Hypocaloric/Permissive Underfeeding: Point/Counterpoint

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When Permissive Underfeeding/Hypocaloric Feeding Regimens May Be Detrimental

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Hypocaloric Regimens vs. Permissive Underfeeding

Rationale for feeding strategies:
• Hypocaloric regimens – provision of high protein/low calorie intake to obese patients to maintain a positive nitrogen balance, avoid risks of overfeeding, and modestly reduce weight.
• Permissive underfeeding – based on the premise that short-term dietary restriction will limit pathologic processes while minimally impairing organ function.

Feeding the Obese Patient

Historical methods for estimating the energy needs of hospitalized obese patients:
• Adjusted BW: IBW + 50% excess incorporated into HBE (Harris Benedict Equation)
  a. Females = 655 + (9.6 x Wt) + (1.7 x Ht) - (4.7 x A)*
  b. Males = 66 + (13.7 x Wt) + (5 x Ht) - (6.8 x A)*
* Wt (kg), Ht (cm), A (yrs)
• HBE using average of actual BW and IBW x 1.3 stress factor
• HBE using IBW + 25% of excess
***All predictive methods are often inaccurate and over-estimate energy needs***

Hazards of overfeeding the critically ill obese patient
• Hyperglycemia and risk of infection
• Difficulty weaning from the ventilator
• Lipogenesis causing hepatic steatosis and hepatic dysfunction
• Pulmonary edema and CHF requiring fluid restriction

Feeding the Obese Patient

• Important concept: a positive nitrogen balance can be achieved by using a low protein/high caloric (LP/HC) intake, a medium protein intake/medium caloric (MP/MC) intake, or high protein/low caloric (HP/LC) intake.
• Marked differences in body composition occur with above three intakes:
  – LP/HC: increased body fat and water
  – MP/MC: maintain body fat and protein
  – HP/LC: increased body protein and decreased body fat

Dickerson RN. Curr Opin Clin Nutr Metab Care 2005;8:189-96.
Support for HP/LC PN in Obesity

- Case series of 13 obese postoperative patients (208% ± 114% IBW)
- Exclusion criteria: renal or hepatic disease
- Nutrient regimens: <50%MREE (881 kcal/day) as dextrose, 2.1 g/kg/d IBW
- Results: Significant increases in serum albumin, serum TIBC, + N₂ balance; complete tissue healing of wounds, abscess cavities, fistulae.


Support for HP/LC PN in Obesity

- Randomized, double-blind, prospective study of HP/LC vs. HP/HC PN administration in obese patients
- Inclusion criteria: > 130% IBW
- Exclusion criteria: renal/hepatic disease, adrenal disease, pediatrics, pregnancy
- Nutrient regimens: HP/LC = 2 IBW/22 IBW (n=16) vs. HP/HC = 2 IBW/36 IBW (n=14)
- No difference in N₂ balance, wt changes, nor albumin
- Significant difference in study days for which insulin was required among NIDDM HP/LC vs. HP/HC (3.2 vs. 8 d, p<0.05)


Published Studies of Hypocaloric Feeding in Obese Patients

<table>
<thead>
<tr>
<th>Reference</th>
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<td>Dickerson</td>
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<td>8 (62%)</td>
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<tr>
<td>Dickerson</td>
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<td>13 (46%)</td>
</tr>
<tr>
<td>Liu</td>
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<td></td>
<td>&gt; 60 years</td>
<td>12</td>
<td>31.1</td>
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Choban PS, Dickerson RN. NCP 2005;20:480-487.

Feeding the Obese Patient

- Studies of hypocaloric, high-protein PN formulations in hospitalized obese patients have documented positive nitrogen balances with wound healing, better glucose control with less requirement for exogenous insulin and weight loss.
- One study using hypocaloric, high-protein EN showed a shorter ICU length of stay, decreased antibiotic days, and a trending decrease in number of ventilator days.

Dickerson RL. NCP 2004;19:245-54.

Feeding the Obese Patient

- Proposed indications for hypocaloric, high-protein feedings include:
  - BMI > 30 kg/m² or actual BW > 150% IBW
- Regimen goals: 22 total kcal/kg of IBW and 2 g/kg protein of IBW
- Contraindications to use of hypocaloric, high-protein feedings include:
  - Advanced renal disease without CRRT
  - Hepatic encephalopathy with end stage liver disease
- Use cautiously in patients with history of diabetic ketoacidosis or significant hypoglycemia
Consequences of Hypocaloric & Permissive Underfeeding

- Glucose control – No change (only demonstrated improvement in obese patients)
- Increased septic risk (pneumonia, bacteremia) – Villet S et al. and Rubinson L et al.
- Prolonged length of mechanical ventilation – Casadei E et al.
- Negative nitrogen balance and protein catabolism – McCowen KC et al.
- Increased overall complications – Villet S. et al.


