Nutrition support in the major trauma patient: Open abdomen??

Easy peasy lemon squeezy!!!

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Within the context of a clinical case:

- Consider how the results of recent clinical research might apply to the patient discussed.

- Review benefits of earlier nutrition \((\text{nutrition} = \text{calories} + \text{protein} + \text{lipids})\) in trauma.

- Summary.
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  - multiple rib fractures, rupture of pulmonary artery
  - blunt abdominal trauma, splenic rupture
  - pelvic fracture, massive blood loss
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  - open abdomen, scheduled for review next day
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  - Temp. 39.2 °C
  - Chest-X-ray:
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4. If I chose PN, I would be concerned about increasing infectious complications.
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- Fear of bowel oedema and ileus, with subsequent aspiration pneumonia.
- Fear of inducing small bowel necrosis by stressing an underperfused bowel.
- Fear of increasing bowel distension, making it harder for the surgeon to obtain fascial closure.

Therefore many open abdomen patients receive no nutrition until fascial closure.

Should we fear enteral nutrition?
Observational study reviewing 597 trauma patients from 11 US trauma centres who were managed with *open abdomen*.

- average age 38, 77% male
- 72% blunt trauma, ISS 31
- 14% mortality and 31 day hospital stay

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49% (292/597) had full thickness bowel injuries, with direct repair, anastomosis or colostomy performed

39% (232/597) received EN before first attempt at closure of the abdomen
  - Average time to EN start, 3.6 days after injury

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Considering all patients, receiving EN before first attempt at closure resulted in significant improvements in outcome.

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For patients with a bowel injury, mortality effect (OR=0.79) was half the effect for no bowel injury (OR=0.3, previous slide). Perhaps an issue of sample size, however the authors conclude “EN seems to be neither advantageous nor detrimental for these patients”

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- Compared with delayed feeding, EN started prior to fascial closure was associated with:
  - Reduced rates of pneumonia
  - Higher rates of primary fascia closure
  - Lower rates of fistula
  - Lower total hospital charges

There were no reported adverse events with the use of EN started prior to fascial closure


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Meta-analysis of all methodologically sound RCT’s conducted in:

- adult trauma patients requiring intensive care and;
- comparing standard EN fed within 24hrs to standard care (oral intake upon return of bowel sounds, TPN, or TPN + delayed EN).

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Although this meta-analysis does not focus on patients managed with open abdomen, patients with major abdominal trauma were enrolled in the included clinical trials.

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Table 2
Characteristics of eligible studies.

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</table>
### Should we fear early enteral nutrition?


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<tr>
<th>Study</th>
<th>Patient population</th>
<th>Early EN intervention</th>
<th>Control intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chuntrasakul 1996</td>
<td>Severe trauma (ISS &gt;20 and &lt;40) Mean ISS 29 ± 1.5</td>
<td>Immediately after resuscitation or surgery: 30 mls/h 3/4 strength EN (Traumacal™) via NGT, concentration increased over time. Goals estimated using modified Harris-Benedict equation. TPN was added if goals were not met.</td>
<td>5% dextrose/NSS for maintenance. Oral intake commenced upon return of bowel sounds.</td>
</tr>
<tr>
<td>Kompan 1999</td>
<td>Multiple trauma (ISS &gt; 25) Mean ISS 33.6 ± 10 Mean APACHE II 11.5 ± 5.8</td>
<td>Immediately after resuscitation: EN (Jevity™) started at 20 ml/h via NGT. Increased to 50% of estimated goal on Day 1, 75% of estimated goal on Day 2 and 100% of goal on Day 3. Estimated goal was set at 25–35 nonprotein kcal/kg per day and 0.2–0.3 g nitrogen/kg per day at 72 h post ICU admission. TPN was added to meet estimated requirements.</td>
<td>Same protocol as Early EN except EN begun a median 41.4 (33.9–53.6 range) hours after trauma. Note: 50% of goal received via TPN for first 24 h before EN was begun.</td>
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<tr>
<td>Kompan 2004</td>
<td>Multiple trauma (ISS &gt; 20) Mean APACHE II 11.3 ± 4.8</td>
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Should we fear early enteral nutrition?

