARIABLE	RANGE	POINTS
Age (years)	<50	0
	50-<75	1
	>75	2
APACHE-II score (points)	<15	0
	15-<20	1
	20-28	2
	>28	3
SOFA-score (points)	<6	0
	6-<10	1
	>10	2
Number of comorbidities	0-1	0
	>2	1
Days from hospital to ICU admission	0-<1	0
	>1	1

NUTRIC score

- Nutritional risk in critically ill patients

- High nutritional risk
  - more likely to benefit from early EN
  - less infectious complications and mortality
    - than their low nutrition risk counterparts

(Crit Care. 2011;15(6):R268)

Nutritional Status

- Surgical patients
  - current nutritional status
  - type of surgery, potential anatomic alterations, etc.
- Traditional protein markers
  - albumin, pre-albumin, transferrin, etc.
  - reflect acute-phase response
    - vascular permeability ↑ & hepatic synthesis ↓
  - do not represent nutrition status in the ICU setting

Nutritional Status

- Ultrasound (US)
  - ease of use and availability
  - bedside tool to measure muscle mass
  - changes in muscle tissue over time
- Computed tomography (CT) scans
  - quantification of skeletal muscle & adipose tissue
  - validation & reliability studies regarding use of US & CT in surgical ICU are still pending

Energy Requirements

- Over 200 predictive equations
  - simplistic weight-based formulas
    - 25~30 kcal/kg/day
  - published predictive equations
    - Penn State, Mifflin, St. Jeor, etc.
  - none has more than approximately 70 % accuracy in ICU patients

Energy Requirements

Energy requirements		Protein requirements	
BMI	Energy (Kcal/kg/day)	Clinical condition	Protein needs[b] (grams/kg IBW/day)
<15	35–40	Normal (nonstressed)	0.75
15–19	30–35	Critical illness/injury	1.0–1.5
20–25	20–25	ARF (undialyzed)	0.8–1.0
26–29	15–17	ARF (dialyzed)	1.2–1.4
>29	15[a]	Peritoneal dialysis	1.3–1.5
		Burns/sepsis	1.5–2.0
		CVVHD	1.7–2.5

Preoperative Period

- Patients anticipating major surgery
  - rarely is the optimization of nutrition management through the perioperative period
- Preoperative nutrition therapy
  - beneficial in patients who are severely malnourished or at high nutrition risk
  - appropriate duration and measures
    - remains difficult to identify
  - current expert opinion
    - 10~14 days of preoperative nutrition therapy

(Nutrition. 2012;28(10):1022–7)

Enteral Nutrition

- Benefit of EN in the ICU patient
  - early EN
    - within 24~48 hours of surgical ICU admission
    - supports both functional & structural integrity of gut
  - decreases risk of infection and late multi-organ failure
    - by supporting the gut-associated lymphoid tissue and subsequently the mucosal-associated lymphoid tissue
  - patients at highest nutrition risk
    - more likely to have a positive impact on infection, organ failure, and length of stay

Enteral Nutrition

Early Enteral Nutrition Within 24 h of Intestinal Surgery Versus Later Commencement of Feeding: A Systematic review and Meta-analysis

Stephen J. Lewis · Henning K. Andersen · Steve Thomas

- Meta-analysis of early aggressive use of EN
- 13 trials, N=1,173
- Mortality was reduced from 6.8 % to 2.4 %
  - with use of early EN vs STD (RR=0.42, 95 % CI 0.18–0.96, p=0.030)

(J Gastrointest Surg (2009) 13:569–575)

Enteral Nutrition

Early Versus Traditional Postoperative Feeding in Patients Undergoing Resectional Gastrointestinal Surgery: A Meta-Analysis

Emma Osland, BHSc, MPhil[1,2]; Rossita Mohamad Yunus, MSc[2,3]; Shahjahan Khan, PhD[2]; and Muhammed Ashraf Memon, MBBS, MA Clin Ed, DCH, FRACS, FRCSI, FRCSEd, FRCSEng[1,4,5,6]

