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Hypocaloric, High Protein Nutrition Support for the Obese Patient:
New 2016 A.S.P.E.N. Guidelines for the Critically Ill Patient

Ainsley Malone, MS, RDN, LD, CNSC, FAND, FASPEN

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Hypocaloric, High Protein Nutrition Support for the Obese Patient:

New 2016 A.S.P.E.N. Guidelines for the Critically Ill Patient

Ainsley Malone, MS, RDN, LD, CNSC, FAND, FASPEN

Mt. Carmel West Hospital
Columbus, OH
March 3rd, 2016

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Objective

1. Describe the prevalence of obesity and the challenges with the obese patient in the ICU setting
2. Outline hypocaloric, high protein nutrition support for the obese critically ill patient
3. Detail practical strategies for implementation of the new 2016 A.S.P.E.N. Nutrition Support Therapy Guidelines

Obesity Prevalence

- 2011-12– 34.9% of adults (20+ years)[1]
  - Not significantly increased since 2003-04
- Intensive care unit

BMI	US[2]	Europe[3]
25-29.9	27%	36%
30-39.9	18%	15%
≥40	7%	3%

- Canadian ICU Nutrition Survey 07-09[4]
  - BMI 25 – 39.9: 46%
  - BMI 40 – 49.9: 4%
  - BMI 50 – 59.9: 1.3%
  - BMI ≥ 60: 0.06%

[1]JAMA 2014;311:806-14; [2]Chest 2005;127:2125-31;[3]Intens Care Med 2008;34:1999-2009;[4]Chest 2011;Aug 4 EPub

Cardiopulmonary Changes in Obesity

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Decreased compliance of the respiratory system

Reduced lung volumes

Oxygen consumption and carbon dioxide production are increased

Severe gas exchange impairment in post op and supine patients

Increased susceptibility to depressant effects of sedatives and anesthetic agents

Best Pract Res Clin Anes 2011;25:95-108

Management Challenges in the ICU Patient

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Airway management	More difficult tracheal intubation
	Post extubation stridor
	Weaning difficulty – hypoventilation, sleep apnea
	Have reduced lung volumes
Positioning	Supine and Trendelenberg restrict cardiac reserve
	Prone positioning can be difficult
Difficulty with central venous and arterial catheters	
Difficult to assess volume status	

Metabolism in Critically Ill Obese

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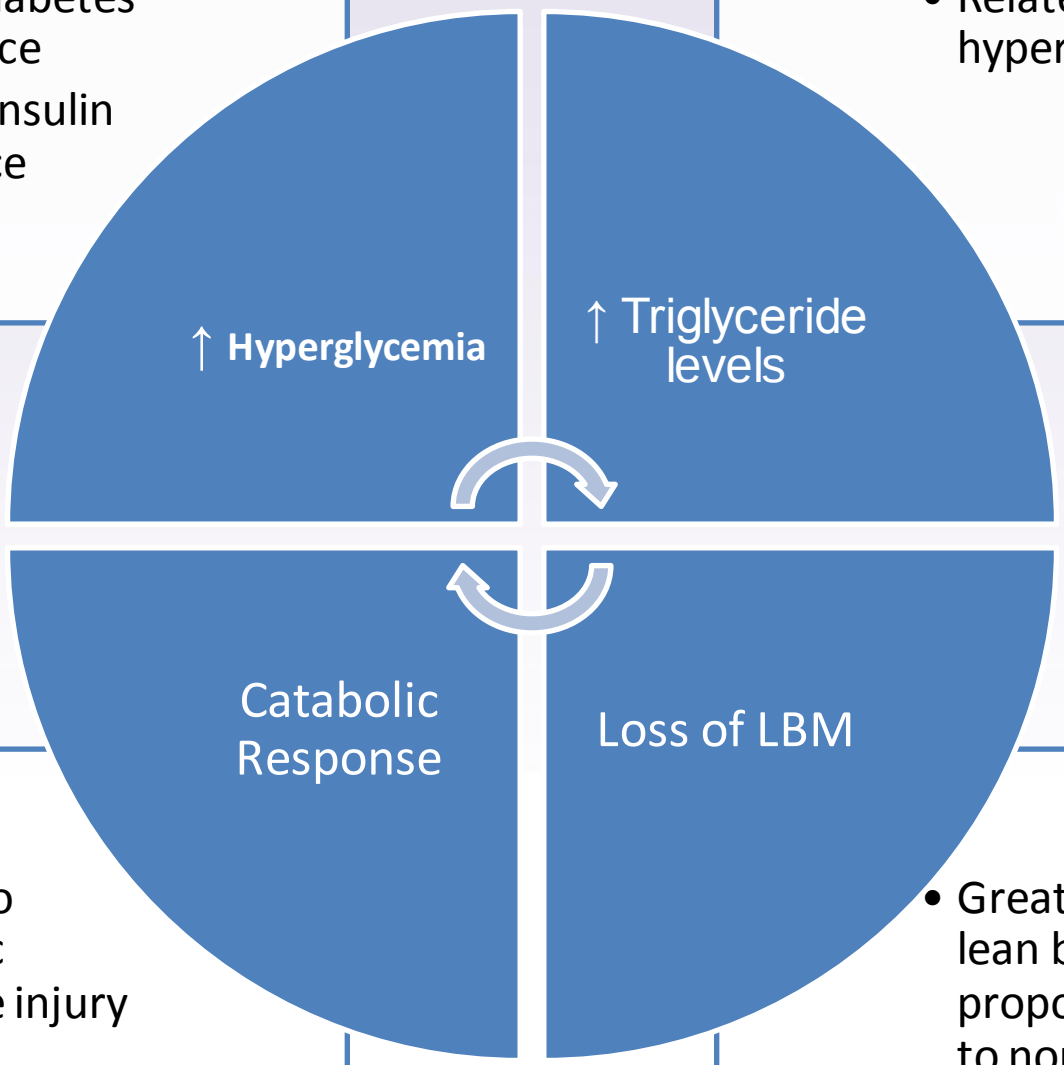
- Higher diabetes prevalence
- Greater insulin resistance

