Nutrition in head trauma patients

Folke Hammarqvist
Nutrition in head trauma patients

Educational symposia

ESPEN 2011 09 04

To feed or not to feed? – that is the question

How to feed and not to feed? – that’s another question
Participants

• Pierre Singer - Intensivist
• Torsten Mossberg - Anesthetist/Intensivist
• Mette Berger - Intensivist
• Luc Cynober - Clinical Chemist
• Karolina Krakau - Nurse / rehabilitation
• Ingrid Poulsen - Nurse / rehabilitation
• Folke Hammarqvist - Emergency and trauma surgeon

And YOU!!!!
Introduction

• TBI has special needs: 50% of the patients do not tolerate enteral feeding (elevated ICP is associated with low gastric contractibility)
• Metabolite variations with increased energy expenditure, catabolism and glucose intolerance
• Besides adequate O2, CPP, is nutrition playing a role?
• When to start, how much, which route, special nutrients?
Nutritional disturbances are not usually considered very important in the postoperative care of patients with head trauma.

In the sixties it was suggested that no efforts is needed to correct the imbalances of fluid, electrolytes and amino acids. Wise 1965 och 1972 among others.
Head trauma
historical aspects:
the sixties a case at the ICU, S:t Görans hospital, Stockholm

• 30 year old man, head trauma, fractures, surgical intervention. Treated in ventilator, antibiotic treatment.

• The “nutrition” was two or three liters of glucose 50 mg/ml. He didn’t tolerate any enteral nutrition

• The patient developed a severe catabolism with depletion of the protein stores. He lost around 20% of his body weight. His heart rate began to fall after two weeks.
Head trauma historical aspects: the sixties

Arvid Wretlind

• “You must understand”, Arvid said, “this traumatic brain injury can increase the metabolism as much as other traumas and that you have to give him a complete intravenous nutrition”.

• That was the time of hyper alimentation in the US. Arvid calculated that the patient needed around 2500 kcal per day. We gave the patient a complete intravenous nutrition with Intralipid, Glucose 200mg/ml and Aminosol

• The patient recovered- a miracle
Head trauma historical aspects: The seventies

- If any nutrition at all, still hyper alimentation with hyper-glycemia-problems
- Poor knowledge of the impact of different ventilation methods
- Poor monitoring of the patient
Head trauma historical aspects: The eighties

- Head injury leads to increased energy expenditure (Clifton, Robertson and Grossman in J neurosurgery 1984 a.o)

- In textbooks on intensive care at that time one could still read that you had to wait for up to ten days until you began feeding the (head-) trauma patients.
Head trauma historical aspects:
The nineties

”Most investigators agree that aggressive nutritional support, starting within 48 hours of admission to the ICU, maximizes survival”

(Critical Care Practice, The American Society of Critical Care Anesthesiologists, 1992)

The neurosurgical intensive care has achieved major advancements since then including advanced monitoring of ICP, oxygen tension, glucose etc etc.
Head injury

• Very common in trauma patients
  – Isolated
  – Multiple injuries

• Young patients

• Determines outcome in trauma
  – Potential to rehabilitation
  – Functional status
  – Level of independency
Clinical classification
Glasgow Coma Scale (GCS)
A summary of verbal, motor and eye-response (3 – 15)

GCS 3-8: Severe TBI
GCS 9-12: Moderate TBI
GCS 13-15 Light TBI
ATLS
Advanced trauma and life support

• Priorities
  – A  Airways
  – B  Breathing
  – C  Circulation
  – D  Disability
  – E  Environment

• Primary survey
• Secondary survey
Trauma CT – B Leidner
Intracranial traumatic lesions
Simultaneous actions are important. Nutritional is one of the instruments.
Brain injury

- Primary – mechanical forces
  - Immediately at injury

- Secondary – insults (all with some link to metabolism and potential metabolic treatment)
  - Hypoxia
  - Hypotension
  - Hyper – hypocarbia
  - Fever
  - Hyper-hypoglycemia
  - Hyponatremia
  - Intracranial hypertension
  - Oedema
  - Vascular Spasm
  - Epilepsia
Biochemical / metabolic processes - Clear association with metabolism and nutrition