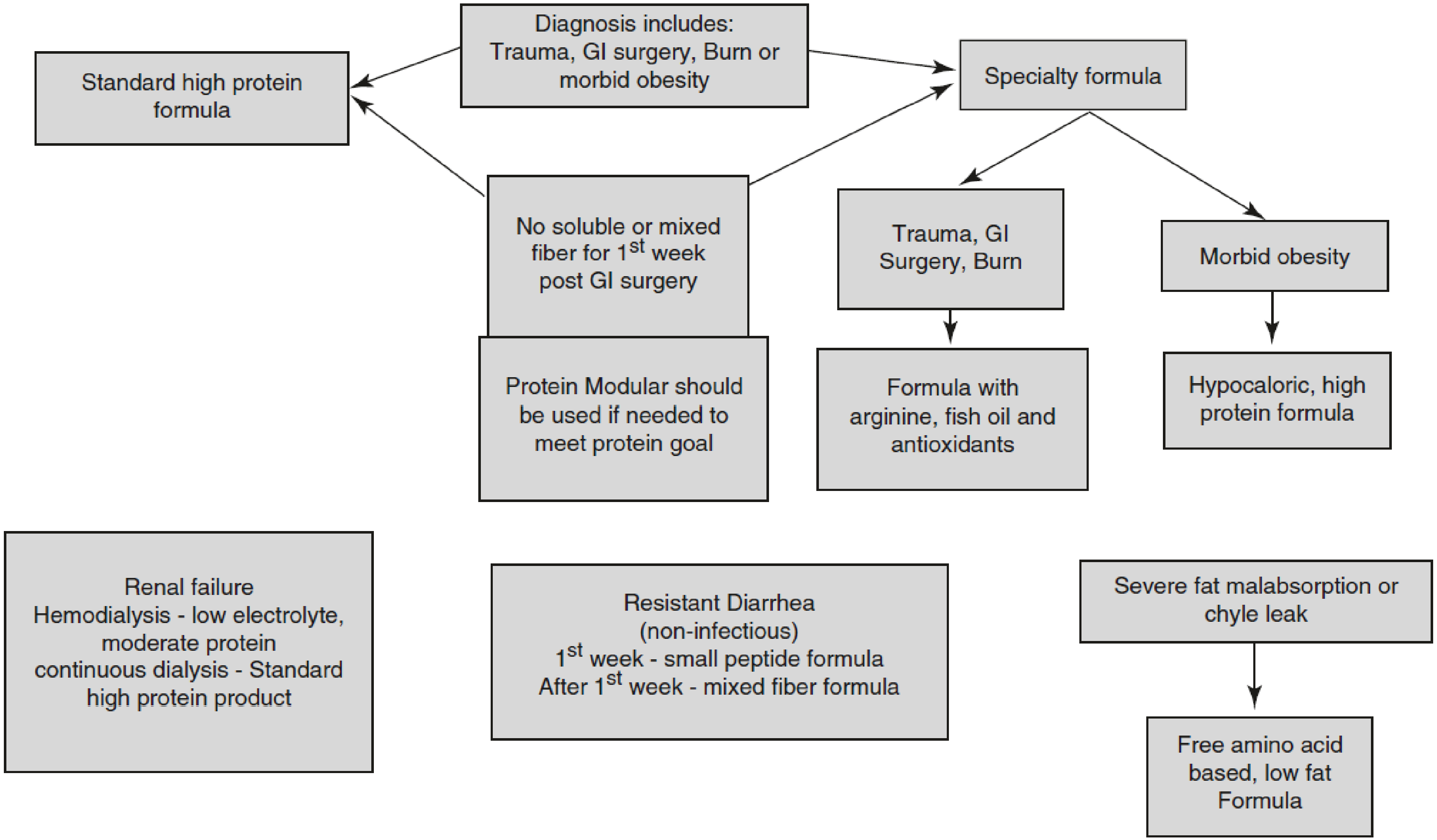
- Meta-analysis
- 15 studies, N=1,238
- Complications were reduced in early EN group (RR 0.53, 95 % CI 0.33–0.86)
  - mortality and LOS were not significantly different

(J Parenter Enteral Nutr. 2011 Jul;35(4):473–8)

Enteral Nutrition

- Early EN
  - 24~48 hours post admission to the surgical ICU
  - 1st choice over PN and delayed feeding
  - contraindication
    - continued obstruction, bowel discontinuity, ongoing peritonitis, high risk of bowel ischemia