- Related to hypergylcemia



- Similar to catabolic response injury

- Greater loss of lean body mass proportionate to non-obese

Obesity and Inflammation

- Excess lipid deposition causes lipotoxicity
- Induces cell inflammation
- May lead to organ dysfunction

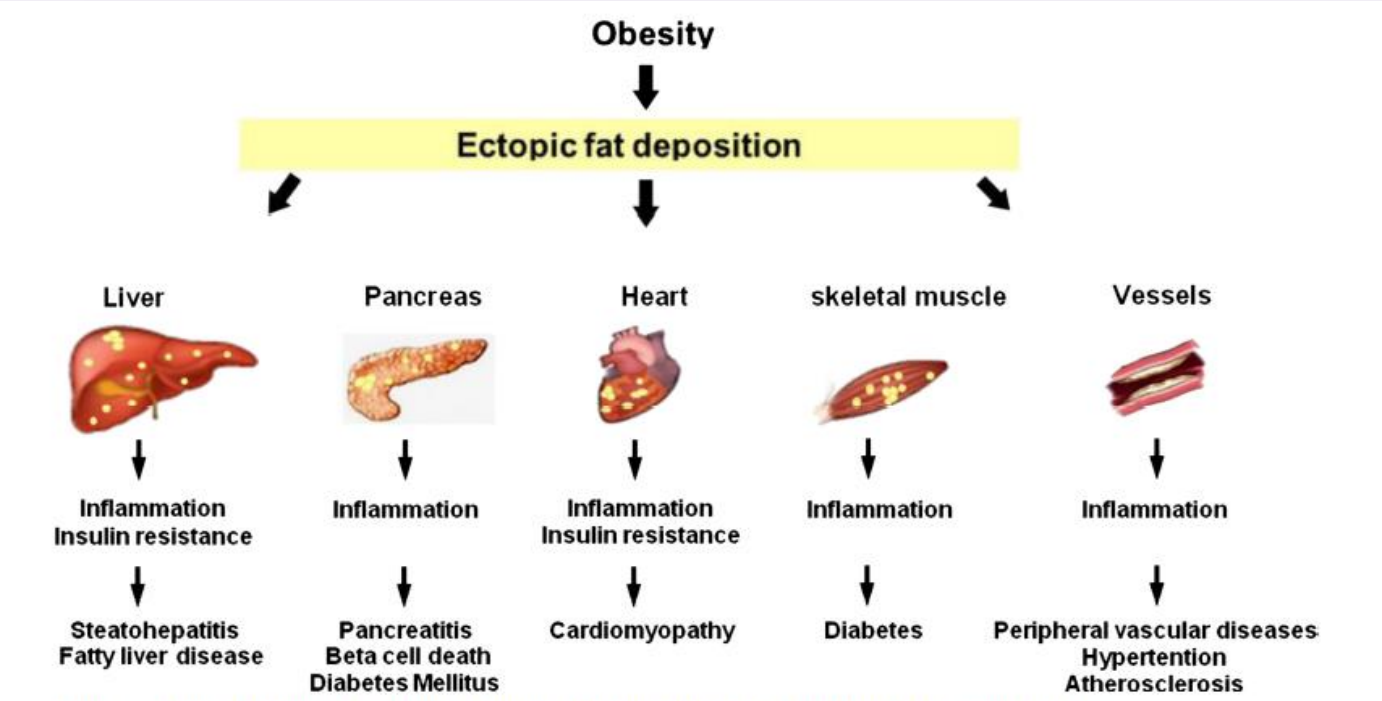


Figure 1. Ectopic fat deposition and pathophysiological dysfunctions in vital organs associated with obesity.

Gharib M, J Trauma Acute Care Surg 2015;78:866-873.

