Nutrition Intervention for Spinal Cord Injury in Critical Care

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Spinal cord injury (SCI)

is an insult to the spinal cord resulting in a change, either temporary or permanent, in the cord’s normal motor, sensory, or autonomic function.

classified into: tetraplegia or paraplegia
INCIDENCE

(SCI) affects 11.5–57.8 people for every million members of the global population.

Damage at the cervical level (CSCI), accounts for 41.6–76.0% of all SCI occurrences.¹
METABOLIC CHANGES AFTER ACUTE SCI

As all type of trauma the initial changes in metabolism start by elevated circulating levels of glucagon, cortisol, catecholamine and cytokines (stress hormones).

*But in the acute phase post-injury patients with SCI undergo metabolic changes, including reduced basal energy expenditure due to paralysis, coupled with increased nitrogen excretion.* (Laven et al., 1989)
Reduced basal energy expenditure:

muscle atrophy and the subsequent reduction in fat-free lean body mass *leads to* reductions in basal metabolic rate.

In the first 4 weeks following SCI, weight loss occurs, “estimated at 10-20% of body weight, and about 85% of this is lean mass loss”. 

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• Hypermetabolic response in case of acute traumatic brain injury ((REE) of approximately 140% of predicted normal basal energy expenditure) appears to be *blunted* in SCI patients (reductions in resting energy expenditure by 20% to 30%).

Kearns et al. reported that in 10 patients, the mean REE after acute injury was only 67% of BEE predicted by Harris-Benedict formula. REE was raised by 5% with the return of muscle tone.
Negative nitrogen balance:

- During the acute stage, negative nitrogen balance as measured by urinary nitrogen can be increased up to 27% (0.18 to 0.23 g/kg/day).⁶
- The nitrogen losses are always present and last at least 7 weeks.
- In cases of acute injury, despite the provision of sufficient quantities of calories and protein usually occurs a (-NB), which peaks during the third week after injury.
In study on twelve patients with acute SCI, no SCI patient established positive NB during the 7-week period following injury despite an average delivery of 2.4 g of protein/kg IBW and 120% of the PEE. (Rodriguez et al, 1997).
MALNUTRITION

• Upon admission to hospital, about 15–70% patients are under or malnourished.
• it has been reported that up to 70% malnutrition remains undiagnosed.\textsuperscript{8}
Clinical observations revealed that 44.3% of patients with CSCI were at risk for malnutrition or were already malnourished at the time of admission.

The risk higher with acute high cervical SCI than those with lower SCI (60.7 v. 34.5%), and more common with additional complications including ventilator support (with tracheotomy 56.3 v. 38.7%). (Wong et al, 2012)
Malnutrition can lead to:

muscle loss, atrophy of the lining of the intestine, immunochemical reduction, poor wound healing and fluid overload, hyperglycemia, high levels of urea nitrogen in blood, high triglycerides, elevated liver enzymes, and difficulty weaning from the ventilator. ¹⁰
Increase LOS median (days): 129 vs 85, greater 12-month mortality (% deceased: 9.2% vs 1.4%). (S Wong 2014) 11

Declining dynamic nutritional status indicated by low serum protein levels in the 2 weeks following initial treatment for CSIC was linked to early mortality in CSIC patients. 12

In Jiang Shao study, nearly 80% of patients in the early mortality group were nutritionally malnourished compared to 27% of the patients surviving >30 days.
Biochemical indicators for nutritional status:

*Albumin:*

- long half-life of 21 days.
- cannot be effectively used for monitoring the acute response to nutritional therapy.
- should be included in the initial profile for food control and monitoring purposes during hospitalization for measuring trends of visceral protein or as an indicator of chronic nutritional status.
Transferrin:

- lower half-life (8 - 9 days), better indicator of nutritional status.
- Normal level (200 - 400 mg/dl).
- 150 mg/dl are considered nutritionally decision point or a point where nutritional support should be revised or adjusted.

Transferrin can be easily calculated from TIBC, using the following formula:

\[ \text{TIBC} \times 0.8 - 43 = \text{transferrin}. \]
**Pre-albumin:**

- very short half-life (2 days).
- Normal level (16 - 35 mg/dl).
- A value of dietary intervention is 11 mg/dl because a value below this level means malnutrition.
- Fail to increase pre-albumin above 11 mg/dl with dietary therapy nutritional needs are not met.
- With appropriate intervention, pre albumin should increase about 1 mg/dl per day or twice a week.
NUTRITIONAL ASSESSMENT

Role of the Registered Dietitian:

RD should be an active participant of the interdisciplinary team. Results in improved nutrition-related patient outcomes, such as:

- adequate nutrient intake and management of serum lipids, weight, dysphagia, bowel function and pressure ulcers.