Determining EN formulation



(Nutr Clin Pract. 2014;29(1):90–6)

Immunonutrition

- Immunonutrition (IMN) components
  - Arginine, Omega-3 fatty acids, and antioxidants
  - beneficial in patients who underwent major surgery
    - compared to standard enteral formulas (intact proteins with general amino acid profile & omega-6 fatty acids)
  - synergistic effect of fish oil and arginine

Arginine

- Relative arginine deficiency
  - specialized immune myeloid suppressor cells rapidly increase levels of arginase−1
    - following major surgery or injury
  - inadequate supply from endogenous arginine
    - making it a conditionally essential amino acid
- Potential benefit
  - stimulates release of anabolic hormones
    - such as growth hormone, prolactin, and insulin
  - initiates proliferation & activation of T-cells

Immunonutrition

Perioperative Use of Arginine-supplemented Diets: A Systematic Review of the Evidence

John W Drover, MD, FRCSC, Rupinder Dhaliwal, RD, Lindsay Weitzel, PhD, Paul E Wischmeyer, MD, Juan B Ochoa, MD, FACS, Daren K Heyland, MD, FRCPC, MSC

- Meta-analysis of 35 RCTs
- Use of an arginine/fish oil-containing formula given postoperatively reduced infectious complications (RR = 0.78, 95 % CI 0.64–0.95, p = 0.01)
- But not mortality compared to a standard formula

(J Am Coll Surg. 2011;212(3):385–99. 399.e1)

Immunonutrition

Effect of Timing of Pharmaconutrition (Immunonutrition) Administration on Outcomes of Elective Surgery for Gastrointestinal Malignancies: A Systematic Review and Meta-Analysis

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Emma Osland, BHSc, MPhil[1]; Md Belal Hossain, PhD[2,3]; Shahjahan Khan, PhD[2]; and Muhammed Ashraf Memon, MBBS, MA Clin Ed, DCH, FRACS, FRCSI, FRCSEd, FRCSEng[4, 5, 6, 7]

- Meta-analysis of 21 RCTs
- N=2,005
- When IMN and standard formulas were given perioperatively (both prior to and following surgery)
- Significant reductions in infection (OR=0.61, 95% CI 047–0.79, p<0.01)

(JPEN J Parenter Enter Nutr. 2014;38(1):53–69)

EN Access

- Gastric route
  - majority of surgical ICU patients
  - clinical concerns
    - aspiration, and increased risk of pneumonia
    - delay in feeding until SB access could be obtained
- Small bowel feeding
  - not decrease rates of pneumonia

    (Crit Care Med. 2012;40(8):2342–8)
  - prolonged gastric decompression d/t gastroparesis

EN Access

- Intolerance of gastric feeding
  - timely bedside placement of SB tubes is not an option
  - slow continuous infusion & use of prokinetics
- Prokinetics
  - metoclopramide or erythromycin
  - side effects
    - cardiac toxicity, tachyphylaxis, tardive dyskinesia, QT prolongation
  - should be used cautiously with monitoring
- Gastrostomy, jejunostomy, or gastrojejunostomy
  - when EN is expected to be needed for 4 weeks or greater

Protocolized Management of EN

- EN protocols
  - starting infusion rate, advancement, flushes
  - how to handle intolerances
    - gastric residual volumes, diarrhea, emesis, etc.
  - circumstance which EN should be adjusted or stopped
  - increase overall percentage of EN provided
- Volume-based feeding protocols
  - empower the nurses to increase feeding rates
    - to "make up" for volume lost while EN is held

Protocolized Management of EN

Improving Enteral Delivery Through the Adoption of the "Feed Early Enteral Diet Adequately for Maximum Effect (FEED ME)" Protocol in a Surgical Trauma ICU: A Quality Improvement Review

Beth Taylor, DCN, RD[1,2]; Rebecca Brody, PhD, RD[2]; Robert Denmark, PhD[3]; Robert Southard, MD[4]; and Laura Byham-Gray, PhD, RD[2]

- Surgical ICU protocol
- Significant increase in percent of EN goal provided (63~89 %, $p<0.0001$)

(Nutr Clin Pract. 2014 Oct;29(5):639–48)