Energy Assessment Methods

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- Controversial
- Indirect calorimetry obvious choice if available
- Predictive equations most frequent choice
- How to account for altered body composition in the obese
  - FFM increased and ranges from 20 – 40% of excess weight
  - Not a linear relationship – greater obesity, less % of LBM
- Predictive equations from non-obese individuals

Poll Question

- How do you assess energy and protein needs?
  A. Indirect calorimetry
  B. Predictive equations
  C. A & B
  D. Other

Rationale for Underfeeding in Obesity

Stems from early work of using protein sparing diets

Obese associated with metabolic changes

Insulin resistance

- Hyperglycemia

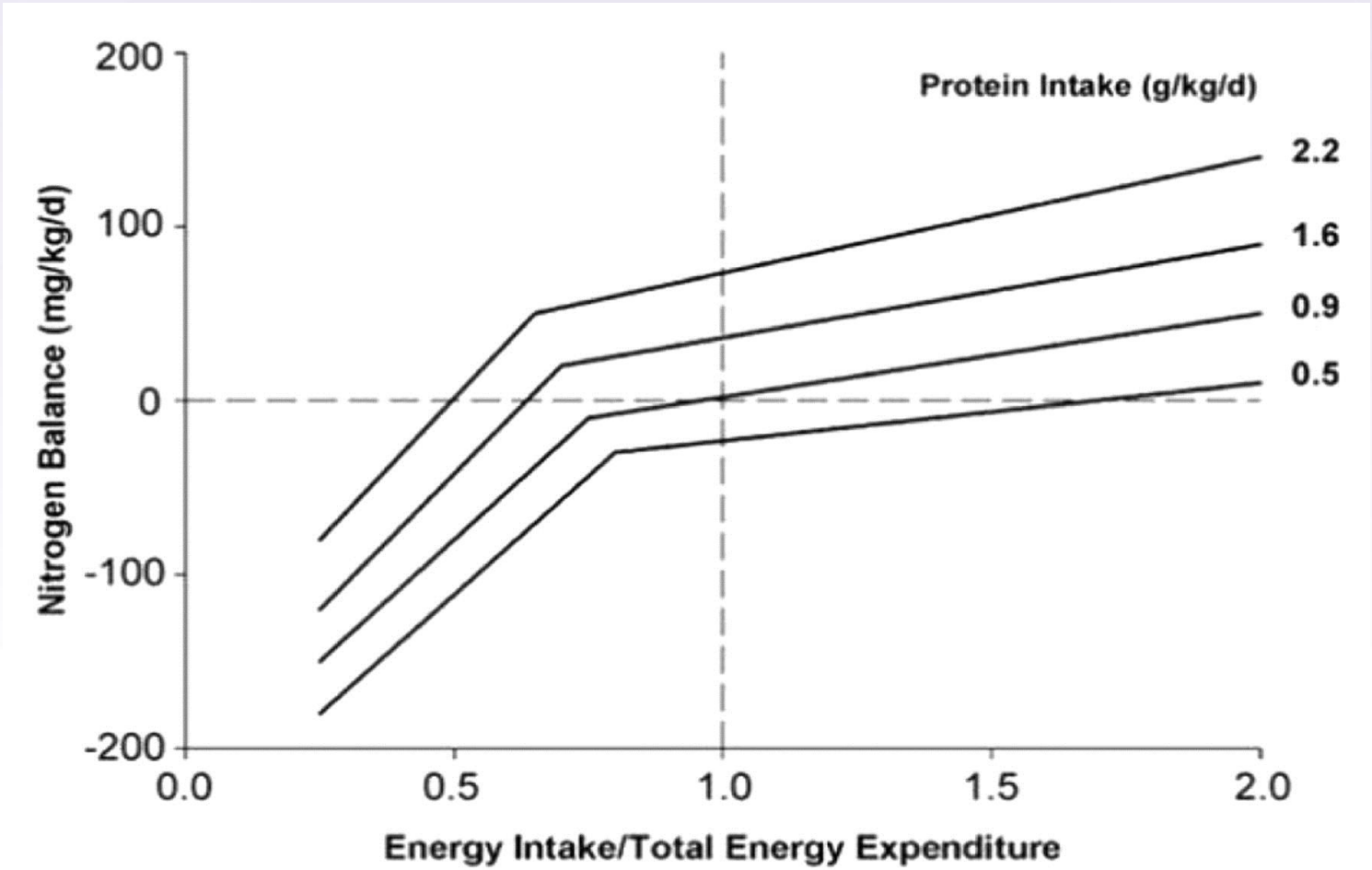
Obstructive sleep apnea

Fatty infiltration

Provide nutrients without exacerbating metabolic issues

Protect lean body mass

Relationship Between Protein and Energy Intake on Nitrogen Balance



JPEN J Parenter Enteral Nutr 2011;35:36S-43S

Hypocaloric Feeding In Obese Patients

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What is the Evidence?