- Ischemia – reperfusion
  - ROS
- Excitatory amino acids
- Apoptosis
- Mitochondrial dysfunction
- Coagulation disturbances
- Neuroinflammation

- Whole body neuroendocrine stress response
Stress response in head trauma

• Metabolic changes in isolated severe head injuries
  – The same pattern as in non-head trauma
    • Increases in “stress hormone”
    • Cytokine response
    • Increased energy expenditure
    • Hyperglycemia, hyperinsulinemia, increased FFA
    • Apart from changes in lactate

• Damage in hypothalamic region common in severe head trauma
  – Important in metabolic control
Nutritional problems

- Metabolic stress
- GI-problems
- Increased muscular activity
- Increased energy consumption
- Loss of lean body mass
- Confusion
Energy Balance out of Balance after Severe Traumatic Brain Injury

Karolina Krakau
Metabolism after moderate to severe TBI

- Hypermetabolism
- Catabolism
- Gastrointestinal dysfunction
- Early feeding may be associated with a trend towards better outcomes

Nutritional route after severe TBI
Nutritional treatment after severe TBI

- Malnutrition in 68% of the patients
- Weight loss 10-29%
- During the first and second month

Energy intake related to basal metabolic rate (BMR) during the first two months post injury
Nutritional routines

- Good resources of qualified staff
- Presence of nutritional guidelines, 47%
- Deficient routines for assessment
- Incomplete energy intake surveillance
- Lost nutritional information

Measurements of total energy expenditure

Continuous indirect calorimetry

Doubly labelled water
Energy balance after severe TBI

During mechanical ventilation period by indirect calorimetry

Energy balance

During the 3rd and 5th week post injury by doubly labelled water

Negative energy balance
Possible influencing factors

- Infections / catabolism
- Nutritional problems
- Increased level of activity
- Assessment of energy need
At time of injury

After 40 days

Soft tissue = HU -29 to 151
Keep the patient in balance!
Case

• 27 year young man - 75 kg bw

• Pedestrian involved in a traffic accident, hit by a car.

• Prehospital resuscitation according to pre-ATLS, GCS (Glasgow Coma Scale) 3 – ”very bad” not reacting at all.
CT- scan

Complex and severe intracranial injuries

Epidural, subdural, intracerebral and traumatic subarachnoidal bleeding, diffuse axonal injury and skull fracture.

Operation
1 hour postinjury – initial resuscitation

- Are there any nutritional aspects at all at this time?
- Are there any metabolic aspects of importance at this time?
- Therapeutical strategies of highest priority at this time to affect outcome?
1 hour postinjury – initial resuscitation

• Are there any nutritional aspects at all at this time? No

• Are there any metabolic aspects of importance at this time? Treat hyponatremia

• Therapeutical strategies of highest priority at this time to affect outcome? Prevent secondary brain damage
Pressure - Perfusion

ICP
Intracranial pressure

Critical level
Cerebral perfusion

Therapeutical action
Compensatory mechanisms

Intracranial volume
Increased in oedema, bleeding, reperfusion
2 h - Acute craniotomy

• Control of bleeding sources
• Lowering the intracerebral pressure
• Ventricular drainage – measurement of intracranial pressure and perfusion

• Is there at this time any role for metabolic treatment or considerations?
2 h - Acute craniotomy

- Control of bleeding sources
- Lowering the intracerebral pressure
- Ventricular drainage – measurement of intracranial pressure and perfusion

- Is there at this time any role for metabolic treatment or considerations? Treat hyperglycemia, hyponatremia, put an enteral feeding tube in place
Continued

Neuro – ICU treatment day 0 - 30

• Treated in ventilator
• Sedated
• Meningitis, increased intracerebral pressure
  – Reoperated with bilateral craniectomy to relieve the increased pressure. Day 6 and 7
• Antibiotic treatment
  – Due to meningitis and pneumonia
  – Causing mucositis and diarrhea
How to assess energy need in head trauma patients

• Assessment of need
  – Indirect calorimetry
  – Equations
    • Harris Benedict
    • Swinamer, the Ireton-Jones 1992
    • more validation studies are needed.
Indirect calorimetry
Difference between Harris Benedict and Indirect Calorimetry