Protocolized Management of EN

Characteristic	FEED ME	PEP uP
Enteral product	Variety (range of 1.0- to 2.0-kcal/mL products)	Single semi-elemental, 1.5-kcal/mL product
Volume based	Yes	Yes
Start of protocol	After patient achieved goal rate of EN	As soon as EN started
Initiation and advancement	SB: Initiate 20 mL/h, increase in 10-mL/h increments every 4 h to goal Gastric: Initiate 100 mL every 4 h, increase in 50-mL increments every 4 h to goal	SB or gastric: Initiate at goal mL/h Option to order "trophic" feeds only: 20 mL/h
Time clock	24-h clock 7 AM to 7 AM	24-h clock 7 AM to 7 AM
Makeup rate calculation	Based on EN prescribed goal rate, hours EN held, and hours remaining *Example*: SB feeds goal 70 mL/h held for 6 h (10 AM to 4 PM) = new rate 80 mL/h from 4 PM to 7 AM	Based on EN volume prescribed, volume missed, and hours remaining *Example*: SB feeds goal 1680 mL/24 h held for 6 h; 1470 mL remaining to infuse before 7 AM 1470 mL/15 h New rate 98 mL/h from 4 PM to 7 AM
GRV threshold	350 mL	250 mL
Promotility agents routinely used	No	Yes
Protein supplement routinely used	No	Yes
Maximum hourly infusion rate—small bowel	120 mL/h	150 mL/h
Gastric feeding maximum	400 mL every 4 h (given as intermittent feeding)	600 mL (given as continuous 150 mL/h)

(Nutr Clin Pract. 2014 Oct;29(5):639–48)

Refeeding Syndrome

- Biochemical and clinical symptoms
  - malnourished patients undergoing refeeding
    - by oral, enteral, and/or parenteral feeding
  - metabolic abnormalities
    - d/t shifts in electrolytes and fluid imbalance

Refeeding Syndrome

- Clinical features
  - low concentrations of intracellular ions
    - phosphate, magnesium, and potassium
  - abnormalities in glucose metabolism, sodium levels, and water balance
  - thiamine deficiency
- Incidence : unknown
  - d/t lack of universal definition

Refeeding Syndrome

- Insulin surge during refeeding
  - glycogen, fat, and protein synthesis ↑
    - requires minerals such as phosphate and magnesium and cofactors such as thiamine
  - absorption of potassium into cells ↑
    - through the sodium-potassium ATPase symporter, which also transports glucose into cells
    - magnesium & phosphate are also taken up into cells
    - water follows by osmosis
  - serum levels of potassium, magnesium & phosphate ↓
    - all of which are already depleted

Phosphorus

- Essential for all intracellular processes
  - many enzymes & second messengers
    - activated by phosphate binding
  - required for energy storage in form of ATP
  - structural integrity of cell membranes
- Regulates affinity of hemoglobin for oxygen
  - regulates oxygen delivery to tissues
- Important in renal acid-base buffer system

Refeeding Syndrome

- Chronic depletion of phosphorus
- Insulin surge
  - greatly increase uptake & use of phosphate in cells
  - deficit in intra & extra-cellular phosphorus
- Widespread dysfunction of cellular processes
  - even small decreases in serum phosphorus
  - affecting almost every physiological system

Refeeding Syndrome

- Management
  - Plasma electrolytes & glucose
    - should be measured before feeding
    - any deficiencies corrected during feeding
  - Hypophosphatemia
    - after start of feeding
    - intake should be reduced to 500 kcal/day for 48 hours
    - replace 15~30 mmol of phosphate over 3 hours

(Ann Pharmacother 1997;31:683–8)

Vasopressor Support

- Use of vasopressor
  - hemodynamic instability in critically ill patients
- Redistribution during hypotension and sepsis
  - decrease blood flow to mucosal region
    - highly vascularized d/t microvilli
  - mucosal ischemia
    - in the absence of adequate blood flow

Vasopressor Support

- Non-occlusive bowel necrosis
  - if perfusion demand is higher than supply
    - EN increases mucosal oxygen requirements
  - rare complication (<1 %)
  - mortality may be as high as 80 %
    - primarily based on case reports and retrospective data

(Nutr Clin Pract. 2014;29(1):90–6)