Dickerson 1986

- Pilot study (n=13)
- Prospective evaluation with PN
  - 7 – gastric bypass
  - 6 – other surgical procedures
- Wt: 120 kg ± 60
- Received average of 881 Kcals (51% MREE) as non-protein kcals
  - 2.1 g/protein/kg IBW
- Duration: 48 ± 31.4 (12-190) days

A J Clin Nutr 1986;44:747

Dickerson 1986

- Weight loss occurred
  - Decrease to 109 kg ± 32.5
- Nitrogen balance +2.4±1.9 g/day
  - Equal or positive balance occurred after 24 ± 9.7 days
- Wounds and fistulas healed
- In mild to mod stressed obese, hypercaloric feedings are not necessary

Burge 1994

- Prospective trial in acutely ill patients receiving PN (n=16)
  - Excluded those with DM
  - Primarily surgical population
- Randomized to receive 50% or 100% MREE non-protein kcals
  - 2 g protein/kg/IBW
  - Higher dextrose and lipid intake in control group
- Duration 2 weeks or transitioned to EN or PO
  - 9.6 ± 3 days (5-15)

J Parent Ent Nutr 1994;18:203

Burge -1994

Parameter	Hypocaloric	Control	P Value
Weight (kg)	90 ± 12.5	102± 19.9	NS
BMI	33 ± 5.5	35 ± 4.2	NS
Non-protein Kcals/d	585	1972	<0.001
Total Kcals/d	1285	2492	<0.001
Total Kcals/kg/IBW	22 ± 6.9	42 ± 7.2	<0.001
Protein g/kg IBW	2 ± 0.6	2.18 ± 0.4	NS

J Parent Ent Nutr 1994;18:203

Burge -1994

- Nitrogen balance
  - +1.3 ± 3.62 hypocaloric group (NS)
  - +2.8 ± 6.9 control group (NS)
- Weight loss
  - 4.1 ± 6.7 kg - hypocaloric group (NS)
  - 7.4 ± 8.4 kg - control group (NS)
- Conclusion – hypocaloric PN can result in a comparable nitrogen balance
  - Moderately stressed

J Parent Ent Nutr 1994;18:203

Choban - 1997

- Prospective evaluation in acute/critically ill patients (n=30) requiring PN
  - Excluded those with renal or hepatic disease
- Stratified by critical or non-critical care
  - n = 13 and n = 17
- Randomized to receive PN formula
  - Hypocalorie
  - Control
  - Both received 2 g protein/kg/IBW/day
- Duration of PN
  - 10 ± 3 d in hypocalorie vs 11 ± 2 d in control
- Glucose controlled - 100-180 mg/dl

Am J Clin Nutr 1997;66:546

Choban-1997

Parameter	Hypocaloric	Control	P Value
Weight (kg)	97 ± 19	90 ± 17	NS
BMI	36 ± 5	34 ± 6	NS
Non-protein Kcals/d	814 ± 225	1507 ± 164	<0.001
Total Kcals/d	1294 ± 299	1937 ± 198	<0.001
Total Kcals/kg/IBW	22 ± 2.9	36 ± 4.3	<0.001
Protein g/kg IBW	2 ± 0.1	2 ± 0.1	NS

Am J Clin Nutr 1997;66:546

Choban - 1997

- Nitrogen balance (NS)
  - 4 ± 4.2 – hypocaloric
  - 3.6 ± 4.1 - control
- Weight change – no difference
  - ICU patients with no difference
- Trend toward lower glucose levels in hypocaloric group
  - Less days requiring insulin (3.2 vs 8.0 d) $p<0.05$
- Concluded that hypocaloric high protein PN can be provided and achieve nitrogen balance

Am J Clin Nutr 1997;66:546

Dickerson - 2002

- Retrospective evaluation in critically ill obese patients (n=40)
  - Hypocaloric = < 20 kcals/kg adj BW
  - Eucaloric = 20 – 25 kcals/kg adj BW
  - Protein intake = 2 g/kg/day IBW for both groups
- Demograhic data
  - BMI = 41.3 ± 13.7 – hypocaloric group
  - BMI = 36 ± 12.4 – eucaloric group
  - Weight
    - 118 ± 41 – hypocaloric group
    - 102 ± 36 – eucaloric group