Negative Impact of Hypocaloric Feeding in ICU Patients

- Prospective observational study in ICU patients (> 5 days)
- Exclusion criteria: major thermal injury
- Indications for early EN (i.e., within 48 hr): multiple injury, major GI surgery for tumor, pre-existing malnutrition
- EN titrated to goal over 4 days; PN used when EN contraindicated
- REE was measured with indirect calorimetry; target set at 1.3 x REE or 30 kcal/kg/d (when not measured)
- Energy balance = energy delivery — energy target


Negative Impact of Hypocaloric Feeding in ICU Patients

- 48 patients (age 57 ± 16 yr) with ICU LOS of ~ 2 wks were evaluated
- MV lasted 11 ± 8 days, 30-day mortality 38%
- Feedings (EN/PN) were started within 3.1 ± 2.2 days after admission
- Mean REE = 1700 ± 325 kcal/d, resulting in a mean target = 2210 ±500 kcal/day (29 ± 7 kcal/kg/d)
- Energy balance decreased from -1270 kcal/day during 1st week to -625 kcal/day during 4th week


Variables F p

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Negative Impact of Hypocaloric Feeding in ICU Patients

- Caloric intake of < 25% of ACCP recommendations (< 6 kcal/kg/day) is associated with increased risk of nosocomial BSI in MICU patients
- As the lag period increased from 2 – 4 days, the association with risk of BSI increased in strength
- Patients who received ≥ 25% of ACCP recommendations exhibited 73% hazard reduction [95% CI, 32-89%] for BSI vs. those who received < 25%.
- Limitation: patients NOT tolerating ≥ 25% may be most ill patients at a higher risk for BSI


Patient baseline characteristics.

<table>
<thead>
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<th>Sex: M/F (n)</th>
<th>33/17</th>
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<tbody>
<tr>
<td>Age (years)</td>
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</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>26.85±5.23</td>
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<tr>
<td>APACHE II</td>
<td>23.1±7.7</td>
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<tr>
<td>Reason for admission</td>
<td>No. of patients</td>
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<tr>
<td>Surgery patients</td>
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<tr>
<td>Patients with multiple trauma or burns</td>
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<tr>
<td>Medical patients</td>
<td>21</td>
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</tbody>
</table>


Negative Impact of Hypocaloric Feeding in ICU Patients

- Prospective cohort in university-affiliated tertiary hospital
- Entry criteria: 50 patients requiring ≥ 96 hr of MV
- Exclusion criteria: FiO₂ ≥ 60%, air leaks, chest tubes, hemodynamic instability, < 18 years old
- Indirect calorimetry performed 6 days/week
- Energy balance calculated as MEE – calories provided (EN, PN, IVFs)
- Primary outcome measures: mortality
- Secondary outcome measures: days of MV, organ dysfunction (renal, hepatic, CV), severe sepsis, & septic shock

What is the Optimal Amount of Energy & Protein Intake?

- Prospective, randomized, controlled, nonblinded trial
- University-affiliated teaching hospital with NST
- Inclusion criteria: requiring PN for ≥ 5 days, based upon ASPEN criteria
- Exclusion criteria: severely underweight (< 50 kg), home PN, requiring specific preoperative PN regimen
- Regimens: hypocaloric (1L of 70 g protein, 1000 kcal) or weight-based (25 kcal/kg & 1.5 g protein/kg); dry weight or adjusted weight if > 130% IBW [IBW + (actual – IBW)0.25]
- Outcome measures: rate of hyperglycemia, pneumonia, CRBSI, wound infection, SIRS

Optimal Energy Intake

• Systematic review comparing combination EN + PN vs. EN alone to optimize nutritional intake in critically ill patients
• Databases searched included Medline, Embase, CINAHL, Cochrane Library from 1980 – 2003
• Included studies if were randomized clinical trials in ICU comparing combination EN + PN vs. EN alone.
• Only 5 studies found to meet inclusion criteria; methodological scores ranged from 6 – 12 (maximal score: 14)


Optimal Energy Intake

• Starting PN with EN in critically ill patients with intact GI tracts who are not malnourished has no added benefit in terms of reducing mortality, infectious complications, days of mechanical ventilation, and length of stay.
• Starting EN with PN in critically ill patients with intact GI tracts who are not malnourished has no added benefit in terms of reducing mortality, infectious complications, days of mechanical ventilation, and length of stay.


Conclusions

• Provision of hypocaloric, high-protein regimens to obese patients can result in clinical benefits (i.e., positive nitrogen balances with wound healing, better glucose control and weight loss).
• Permissive underfeeding critically ill patients at ≤ 25% of ACCP recommendations and creating an energy debt within the first week can be associated with increased complications.
• Energy AND protein intake interactions MUST be considered in feeding strategies.
• Based upon the McCowen study in non-critically ill patients, a minimum of 1.3 g protein/kg must be provided with 20 kcal/kg to prevent severe protein catabolism.