Vasopressor Support

- Start EN on low rate of feeding into stomach
  - stomach may act as a buffering chamber
    - when SB is hypo-perfused and peristalsis is lessened
  - with vigilant monitoring
    - gastric tolerance
    - signs of worsening hemodynamic instability
  - feeding rate should be advanced slowly to goal
    - abdominal exam every 4~6 hours

(Nutr Clin Pract. 2014;29(1):90–6)

Parenteral Nutrition

- PN vs early EN
  - concern that PN would further increase risk of infection
  - differences in infectious complications between the use of early EN or early PN are becoming narrower
    - glycemic control and standard protocol medical management
  - early PN vs No nutrition or early EN
    - meta-analysis of ICU patients (included >60 % of surgical patients)
    - no difference in infectious complications or 60-day mortality

(JAMA. 2013;309(20):2130–8)

  - long-term effect of early PN in postoperative patients
    - has yet to be studied on a large scale

Parenteral Nutrition

- Continued gut disuse with PN
  - worsen gut dysfunction
  - allow gut to become reservoir for bacteria & toxin
    - toxin products can be aspirated or translocated
    - nosocomial infections and MOF
- Only in patients with non-functioning GI tract
  - initiate EN as soon as patient's condition allows
  - supplemental PN
    - until patient is able to tolerate 60 % of their goal of EN

Parenteral Nutrition

- Low nutritional risk
  - well nourished patients
  - PN < 7 days: No further benefit over no nutrition

(Ann Surg. 1993;217(2):185–95)

- High nutritional risk
  - severely malnourished patients
  - benefit from early PN (within 48 hrs of admission)
    - without increased infectious complication

(Crit Care Med. 2011;39(12):2691–9)

Parenteral Nutrition

- High-nutrition risk patient in the early or acute phase of sepsis
  - PN should be avoided
  - lack of data specifically addressing the use of PN in septic patients
  - early supplemental PN added to hypocaloric EN
    - increased infectious complications & longer ICU stay

(N Engl J Med. 2011;365(6):506–17)

Parenteral Nutrition

Current practice in nutritional support and its association with mortality in septic patients—Results from a national, prospective, multicenter study*

Gunnar Elke, MD; Dirk Schädler, MD; Christoph Engel, MD; Holger Bogatsch; Inez Frerichs, MD; Maximilian Ragaller, MD; Jens Scholz, MD; Frank M. Brunkhorst, MD; Markus Löffler, MD; Konrad Reinhart, MD; Norbert Weiler, MD; for the German Competence Network Sepsis (SepNet)

- Prospective single-day point-prevalence trial
- N=415, with severe sepsis or septic shock
- Mortality was significantly higher in PN alone (62.3 %) or EN with supplemental PN (57.1 %) compared to EN alone (38.9 %) (p=0.005)
- APACHE II and SOFA scores were significantly higher in PN alone

(Crit Care Med. 2008;36(6):1762–7)