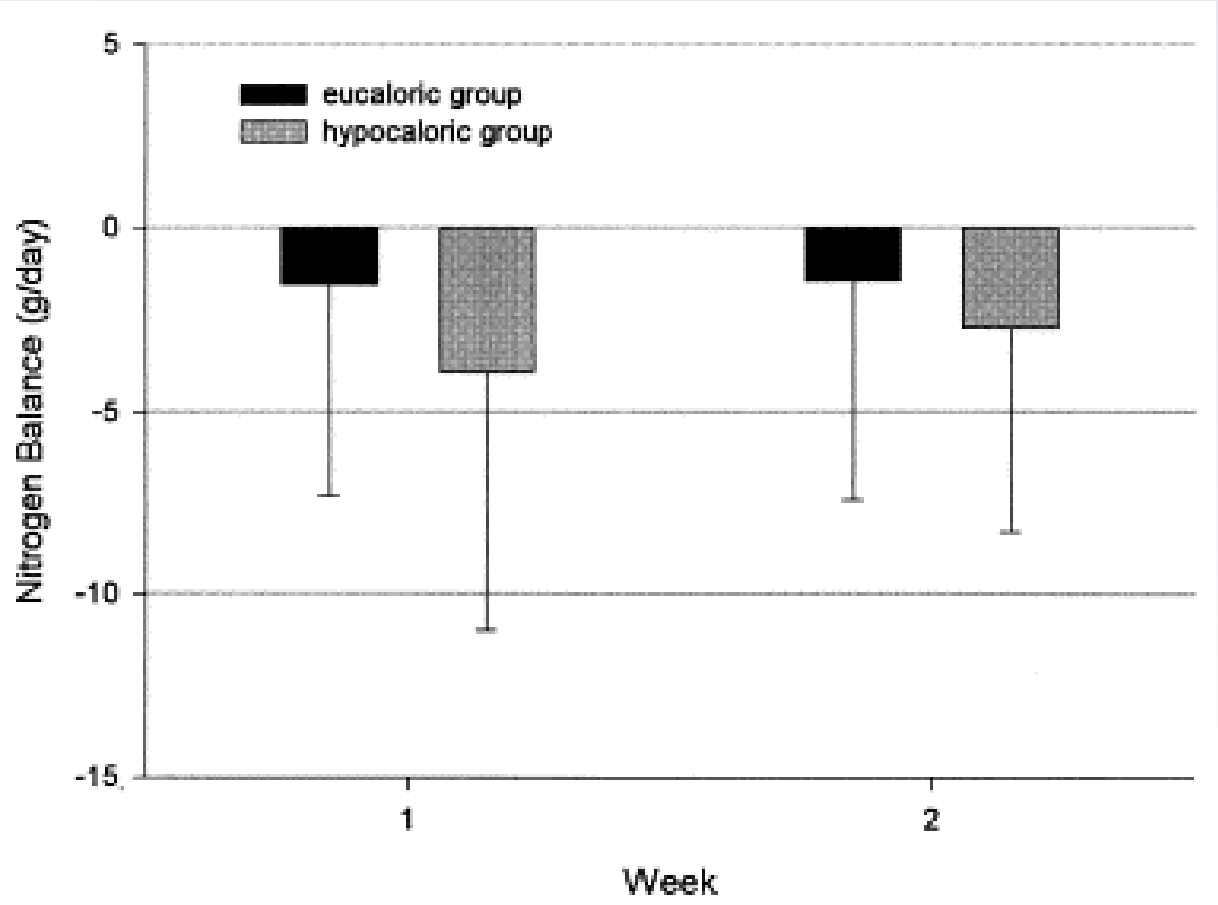
Nutrition 2002;18:241

Dickerson - 2002

- Average calorie intakes
  - 16.2 – 22.2 kg/d over 4 weeks – hypocaloric group
  - 21.5 – 29.9 kg/d over 4 weeks – eucaloric group
- Average protein intakes
  - 1.14 – 1.53 g/kg/IBW/d – hypocaloric group
  - 0.82 – 1.19 g/kg/CBW/d – eucaloric group
- Duration of therapy = maximum of 14 days
- Nitrogen Balance
  - Both groups were near nitrogen equilibrium

Nutrition 2002;18:241

Dickerson 2002 – Nitrogen Balance



P= NS

Nutrition 2002;18:241

Dickerson - 2002

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Clinical outcomes

- Decreased ICU stay (p=0.03)
- Decreased antibiotic therapy (p=0.03)
- Trend toward decreased ventilator days (P < 0.09)
- No difference in glucose levels
  - May be related to EN versus PN

- Conclusion
  - Hypocaloric EN feeding approach at least AS favorable is eucaloric feeding
  - May provide a clinical benefit