(Recommendation Rating: *Fair, Imperative*) (ADA 2009).
Nutrition Assessment in the Acute Care Setting

- within the first 48 hours post-injury.

The nutrition assessment should include but is not limited to:
- Food- and nutrition-related history.
- Anthropometrics.
- Biochemical and medical tests and procedures.
- Nutrition-focused physical findings: Digestive system
- Comparative standards: Energy needs, protein needs, ideal body weight, fluid needs.

Estimation of Ideal Body Weight

- adjust the Metropolitan Life Insurance tables for individuals of equivalent height and weight.

**Quadriplegia**, reduction of 10% to 15% lower than table weight;

**Paraplegia**, reduction of 5% to 10% lower than table weight.

ENERGY REQUIREMENT

• Indirect calorimetry is more accurate than estimation of energy needs in critically ill patients. (Recommendation Rating: Strong, Conditional). (ADA 2009).

• Basic energy expenditure (BEE) by “(HBE) x (activity factor) 1.2 x (injury factor) 1.6” is considered as the standard criterion for many years it may overestimate energy needs. (Rodriguez et al, 1997).
• No research was available to compare Harris-Benedict with other predictive equations in this population.

• Until now there is no predictive equation has been established for this patient population.

• Barco and colleagues incorporated an activity factor of 1.1 and a stress factor of 1.2, and found a strong correlation between measured and predicted energy expenditures (Barco et al., 2002).
• if indirect calorimetry is not available, the RD may consider estimating energy needs with the HBE, using admission weight, an injury factor of 1.2 and an activity factor of 1.1. (Recommendation Rating: Weak, Conditional). (ADA 2009).\textsuperscript{14}

• Overfeeding carries its own risks, including hypercapnia, hyperglycemia, uremia, and hypertriglyceridemia (Todd et al., 2008), and should be avoided.
PROTEIN REQUIREMENT

The RD should calculate protein needs at 2.0g / kg of IBW / day to lessen the obligatory negative nitrogen balance that occurs during the acute phase.


Protein intake of patients with renal and hepatic dysfunction should be individualized based on the patient’s overall condition.
NUTRITIONAL SUPPORT

• Should be started early, once hemodynamic stability is obtained and it is recommended as soon as feasible.\(^5\)

• Historically enteral feeding has been delayed in SCI patients secondary to concerns about ileus and other complications. Studies have found that feeding these patients within the first 72 h is safe (Dvorak et al., 2004; Rowan et al., 2004), but has not been shown to affect neurological outcome, the length of stay, or the incidence of complications in patients with acute SCI. \(^{17-18}\)
If oral feeding is not possible, Enteral feeding is the optimal route for administration of nutritional requirements following SCI. NG, followed by NJ, followed by PEG.

The potential benefits of EN over PN: maintenance of gut integrity and function, lower risk of infection and avoidance of intravenous catheter-related complications.¹⁹
If enteral feeds do not meet the metabolic demands due to bowel injury, mechanical bowel obstruction, or prolonged ileus, within 5 days of injury, TPN should be started until the bowel recovers and conversion to enteral nutrition can be accomplished.

(Recommendation strong, data weak. 2013 Congress of Neurological Surgeons). 5
PRESSURE ULCER

• Because of immobility, all persons with spinal cord injury should be considered at increased risk of developing pressure ulcers.

• *(SCIPUS)* is pressure ulcer risk assessment tool that may help to identify nutritional problems.
<table>
<thead>
<tr>
<th>RISK FACTOR</th>
<th>CODED VALUE</th>
<th>SCORE</th>
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<tbody>
<tr>
<td>1. LEVEL OF ACTIVITY</td>
<td>0: ambulatory, 1: wheelchair, 4: bed</td>
<td></td>
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<tr>
<td>2. MOBILITY</td>
<td>0: full, 1: limited, 3: immobile</td>
<td></td>
</tr>
<tr>
<td>3. COMPLETE SCI</td>
<td>0: no, 1: yes</td>
<td></td>
</tr>
<tr>
<td>4. URINE INCONTINENCE OR CONSTANTLY MOIST</td>
<td>0: no, 1: yes</td>
<td></td>
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<tr>
<td>5. AUTONOMIC DYSREFLEXIA OR SEVERE SPASTICITY</td>
<td>0: no, 1: yes</td>
<td></td>
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<tr>
<td>6. AGE (years)</td>
<td>0: ≤34, 1: 35-64, 2: ≥65</td>
<td></td>
</tr>
<tr>
<td>7. TOBACCO USE/SMOKING</td>
<td>0: never, 1: former, 3: current</td>
<td></td>
</tr>
<tr>
<td>8. PULMONARY DISEASE</td>
<td>0: no, 2: yes</td>
<td></td>
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<tr>
<td>9. CARDIAC DISEASE OR ABN. EKG</td>
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<tr>
<td>10. DIABETES OR Glucose ≥110 mg/dl</td>
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<td></td>
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<td>11. RENAL DISEASE</td>
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<tr>
<td>12. IMPAIRED COGNITIVE FUNCTION</td>
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<tr>
<td>13. IN A NURSING HOME OR HOSPITAL</td>
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<td>14. ALBUMIN &lt;3.4 OR T.PROTEIN &lt;6.4</td>
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<tr>
<td>15. HEMATOCRIT &lt;36.0% (HGB &lt;12.0)</td>
<td>0: no, 1: yes</td>
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</tbody>
</table>