"Hypermetabolism"
Do you take the energy included in Propophol solutions into account?
Impact of computerised information system (CIS) on quality of nutritional support

Energy delivery > 30 kcal/kg

Percentage of days

Before
After CIS
Non nutritional energy

< 30% BSA
> 30% BSA

CIS enables close daily follow-up

P<0.05

EBA07-Berger
Lipids from 2% propofol sedation – M 23 yrs, brain injury

Cumulated daily fat intakes (g)

Cumulated daily propofol doses (2%)

Propofol 2% → 20-30 g iv fat
Propofol (Total/24h)
How do you introduce EN?

Immediately full amount

Step wise
Effects on GI function in TBI

- Corticotropin releasing factor
- Suppressed vagal nerve activity
- Reduced lower esophageal sphincter tonus
- Fasting motor pattern during feeding
Gastrointestinal complications in head trauma patients

- Paralysis
- Obstipation
- Increased gastric residuals
- Reflux/vomiting
- Diarrhea
- Stress induced ulcers
- Complications of antibiotic treatment
- Other complications related to multiple trauma and abdominal injuries
Enteral route in TBI

• Early intolerance due to impairment of GI function in TBI

• Continuous feeding
  – Attention to residual volume
  – Slow continuous increase in volumes given
  – Postpyloric, jejunal feeding

• Nasogastric

• Nasojejunal

• PEG
Pyloric dysfunction
With intracranial hypertension
Male 62 yrs, 72 kg: Multiple injury with severe brain injury; left rib #1-11 // left clavicule // l'omoplate gauche // manubrium sternal // Ethylisation aiguë (3.8 g/l)
Male 62 yrs, 72 kg: Multiple injury with severe brain injury; left rib #1-11 // left clavicule // l'omoplate gauche // manubrium sternal // Ethylisation aiguë (3.8 g/l)
104 patients randomized to TPF or GF groups

Target 25 kcal kg\(^{-1}\) day\(^{-1}\) of calculated energy requirements and a nitrogen intake of 0.2 g N kg\(^{-1}\) day\(^{-1}\).

TPF group → lower incidence of pneumonia, OR 0.3 (95% CI 0.1-0.7, P = 0.01).

The TPF group received higher amounts of diet compared to the GF group (92 vs. 84%, P < 0.01) and lesser incidence of high gastric residuals, OR 0.2 (95% CI 0.04-0.6, P = 0.003).
Gastric versus transpyloric feeding in severe traumatic brain injury: a PRT
Acosta-Escribano J, ICM, 2010;36;1532

### Table 2 Infectious complications at 30 days

<table>
<thead>
<tr>
<th></th>
<th>TPF</th>
<th>GF</th>
<th>Total</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>50</td>
<td>54</td>
<td>104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total pneumonia</td>
<td>16 (34%)</td>
<td>31 (55%)</td>
<td>47 (45%)</td>
<td>0.3 (0.1–0.7)</td>
<td>0.01</td>
</tr>
<tr>
<td>Early pneumonia</td>
<td>5 (10%)</td>
<td>4 (7%)</td>
<td>9 (9%)</td>
<td>1.3 (0.3–5.4)</td>
<td>0.45</td>
</tr>
<tr>
<td>Late pneumonia</td>
<td>11 (24%)</td>
<td>27 (48%)</td>
<td>38 (36%)</td>
<td>0.2 (0.1–0.6)</td>
<td>0.02</td>
</tr>
<tr>
<td>Other infections</td>
<td>13 (26%)</td>
<td>7 (13%)</td>
<td>20 (19%)</td>
<td>2.3 (0.9–6.5)</td>
<td>0.07</td>
</tr>
<tr>
<td>Primary bacteremia</td>
<td>6 (12%)</td>
<td>2 (4%)</td>
<td>8 (8%)</td>
<td>3.5 (0.6–18)</td>
<td>0.11</td>
</tr>
<tr>
<td>Catheter-related sepsis</td>
<td>2 (4%)</td>
<td>2 (4%)</td>
<td>4 (4%)</td>
<td>1 (0.1–8)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