Nutrition 2002;18:241

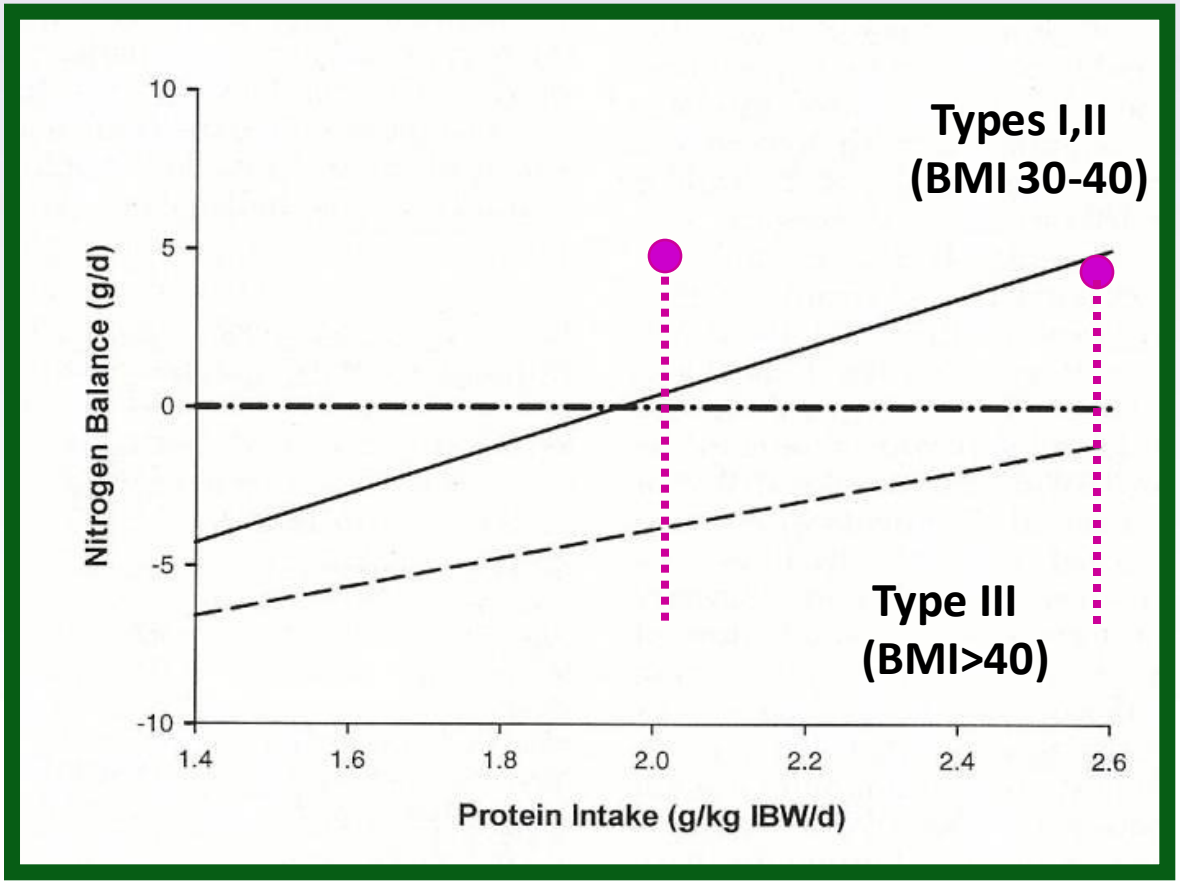
Choban and Dickerson - 2005

- Combined data sets
- Evaluated morbidly obese (Class III = BMI ≥ 40) N = 70
  - 44 provided hypocaloric regimen
  - 26 provided eucaloric regimen
  - Via regression determined higher protein intake is needed
    - 1.9 - 2.5 g/kg/IBW in critically ill patients
  - Trend toward worsening hyperglycemia in Class III compared to less obese

Nutr Clin Pract 2005;20:480

Protein Intake and Nitrogen Balance

Protein Requirements



Choban, Dickerson (NCP 2005;20:480)

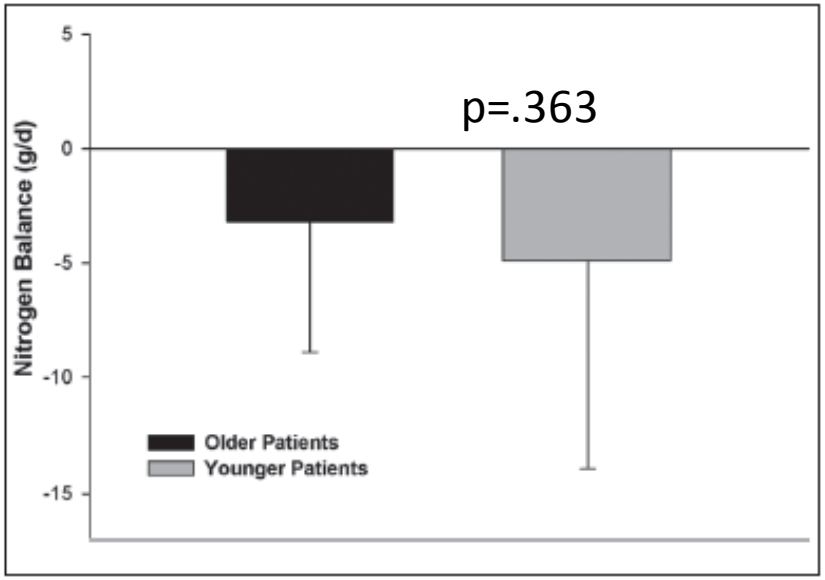
Dickerson - 2013

- Prospective evaluation in critically ill older trauma patients requiring EN or PN
  - Question: differences in nutrition response and clinical outcomes in older vs younger patients
- Stratified by age
  - 18-59 yrs (n=41); ≥60 yrs (n=31)

Variable	18-59 years	≥ 60 years	P value
Kcal/kg IBW/day	18±4	21±5	0.002
Protein, g/kg IBW/day	2.1± 0.4	1.9±0.3	0.016
Serum urea nitrogen (SUN)	30±14	20±9	0.001
SUN Max	43±19	28±12	0.001

J Parent Ent Nutr 2013;37:342

Dickerson - 2013



- Nitrogen Balance (mean) - NS
  - 2.3 ± 0.3 g/kg IBW/day (older group)
  - 2.3 ± 0.2 g/kg IBW/day (younger group

- No significant clinical outcome differences between older and younger groups
- Those who achieved a positive N Balance more likely to survive

J Parent Ent Nutr 2013;37:342

Guidelines – What Do They Tell Us?