Parenteral Nutrition

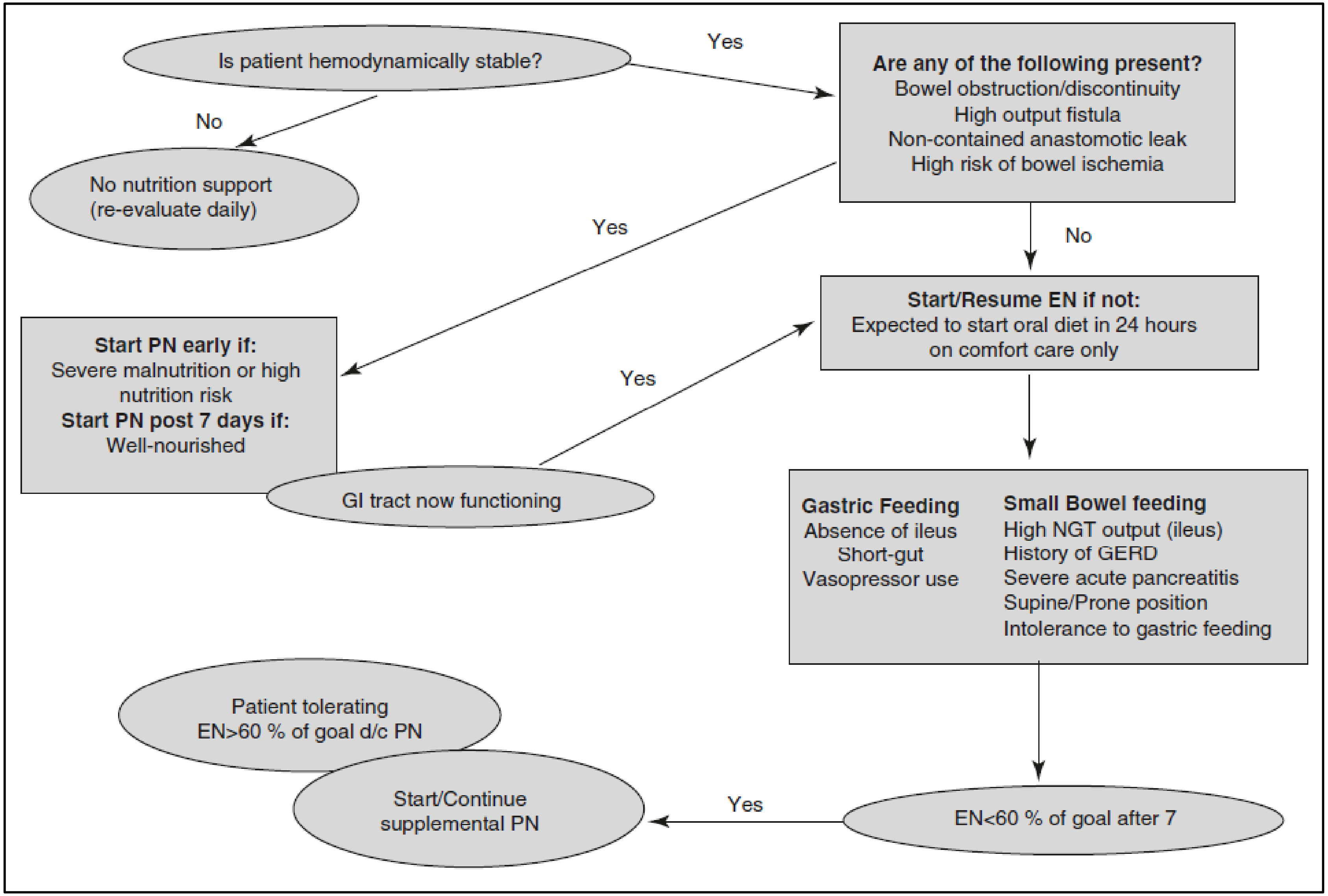
Enteral nutrition is associated with improved outcome in patients with severe sepsis

A secondary analysis of the VISEP trial

- Secondary analysis of a RCT multicenter trial
- N=353, with severe sepsis or septic shock
- Patients with EN alone had lower mortality than those given EN and supplemental PN

(Intensivmed Notfmed. 2013;108(3):223–33)

Determining route of nutrition support



Oral Diet

- Liquid diet vs Solid diet
  - advancing postop. patient first to clear liquid diet
    - no physiologic basis
  - clear liquids
    - may leave stomach more rapidly than solid foods
    - the texture easiest to aspirate
  - No difference in dietary intolerance between those receiving clear liquid diet or regular diet

(Am Surg. 1996;62(3):167–70)

Oral Diet

- Liquid diet vs Solid diet
  - solid foods on postoperative day 1
    - did not increase morbidity or mortality
  - early solid foods
    - decrease risk of ileus by early passage of gas and stool

(Ann Surg. 2008;247(5):721–9)

  - clear liquid diet
    - patient preference
    - when the surgeon has a high level of concern regarding the integrity of the anastomosis

Summary

- Use EN in preference to PN
  - in the presence of a functioning GI tract
- Start EN
  - within 24~48 hrs of surgery in non-septic patients
  - gastric route, for 7~10 days
  - consider refeeding syndrome
- Adopt volume-based EN protocols

Summary

- Hold small bowel EN
  - in patients with increasing vasopressor requirements
  - consider trophic (10~20 ml/h) gastric feeds
- Begin PN
  - in severely malnourished or high nutrition risk patients
    - with nonfunctioning GI tracts
  - within 5~7 days
  - if not tolerating at least 60 % of goal of EN prescribed
  - PN should be avoided in the acute phase of sepsis

Thank you for your attention !