TOTAL SCORE (0-25)

RISK: LOW 0-2, MODERATE 3-5, HIGH 6-8, VERY HIGH 9-25
Potential nutritional risk factors:

- Patients with albumin levels below 3.5 gm/dl were nearly five times as likely to develop a pressure ulcer.²⁰
- < 36% hematocrit and <12 gm/dl the hemoglobin. ²¹
- Negative nitrogen balance
- Low body mass index/thinness
- Inadequate fluid intake/dehydration
- Poor nutritional intake
- Obesity
- Inadequate serum ascorbic acid
- Inadequate serum zinc
- Triceps skinfold thickness below normal
- Inadequate protein intake
- Vitamin deficiencies in general.²⁰
Assessment for persons with spinal cord injury with pressure ulcers:

Energy Needs:

- indirect calorimetry (IC).
- If not available:
  - 30kcal to 40kcal per kg of body weight per day
  - Harris-Benedict times stress factor (1.2 for stage II ulcer, 1.5 for stage III and IV ulcers).

(Recommendation Rating: *Consensus, Conditional*). (ADA 2009).
Protein Needs:

- 1.2g to 1.5g of protein per kg body weight per day (Stage II pressure ulcers)
- 1.5g to 2.0g of protein per kg body weight per day (Stage III and IV pressure ulcers). (Recommendation Rating: Consensus, Conditional). (ADA 2009).

- ABW should be used in calculation.
- The patient should be closely monitored for signs and symptoms of overfeeding or underfeeding.
Fluid Needs:

- Assess hydration status to determine fluid needs. (input and output, urine color, skin integrity, BUN and serum sodium).
  A BUN/creatinine ratio greater than 20:1 mg/dl is a red flag for dehydration “inaccurate with renal impairment”

- Normal requirement: 30ml to 40ml per kg
- Minimum of 1.0ml per kcal per day
- 10ml to 15ml per kg additional fluids may be required in Fluid loss.

Micronutrients needs:
“The dietitian should re-evaluate the need for micronutrient supplementation every seven to 10 days”.

Vitamin C:
• The Agency for Health Care Research and Quality recommends 100mg to 200mg per day for Stage I and II and 1,000mg to 2,000mg per day for Stage III and IV.
• “Use caution with renal failure due to the possibility of renal oxalate stone formation”.
Zinc:
• (50mg elemental Zinc) twice per day is recommended.
• High-dose supplementation can adversely affect copper status, immune response and lipid profiles.
• Some authors have suggested that high-dose supplementation should be limited to two to three weeks to minimize the risk.

Vitamin A:
• Documented recommendations for amount of Vitamin A for enhanced wound healing in injured patients is 10,000 IU to 50,000 IU per day.
• Should be implemented cautiously because of potential toxicity.\textsuperscript{14} (for a limit of 10 days)
NEUROGENIC BOWEL

*Neurogenic bowel is*

a condition that causes loss of bowel function after (SCI).

**Fiber:**
It recommended initial fiber intake of 15g per day, with gradual increases up to 30g per day of fiber, as tolerated (Recommendation Rating: *Weak, Conditional*). (ADA 2009).

**Fluid:**
- Adequate fluid intake is also important for bowel movement with a recommendation of One ml fluid per kcal estimated energy (a minimum of 1.5L). (Recommendation Rating: *Consensus, Conditional*). (ADA 2009).
CONCLUSION

• Nutrition in acute spinal cord injury is complicated.

• The stress response to injury, fever, infection, sepsis, and surgery alter nutritional needs, as does the spinal cord injury itself.

• The assessment of nutritional requirements includes not only calculations but also the opinion of an expert clinician in order to assess the clinical data before applying the equations that provide the energy and protein requirements.
• Obligatory nitrogen losses due to paralysis in the spinal cord-injured (SCI) patient prevent positive nitrogen balance (NB) regardless of the calorie and protein intakes.

• Aggressive attempts to achieve positive NB in these patients will fail and result in overfeeding.
THANK YOU
References:


