
C Ghanbari

Citation

Abstract
Patients with neurological disorders often require non-oral nutrition support because of intubation, altered mental status or dysphagia, irrespective of surgical intervention. To maximize patient outcome, nutrition support must be initiated within a 48- to 72-hour window immediately post-injury or surgical insult. In an attempt to provide nutrition support in an uniform manner without unnecessary delays, a multidisciplinary team of physicians, nurses, speech pathologists and the unit dietitian developed a set of nutrition support protocols for use in the neuro intensive care unit at our institution. Although new residents receive a handbook with extensive references on nutrition support, a brief orientation on the protocols and a one hour nutrition support lecture, a need was identified for a concise, pocket-sized reference outlining the fundamentals of nutrition support and the unit's nutrition protocols step-by-step. Towards this end, the unit dietitian developed a six-page nutrition support reference in outline form that is reproduced here. Although the material is geared towards the neurosurgical patient, it provides nutrition support basics appropriate for nearly any intensive care patient population. The material covers selection of an appropriate feeding route, assessment of nutritional status and nutrient requirements, calculation of parenteral and enteral feeding regimens, monitoring of nutrition support patients, and weaning patients off of nutrition support onto oral diets.

Glossary of Medical Terms and Abbreviations

- A (vitamin): retinol
- ARDS: adult respiratory distress syndrome
- BEE: basal energy expenditure
- BM: bowel movement
- B12 (vitamin): cobalamin
- C. Diff: Clostridium difficile
- CHF: congestive heart failure
- CHI: closed head injury
- C V V H: continuous veno-venous hemofiltration
- CAVHD: continuous arterio-venous hemodialysis
- d: day
- dl: deciliter
- DHT: Dobhoff tube (brand name for nasoenteral feeding tube)
- E (vitamin): tocopherol
- FIO2: forced inspiratory oxygen
- FSBG: fingerstick blood glucose
- GI: gastrointestinal
- H2 blocker: histamine-2 blocker
- I & O: intake and output
- IBW: Ideal Body Weight
INTRODUCTION

Neurologically impaired patients often require non-oral nutrition support because of intubation, altered mental status or dysphagia. Common diagnoses of patients admitted to a neuro intensive care unit (NICU) include traumatic head injury, stroke, brain tumor, spinal cord injury, degenerative disease (multiple sclerosis, amyotrophic lateral sclerosis, Alzheimer’s, Parkinson’s) or a mobility disorder (myasthenia gravis, Guillain-Barre syndrome). All of these conditions have the potential to promote visceral protein depletion and wasting of skeletal musculature through dysmobility, inadequate oral intake or hypercatabolism secondary to the disease process. Even non-surgical patients may be in a hypermetabolic, hypercatabolic state due to the nature of their disease and the invasive interventions required to support them during treatment and recovery. 1

Early nutrition support through the enteral route has been shown to blunt catabolism, reduce complications and reduce length of stay in a number of patient populations, including both surgical and non-surgical neuro patients. 2,3 However, nutrition support must be initiated within the 48- to 72-hour period immediately following injury or surgical insult to achieve these benefits. 2 Clinicians are often hesitant to feed critically ill neuro patients too soon. However, studies indicate patients with severe neurological deficits and clinically silent abdomens can tolerate low-rate jejunal feedings within 36 hours of injury 4 with a gradual increase in feeding rate to meet initial caloric goals within two to four days. 4,5 If jejunal feedings are initiated prior to induction of pentobarbital infusion, even patients in pentobarbital coma can be fed enterally. 6

In an attempt to provide nutrition support in an uniform manner without unnecessary delays, a multidisciplinary team of physicians, nurses, speech pathologists and the unit dietitian developed a set of nutrition support protocols for use in the neuro intensive care unit at our institution. The team also developed pre-printed orders to be used in conjunction with the protocols. The primary responsibility for initiating and monitoring nutrition support lies with a team of NICU residents in collaboration with the attending physician, nursing staff and the unit dietitian.

New residents receive a brief orientation on the protocols and an ICU handbook with extensive references on nutrition support on their first day of rotation. Later in the month, the residents attend a one-hour lecture on nutrition support. Nevertheless, a lack of nutrition support knowledge was
identified among NICU residents that the orientation, handbook and lecture did not adequately address. As a result, nutrition support was often delayed or inappropriate. A need was identified for a concise, pocket-sized reference outlining the fundamentals of nutrition support as per the unit protocols in a step-by-step fashion to assist the residents in writing nutrition support orders.