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<tr>
<th>Study or sub-category</th>
<th>Early EN (&lt;24 h) n/N</th>
<th>Standard Care n/N</th>
<th>Peto OR 95% CI</th>
<th>Weight %</th>
<th>Peto OR 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kompan 1999</td>
<td>0/17</td>
<td>2/19</td>
<td></td>
<td>29.48</td>
<td>0.14 [0.01, 2.38]</td>
</tr>
<tr>
<td>Kompan 2004</td>
<td>0/27</td>
<td>1/25</td>
<td></td>
<td>15.20</td>
<td>0.12 [0.00, 6.31]</td>
</tr>
<tr>
<td>Chuntrasakul 1996</td>
<td>1/21</td>
<td>3/17</td>
<td></td>
<td>55.32</td>
<td>0.26 [0.03, 2.06]</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>65</td>
<td>61</td>
<td></td>
<td>100.00</td>
<td>0.20 [0.04, 0.91]</td>
</tr>
</tbody>
</table>

Total events: 1 (Early EN (<24 h)), 6 (Standard Care)
Test for heterogeneity: Χ² = 0.18, df = 2 (P = 0.91), I² = 0%
Test for overall effect: Z = 2.09 (P = 0.04)

Mortality reduced by 8.3%, p=0.04

Should we fear early enteral nutrition?

• Early EN also resulted in:
  • Reduced incidence of pneumonia (33% eEN vs 64%, p=0.050)
  • No significant difference in the incidence of MODs, (70% eEN vs 68%, p=0.82) but a trend towards a reduction in the severity of MODS (2.5 vs 3.1 organ failures per patient, p=0.057)

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There were no signs of any harms.

Should we fear feeding across an anastomosis?
A Meta-analysis comparing RCT’s of early feeding (within 24h) versus no feeding in patients undergoing gastrointestinal surgery.

- 13 studies, 1,173 patients

\[\text{Should we fear feeding across an anastomosis?}\]

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Early feeding resulted in a significant decrease in:

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  - Anastomotic dehiscence (2.8% eEN vs 4.3%, p=0.27)
  - Pneumonia (2.3% eEN vs 3.3%, p=0.46)

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“There is no obvious benefit for keeping patients “nil by mouth” after gastrointestinal surgery”

Summary: Should we fear enteral nutrition?
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In the trauma patient with an open abdomen, starting EN prior to abdominal closure may:

- Significantly reduce time to closure
- Significantly reduce mortality
- NOT result in any increase in complications

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In the trauma patient who may be managed with an open abdomen, starting EN within 24 h of injury:

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In the trauma patient with an open abdomen, starting EN prior to abdominal closure may:

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It is very unlikely to blow apart a bowel anastomosis.


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...... but .....
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Should we fear parenteral nutrition?
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Table 4. New Infections During Study

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<th>Patients With New Infections&lt;sup&gt;a&lt;/sup&gt;</th>
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new infections based on cultures obtained in the study ICU.

venous or arterial catheters

CPIS ≥ 6 plus detection (by staining or culture) of a likely pulmonary pathogen in respiratory secretions (expectorated sputum, endotracheal or bronchoscopic aspirate, or quantitatively cultured bronchoscopic BAL fluid or brush catheter specimen), or the presence of a negative lower respiratory tract culture if collected within 72hrs after starting a new antibiotic regimen.

CPIS ≥ 6 (using a Gram stain of a lower respiratory tract sample) plus a definite cause established by the recovery of a probable etiologic agent from a) an uncontaminated specimen (blood, pleural fluid, transtracheal aspirate, or transthoracic aspirate); b) the recovery from respiratory secretions of a likely pathogen that does not colonize the upper airways (e.g., Mycobacterium tuberculosis, Legionella species, influenza virus, or Pneumocystis jiroveci (carinii); c) recovery of a likely/possible respiratory pathogen in cultures of a lower respiratory tract sample (endotracheal aspirate, BAL, or protected specimen brush); or d) positive serology.
a new infections based on cultures obtained in the study ICU.

c venous or arterial catheters

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g Attributable excess case mortality greater than 15%.