### Table 4 Incidence of gastrointestinal complications

<table>
<thead>
<tr>
<th></th>
<th>TPF</th>
<th>GF</th>
<th>Total</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>50</td>
<td>54</td>
<td>104</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEV (%)</td>
<td>92 ± 7</td>
<td>84 ± 15</td>
<td>88 ± 12</td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>EN withdrawal</td>
<td>3 (6%)</td>
<td>10 (18%)</td>
<td>13 (12%)</td>
<td></td>
<td>0.06</td>
</tr>
<tr>
<td>Increased gastric residuals</td>
<td>3 (6%)</td>
<td>15 (28%)</td>
<td>17 (17%)</td>
<td>0.3 (0.1–1.1)</td>
<td>0.003</td>
</tr>
<tr>
<td>Aspiration</td>
<td>0</td>
<td>2 (4%)</td>
<td>2 (2%)</td>
<td>1.8 (0.2–21)</td>
<td>0.5</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>4 (8%)</td>
<td>8 (15%)</td>
<td>12 (11%)</td>
<td>0.5 (0.1–1.7)</td>
<td>0.2</td>
</tr>
<tr>
<td>Distention</td>
<td>0</td>
<td>2 (4%)</td>
<td>2 (2%)</td>
<td>1.8 (0.2–21)</td>
<td>0.5</td>
</tr>
<tr>
<td>Total complications</td>
<td>7 (14%)</td>
<td>27 (47%)</td>
<td>34 (33%)</td>
<td>0.3 (0.06–0.4)</td>
<td>0.001</td>
</tr>
</tbody>
</table>
PEG

• **Indications - Consider PEG**
  – Glasgow coma scale (GCS) 3-9
  – Rancho Los Amigos Scale (RLAS) 1-2
  – Or when there are swallowing disturbances

• **Contraindications?**
  – Technical

• **Early?**

• **Procedure**
Continued
At the neurosurgical ward after 30 days

• Weaned from sedation
• Increased motor tonus, restlessness
• Confusion
  – Tubes and catheters were pulled out by the patient
Continued
Day 30 - 45

• Mobilisation
• Oral intake

• Problems along the way
  – Apraxia
  – Neurological deficit
  – Impaired coordination
### Data "along the way"

<table>
<thead>
<tr>
<th>Day</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>60</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>75</td>
<td>78</td>
<td>76</td>
<td>74</td>
<td>72</td>
<td>66</td>
<td>65</td>
<td>61</td>
<td>63</td>
</tr>
<tr>
<td>EE (kcal)</td>
<td>1850</td>
<td>1900</td>
<td>2200</td>
<td>2300</td>
<td>2100</td>
<td>2000</td>
<td>1800</td>
<td>1600</td>
<td>1700</td>
</tr>
<tr>
<td>E-intake</td>
<td>660</td>
<td>2400</td>
<td>1795</td>
<td>2300</td>
<td>2390</td>
<td>1750</td>
<td>1570</td>
<td>990</td>
<td>1800</td>
</tr>
<tr>
<td>Route</td>
<td>EN/PN</td>
<td>EN/PN</td>
<td>EN/PN</td>
<td>EN/PN</td>
<td>EN/PN</td>
<td>OR</td>
<td>OR</td>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
<td>Bowel</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+++</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Sedation</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++++</td>
<td>++++</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>GCS</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>CRP</td>
<td>196</td>
<td>92</td>
<td>215</td>
<td>120</td>
<td>90</td>
<td>15</td>
<td>29</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Ward</td>
<td>ICU</td>
<td>ICU</td>
<td>ICU</td>
<td>ICU</td>
<td>ICU</td>
<td>Ward</td>
<td>Ward</td>
<td>Ward</td>
<td>Rehab</td>
</tr>
</tbody>
</table>
From 75 kg to 62 kg
Energy intake

- **Enteral Nutrition** Day 1-31
- **Parenteral Nutrition** Day 1-39
- **Oral Intake** Day 31-82
Nutrition along the way

• Nutritional need?
• To cover the nutritional need?
• Route of nutrition?
• Specific
  – composition
  – nutrients
• Pharmaconutrients?
• Importance of normoglycemia – at which level?
Rehabilitation
Rehabilitation