Towards this end, the unit dietitian developed a six-page nutrition support reference in outline form that is reproduced here. Although the material is geared towards the NICU patient, the basic information it provides is appropriate for nearly any intensive care patient population. The material covers selection of an appropriate feeding route, assessment of nutritional status and nutrient requirements, calculation of parenteral and enteral feeding regimens, monitoring of nutrition support patients, and weaning patients off of nutrition support onto oral diets. The reference is not designed to be all-inclusive, adding to its ease of use by residents in a busy intensive care unit where many nutrition support regimens must be initiated, adjusted and monitored daily.

**PROTOCOLS**

**Figure 1**

A. Oral: for patients who are extubated, awake/alert, following commands
   - AND have intact swallowing ability and adequate GI function

B. Enteral: for patients who are intubated, unable to swallow OR eat adequate
   - FLUS have adequate small bowel function

C. Parenteral, central: for patients who have inadequate small bowel function
   - OR on whose all forms of enteral access or support are contraindicated AND who have central venous access

D. Parenteral, peripheral: for patients who have adequate small bowel function
   - OR on whose all forms of enteral access is contraindicated
   - FLUS on whose central venous access is contraindicated

II. Assess the patient’s nutritional status and nutrient requirements.8

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**Figure 2**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assess energy reserve based on pre-resuscitation weight</td>
<td></td>
</tr>
<tr>
<td>1. Calculate Ideal Body Weight (IBW) by Handels method</td>
<td></td>
</tr>
<tr>
<td>Males: 166 pounds for the first 5 feet plus 5 pounds for each inch above 5 feet</td>
<td></td>
</tr>
<tr>
<td>Females: 108 pounds for the first 5 feet plus 5 pounds for each inch above 5 feet</td>
<td></td>
</tr>
<tr>
<td>2. Obtain admission weight and usual weight as a percentage of IBW</td>
<td></td>
</tr>
<tr>
<td>&gt; 100% IBW: morbidly obese</td>
<td></td>
</tr>
<tr>
<td>126% - 199% IBW: obese</td>
<td></td>
</tr>
<tr>
<td>111% - 126% IBW: overweight</td>
<td></td>
</tr>
<tr>
<td>90% - 110% IBW: adequate energy reserve</td>
<td></td>
</tr>
<tr>
<td>80% - 90% IBW: lean body habitus or mildly depleted energy stores</td>
<td></td>
</tr>
<tr>
<td>70% - 79% IBW: moderate depletion of energy reserve</td>
<td></td>
</tr>
<tr>
<td>&lt; 65% IBW: severe depletion of energy reserve</td>
<td></td>
</tr>
</tbody>
</table>

E. Assess visceral protein stores: Note that these parameters are unreliable if creatinine clearance is under 50 mg/minute or if patient is in fulminant renal or hepatic failure. Serum albumin is a valid indicator of protein store when fluid resuscitation has been initiated and acute stress response has occurred. Laboratory values may differ slightly by institution and assay used.

1. Adequate stores: |
   - Albumin 3.5 - 5.0 mg/dl |
   - Transferrin 212 - 366 mg/dl |
   - Prealbumin > 45 mg/dl |

2. Mildly depleted stores: |
   - Albumin 2.9 - 3.4 mg/dl |
   - Transferrin 160 - 211 mg/dl |
   - Prealbumin < 15 mg/dl |

3. Moderately depleted stores: |
   - Albumin 2.1 - 2.7 mg/dl |
   - Transferrin 100 - 149 mg/dl |
   - Prealbumin 11 - 14 mg/dl |
Figure 3

<table>
<thead>
<tr>
<th>4. Severely depleted stores:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumin &lt; 2.1 mg/dl</td>
</tr>
<tr>
<td>Transferrin &lt; 100 mg/dl</td>
</tr>
<tr>
<td>Prealbumin &lt; 19 mg/dl</td>
</tr>
</tbody>
</table>

C. Access nitrogen balance, reliable only when creatinine clearance stable and above 50 ml/min.

1. Method: Obtain 24 hour timed urine nitrogen in grams per 24 hours. Divide by 0.65 to correct for urinary urea nitrogen losses.