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A trial of hypocaloric high protein feeding is suggested in patients who do not have severe renal or hepatic dysfunction (weak)

A.S.P.E.N. Clinical Guidelines: Nutrition Support of Hospitalized Adult Patients With Obesity

Patricia Choban, MD[1]; Roland Dickerson, PharmD, BCNSP[2]; Ainsley Malone, MS, RD, CNSC[3]; Patricia Worthington, MSN, RN[4]; Charlene Compher, PhD, RD, CNSC, LDN, FADA, FASPEN[5]; and the American Society for Parenteral and Enteral Nutrition

Hypocaloric feeding may be started with 50%-70% of estimated energy requirements or **< 14 kcal/kg** actual weight

High protein feeding may be started with 1.2 g/kg actual weight or 2-2.5 g/kg ideal body weight, with adjustment of goal protein intake by the results of nitrogen balance studies

J Parent Ent Nutr 2013;37:714-744

Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

Journal of Parenteral and Enteral Nutrition
Volume 40 Number 2
February 2016 159–211

"Suggest that high-protein hypocaloric feeding be implemented in the care of obese ICU patients" (EC)

Goals of EN regiment should not exceed 65-70% of target energy requirements from IC.
If IC unavailable:

- BMI 30 – 50: Suggest 11-14 kcals/kg actual body
- BMI > 50: 22-25 kcal/kg/IBW

Suggest protein should be provided in a range:

- BMI 30 – 40: 2 g/kg/IBW/day
- BMI > 40: 2.5 g/kg/IBW/day

McClave, et al., J Parent Ent Nutr 2016;40:159-211

Guidelines – What Do They Tell Us?

Hypocaloric low protein feedings are associated with unfavorable outcomes. Clinical vigilance for adequate protein provision is suggested

- Observational cohort study of ICU patients
- 2722 patients – 333 with Class II or III obesity
- Average calorie intake – 1009 kcals
- Average protein intake – 46 g/day
  - 0.9 - 1 g/kg/day
- Mortality higher in the Class II obesity group (0.039)

Intens Care Med 2009;35:1728.

Poll Question

- Do you currently follow the 2016 A.S.P.E.N. hypocaloric high protein recommendations for your obese patients?
  - Yes
  - No

Hypocaloric Regimens in Obese Patients - ??'s

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What are the patient populations studied?

- Does my patient fit within that population?

Renal function

- Severe azotemia without RRT?
- Marked renal dysfunction with RRT?

Liver function

- Encephalopathic or failing liver?

Duration of hypocaloric intake?

Duration of Hypocaloric Feeding

Author-Year	Population	Duration of Regimen
Dickerson - 1986	Non-ICU surgical	48 (20-190 days
Burge - 1994	Non-ICU surgical	9.6 (5-15) days
Choban - 1997	ICU and non-ICU	9 days
Dickerson - 2002	ICU	Maximum of 14 days

- Mirtallo 2010 (NCP 25:38S)
  - Long term hypocaloric PN (BMI ≥ 40 with ECF in 67%
  - Therapy duration: 130 ± 60 days
  - Transition to enteral nutrition: 67%
- Hamilton 2011 (NCP 26:577)
  - HPN in bariatric surgical patients (BMI ≥ 35)
  - Median duration of therapy: 1.5 months
  - 83% weaned to oral diet

How To Achieve High Protein Intakes

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- **TPN formulas**
  - Requires high amino acid base formulation
    - 15%
    - Lower base AA formulations result in increased fluid intakes
    - Difficulty with standardized (pre-mix) formulas
- **Enteral formulas**
  - Improved options with introduction of very high protein EN formulas
    - Protein content = 35% - 37% (87.3 - 92.5 g/liter)
  - Additional formulas to consider (25% protein)
  - Modular protein supplementation

Practicalities in Achieving Protein Requirements

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BMI	Protein Requirements (75 kg IBW)	EN Formula 18% protein	EN Formula 25% protein	EN Formula 37% protein	Protein supplement
		Per Guideline Energy Recommendations			
30-40	150 g/day	55 g	83 g	115 g	35 g – 55 g/day
40+	188 g/day	55 g	83 g	115 g	73 g – 133 g/day
50+	188 g/day	76-87 g	103-117 g	144-164 g	24 g – 112 g/day

- 14 kcals/kg actual weight (200#/90.9kg) – 1270 kcals
- 22-25 kcals/kg IBW (70”/166#/75kg) – 1650 – 1875 kcals

Poll Question

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- Do you use modular protein to meet the protein needs of your obese patients?
  - Yes
  - No

What If Hypocaloric Regimen Is Contraindicated?

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- In the critically ill obese patient, if indirect calorimetry is unavailable, energy requirements should be based on the Penn State University 2003b predictive equation or the modified Penn State University equation if the patient is over the age of 60 years (strong).
- If the Penn State University equations cannot be used, energy requirements may be based on the Mifflin–St Jeor equation using actual body weight.