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<td>Airway or lung$^d$</td>
<td>123 (18.04)</td>
<td>101 (14.83)</td>
<td>$-3.20 (-8.52$ to $2.08)$</td>
<td>$.12$</td>
</tr>
<tr>
<td>CPIS-probable pneumonia$^g$</td>
<td>96 (14.08)</td>
<td>81 (11.89)</td>
<td>$-2.18 (-7.50$ to $3.11)$</td>
<td>$.26$</td>
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<tr>
<td>CPIS-confirmed pneumonia$^f$</td>
<td>45 (6.60)</td>
<td>43 (6.31)</td>
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<td>$.91$</td>
</tr>
<tr>
<td>Any major infection$^g$</td>
<td>78 (11.4)</td>
<td>74 (10.9)</td>
<td>$-0.57 (-5.89$ to $4.72)$</td>
<td>$.80$</td>
</tr>
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</table>
Eligibility Criteria

Main inclusion criteria:

• Adult patients admitted to ICU for less than 24 h.
• Not expected to receive enteral, parenteral or oral intake ‘today’ or ‘tomorrow’.

www.evidencebased.net/EarlyPN
Who got into the trial:

Main types of patients enrolled:

- 234 (17%) GI perforation (surgical),
Who got into the trial:

Main types of patients enrolled:

- 234 (17%) GI perforation (surgical),
- 140 (10%) GI obstruction (surgical or medical management),
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Major trauma patient with open abdomen who is NOT going to receive EN today or tomorrow would have been eligible for this trial.
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<th>Baseline Characteristics</th>
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<th>Early PN (n = 681)</th>
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<tr>
<td>Age, mean (SD), y</td>
<td>68.6 (14.3)</td>
<td>68.4 (15.1)</td>
</tr>
<tr>
<td>Female gender, No. (%)</td>
<td>262 (38.4)</td>
<td>281 (41.3)</td>
</tr>
<tr>
<td>BMI, mean (SD)(^{a,b})</td>
<td>28.5 (6.9)</td>
<td>27.9 (6.8)</td>
</tr>
<tr>
<td>APACHE II score, mean (SD)(^{c,e})</td>
<td>21.5 (7.8)</td>
<td>20.5 (7.4)</td>
</tr>
<tr>
<td>Mechanically ventilated, No. (%)</td>
<td>549 (80.6)</td>
<td>572 (83.9)</td>
</tr>
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Nutrition therapy process measures

Early parenteral nutrition (681 patients):

- 679/681 patients (99.7%) commenced PN 44 minutes after enrolment
Nutrition therapy process measures

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- 679/681 patients (99.7%) commenced PN 44 minutes after enrolment
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**Nutrition therapy process measures**

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Pragmatic standard care (682 patients):
Nutrition therapy process measures

Early parenteral nutrition (681 patients):
  • 679/681 patients (99.7%) commenced PN 44 minutes after enrolment
    • 405/679 (59.6%) progressed to EN 3.83 days after PN start

Pragmatic standard care (682 patients):
  • 279/682 (40%) standard care patients commenced EN 3.7 days after enrolment
**Table 2. Mortality**

<table>
<thead>
<tr>
<th></th>
<th>Standard Care (n = 680)²</th>
<th>Early PN (n = 678)²</th>
<th>Risk Difference, % (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deaths before study day 60, No. (%)</td>
<td>155 (22.8)</td>
<td>146 (21.5)</td>
<td>-1.26 (-6.6 to 4.1)</td>
<td>.60</td>
</tr>
<tr>
<td>Covariate-adjusted deaths before study day 60²</td>
<td>0.04 (-4.2 to 4.3)</td>
<td>&gt;.99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

² 5 patients (2 Standard Care, 3 Early PN) could not be contacted on study Day 60 to determine vital status. Considered ‘missing at random’ for ITT Primary and Adjusted primary outcome analysis.

² Multivariate model controlled for confounding due to baseline imbalance and strong predictors: Age, gender, BMI, APACHE 2 score, Chronic Liver, Chronic Respiratory and Source of Admission.

5 patients (2 Standard Care, 3 Early PN) could not be contacted on study Day 60 to determine vital status. Considered ‘missing at random’ for ITT Primary and Adjusted primary outcome analysis.