• The aim:
  – To ensure the nutritional status - to support the rehabilitation process
  – To avoid pneumonia

• Sub-acute rehabilitation
  – Specialized neurorehabilitation in hospital (approx 14 days after TBI)

• Long-term rehabilitation
  – Rehabilitation in primary care included specialized neurorehabilitation (after 3 months in sub-acute rehabilitation)
Sub-acute rehabilitation

- Nutritional Screening (NRS, 2002)
- NGT or PEG
- Screening for dysphagia:
  - Screening by water-test
  - Clinical examination e.g. Facial Oral Tract Therapy (F.O.T.T.®)
  - Fiberoptic endoscopy evaluation of swallowing (FEES)
Developed by Kay Coombes and based on Bobath concept. A holistic structured assessment and treatment tool.

- F.O.T.T covers four areas:
  - Swallowing
  - Oral hygiene
  - Breathing and voice/speech production
  - Non-verbal communication

(Schow & Jakobsen, Disability and rehabilitation, 2010;32 (17):1447-1460)
Long-term rehabilitation

- Getting back to "normal"
  - Undereating
  - Overeating

- Food consistency
Ethical dilemmas

New Judge Holds Off Decision On Schiavo

Terri Schiavo's condition prompted emergency legislation by Congress.

Sherry Manning, center, is aided by Ann Jowers and David Vegel at a demonstration for Terri Schiavo on Monday outside the U.S. Courthouse.
Clinical characteristics for coma, vegetative state and minimal conscious state

<table>
<thead>
<tr>
<th>Coma</th>
<th>Vegetative State</th>
<th>Minimal Conscious State</th>
</tr>
</thead>
<tbody>
<tr>
<td>No eye opening either spontaneously or on stimulation</td>
<td>Sleep-aware cycle, arousal often sluggish, barely sustainable but may be normal</td>
<td>Eyes open spontaneously; sleep-aware cycle, arousal levels from dull to normal</td>
</tr>
<tr>
<td>No sure perception, communication skills or specific motor activity (to follow command)</td>
<td>No sure perception, communication skills or specific motor activity (to follow command)</td>
<td>Reproducible but incoherent perception, communication skills or meaningful motor activity, visual &quot;tracking&quot; is often intact</td>
</tr>
</tbody>
</table>
Vegetative state TBI

- Persistent vegetative state >1 Month
- Permanent vegetative state >1 Year
  - Prognosis for PVS is poor
  - It is unlikely but not impossible that the patient wakes

(Giacino & Kalmar, Neuropsychological Rehabilitation, 2005)
The patient in vegetative state

• Letting die or assisting death?
• The patient is unable to request this course, unless he/she had already made some advance directive
• The patient is not suffering, nor he is terminally ill – the two reasons usually given for withdrawing or withholding treatment

(Jennet, Current Anaesthesia and Critical care, 1999)
Potential outcomes continuing nutritional support

- The person may emerge from the vegetative state
- The person may not emerge
- If the person does emerge, he/she may be left with significant disabilities
- If the person does not emerge, he/she can relate to no-one
- If the person does not emerge, other relationships within the family group may be threatened by the emotional or financial strain of the situation

(Malec, Brain Injury, 1996)
The potential outcomes and risks of discontinuing nutritional support may include

- The person will die
- Guilt in reaction to the person’s death will threaten relationships among significant others
Challenges
Challenges

• The importance of diagnostics
• Proffesionality among staff
• Communication with families
• Treat the patient as if he/she was conscious
• Families may change their perception of quality of life for the person in the vegetative stage prior to injury to after injury

(Fins, Disorders of consciousness, 2009; 1157:131-147)
Concluding remarks

• Early
  – Metabolic and nutritional considerations

• Later
  – A prerequisite for rehabilitation
Concluding remarks

• Nutritional treatment important
• Measure if possible the patients need
• Early enteral nutrition
  – But intolerance common
  – Partial PN
• Consider PEG in selected cases
• An important multidisciplinary teamwork
Lives on his own in an apartment
Is back in collage (adjusted study program)
Enjoys life with his friends and family
Plays the guitar