Add 2 to 4 grams for correct for inosensible nitrogen losses.

Multiply by 6.25 to determine protein intake required for equilibrium.

2. Interpretation: Compare result to patient’s protein intake from all sources: oral, enteral and parentral.

Intake < output: “negative” = catabolism exceeds anabolism

Intake > output: “positive” = anabolism exceeds catabolism

3. Goal: To achieve a positive to zero nitrogen balance. May not be feasible in severe hypercatabolic patients for several weeks.

D. Calculate macronutrient and fluid requirements:

4. Fluid requirements:
   a. By weight: 25 - 35 ml/kg depending on age, sex, activity
   b. By calorie intake: 1 ml/kcal
   c. Limit in CHF, edema, oliguria, hypernatremia, S1NDH
   d. Increase if abnormal gastrointestinal, skin or renal fluid losses
   e. Consider all sources, intravenous, enteral and oral

5. Caloric requirements:
   a. Per kg: 25 - 35 kcal/kg BMI
   b. Harris-Benedict prediction equation × injury factor

Figure 4

<table>
<thead>
<tr>
<th>Injury factors</th>
<th>BEE X 1.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor surgery w/o complications</td>
<td>BEE X 1.1</td>
</tr>
<tr>
<td>Infusion, major surgery w/o comp</td>
<td>BEE X 1.2</td>
</tr>
<tr>
<td>Trauma</td>
<td>BEE X 1.3</td>
</tr>
<tr>
<td>&gt; 20% TBSA burn, multiple flx</td>
<td>BEE X 1.5</td>
</tr>
<tr>
<td>Inotropes, PEFOP, ARDS, CHF</td>
<td>BEE X 1.6 - 1.8</td>
</tr>
<tr>
<td>Burns &gt; 20% TBSA</td>
<td>BEE X 1.8 - 2.0</td>
</tr>
</tbody>
</table>

6. RTIZ and RCZ by metabolic rate analysis

Not reliable if VO2 > 50%, PEEP > 10, variable Vd/VO2/CO2/RCZ. Not useful if standard deviation of BEE < 15%

7. Protein requirements:
   a. Per kg: 1.2 - 2.5 gmas/kg in critical illness/injury or for repletion
   b. As percent of total kcal: 15 - 25%
   c. As calories/protein ratio: 100 - 150:1

8. In renal failure:
   a. No metabolic stress, no dialysis
   b. Metabolic stress, no dialysis
   c. Renalalysis
   d. Peritoneal dialysis
   e. Centrallalysis

9. C/VH/C/CAH

   a. Protein contains 4 calories/gram

Figure 5

5. Carbohydrate requirements:
   a. To provide remaining non-protein kcal
   b. Diet: 3.4 kcal/g
   c. Sucrose: 4 kcal/g

V. Protocol, enterally-fed patients 7,13

NOTE: Bowel sounds are an unreliable indicator of small bowel function. Patients with altered GI function may be fed with elemental solutions via the small bowel in most instances. Continuous small bowel feedings are associated with a lower incidence of feeding-induced GI dysfunction and a higher incidence of achieving and maintaining feeding goals in the ICU setting than with gastric or bolus feedings.14
VI. Protocol for parenterally fed patients, central access

If patient meets all 4 criteria, start peripheral nutrition to provide > 75% calorie/protein needs
If patient does not meet all 4 criteria, start support via central line or reconsider enteral feedings

VII. Protocol for parenterally fed patients, peripheral access

If patient meets all 4 criteria, start peripheral nutrition to provide > 75% calorie/protein needs
If patient does not meet all 4 criteria, start support via central line or reconsider enteral feedings

VIII. Monitor the patient and adjust nutrition support as indicated

If patient meets all 4 criteria, start peripheral nutrition to provide > 75% calorie/protein needs
If patient does not meet all 4 criteria, start support via central line or reconsider enteral feedings
IX. Parenteral Electrolyte Requirements

Figure 11

Potassium and sodium are available as phosphorus or chloride, or as acetate, a bicarbonate precursor. Calcium is available as gluconate or chloride. Magnesium is available as sulfate.

X. Parenteral Electrolyte and Vitamin Requirements in Acute or Chronic Renal Failure19

Figure 13

References
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