J Parent Ent Nutr 2013;37:342

Patient Case

- 45 yr male admitted for planned roux-en-y gastric bypass
- Developed post-op respiratory failure requiring intubation
  - AKI – requiring continuous renal replacement therapy
  - Severe ileus (per radiology)
- Started on PN on 5th PO day
- On 12th PO day, trach placed and G-tube placed in gastric remnant

Patient Case

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- Height: 64#
- Admission weight: 467# (212 kg)
- Ideal weight: 160# (72.7 kg)
- BMI: 69

	Energy	Protein
2009 Guidelines	1600-1815 kcals/day	145 g/day
2016 Guidelines	1600 – 1815 kcals/day	182 g/day

- EN initiated – very high protein formula
  - 35% protein; 87.5 g/L

Patient Case

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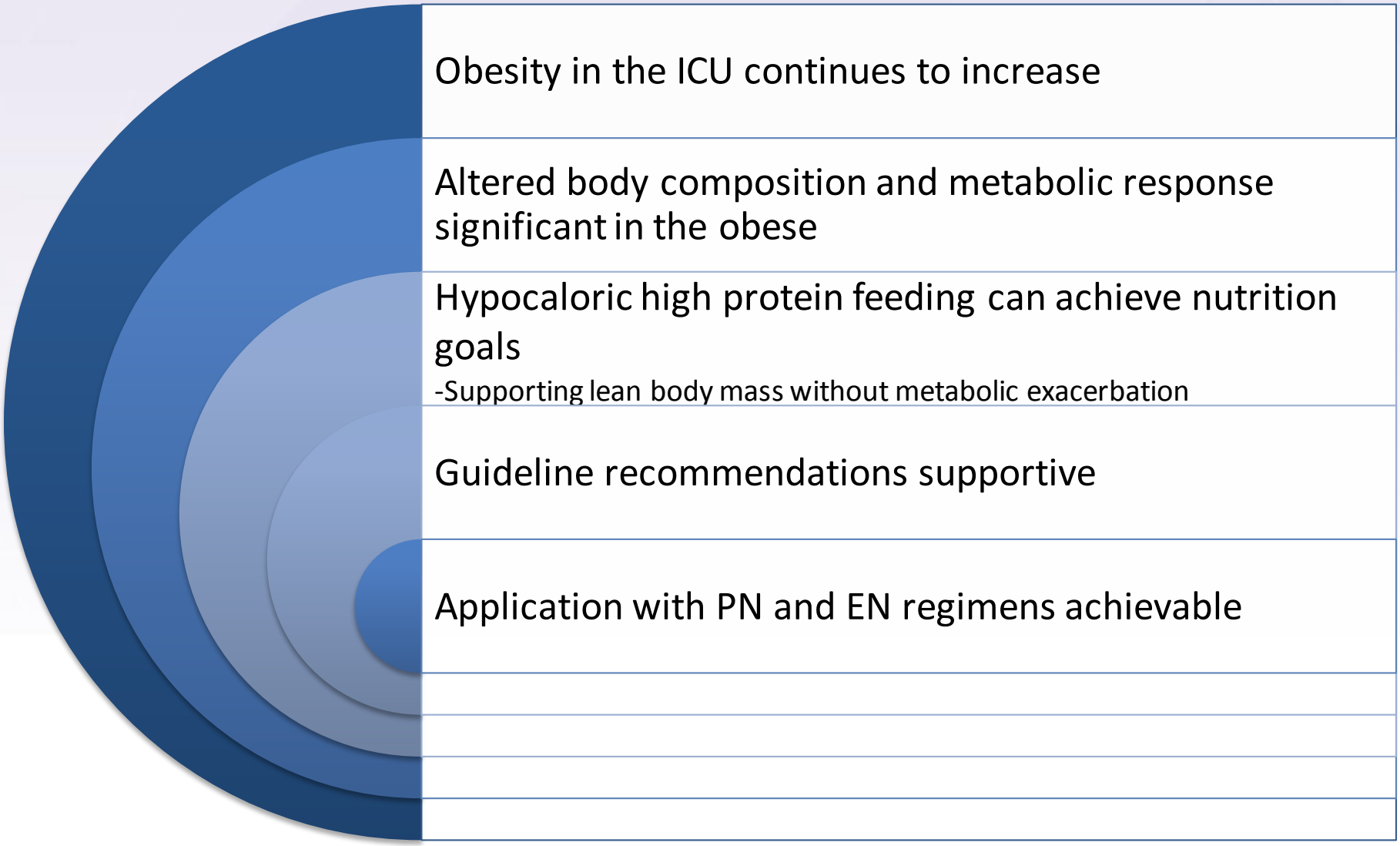
- Enteral feeding goal rate for calories = 75 mL/hr
- Provides 157 g protein/day
- Additional 25 g protein needed for supplementation
- TPN weaned off on post op day #14th
  - Initiated protein supplementation once TPN d/c'd.
- Review of enteral infusion next 5 days
  - 79% of goal volume
  - 1422 kcals/148 g protein (with supplement)
- Increased rate to 80 mL/hr (22 hr basis)

Patient Case

- Transferred out of the ICU on post op day 20
- EN volume intake next 5 days
  - 96% of goal volume
  - 1728 kcals/183 g protein (with supplement)
- PO diet initiated after swallowing study
- EN continued throughout hospitalization
  - Transitioned to cycle infusion
  - 100 mL/h X 12 hrs
  - 66% of goal requirements – w/protein supplement
- Transferred to LTACH with cycled EN and PO

Putting It All Together



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