Multivariate model controlled for confounding due to baseline imbalance and strong predictors: Age, gender, BMI, APACHE 2 score, Chronic Liver, Chronic Respiratory and Source of Admission.

Table 4. New Infections During Study

<table>
<thead>
<tr>
<th>Patients With New Infections&lt;sup&gt;a&lt;/sup&gt;</th>
<th>No. (%)</th>
<th>Standard Care (n = 682)</th>
<th>Early PN (n = 681)</th>
<th>Risk Difference (Exact 95% CI)</th>
<th>Exact P Value&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early PN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> new infections based on cultures obtained in the study ICU.
a new infections based on cultures obtained in the study ICU.

c venous or arterial catheters

e CPIS $\geq 6$ plus detection (by staining or culture) of a likely pulmonary pathogen in respiratory secretions (expectorated sputum, endotracheal or bronchoscopic aspirate, or quantitatively cultured bronchoscopic BAL fluid or brush catheter specimen), or the presence of a negative lower respiratory tract culture if collected within 72hrs after starting a new antibiotic regimen.

f CPIS $\geq 6$ (using a Gram stain of a lower respiratory tract sample) plus a definite cause established by the recovery of a probable etiologic agent from a) an uncontaminated specimen (blood, pleural fluid, transtracheal aspirate, or transthoracic aspirate); b) the recovery from respiratory secretions of a likely pathogen that does not colonize the upper airways (e.g., Mycobacterium tuberculosis, Legionella species, influenza virus, or Pneumocystis jiroveci (carinii); c) recovery of a likely/possible respiratory pathogen in cultures of a lower respiratory tract sample (endotracheal aspirate, BAL, or protected specimen brush); or d) positive serology.

g Attributable excess case mortality greater than 15%.
<table>
<thead>
<tr>
<th>Quality of life and physical function, mean (SD)</th>
<th>Standard Care (n = 680)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Early PN (n = 678)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAND-36 general health status&lt;sup&gt;d&lt;/sup&gt;</td>
<td>45.5 (26.8) (n = 516)</td>
<td>49.8 (27.6) (n = 525)</td>
<td>.01</td>
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</tr>
</tbody>
</table>

Minimally Important Difference = \( \frac{1}{2} \) SD = 13.5


Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: The remarkable universality of a half a standard deviation. *Medical Care* 2004;41:582-592.

**Table 3. Concomitant Interventions, Adjusted for Time at Risk (ICU Stay)**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Standard Care (n = 682)</th>
<th>Early PN (n = 681)</th>
<th>P Value&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invasive mechanical ventilation</td>
<td>7.73 (7.55 to 7.92)</td>
<td>7.26 (7.09 to 7.44)</td>
<td>.01</td>
</tr>
<tr>
<td>Treatment</td>
<td>Standard Care (n = 682)</td>
<td>Early PN (n = 681)</td>
<td>P Value&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------</td>
<td>--------------------</td>
</tr>
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<td>7.26 (7.09 to 7.44)</td>
<td>.01</td>
</tr>
<tr>
<td>Pressure ulcer treatment</td>
<td>0.87 (0.74 to 1.02)</td>
<td>0.78 (0.67 to 0.92)</td>
<td>.54</td>
</tr>
<tr>
<td>Low serum albumin ((&lt;2.5 \text{ g/dL}))</td>
<td>5.47 (5.28 to 5.67)</td>
<td>5.76 (5.56 to 5.97)</td>
<td>.15</td>
</tr>
<tr>
<td>Systemic antibiotic use</td>
<td>7.95 (7.78 to 8.12)</td>
<td>8.05 (7.88 to 8.22)</td>
<td>.55</td>
</tr>
<tr>
<td>Witnessed aspiration</td>
<td>1.59 (0.98 to 2.54)</td>
<td>1.96 (1.21 to 3.13)</td>
<td>.66</td>
</tr>
<tr>
<td>With new pulmonary infiltrates</td>
<td>0.48 (0.20 to 1.15)</td>
<td>0.71 (0.30 to 1.72)</td>
<td>.65</td>
</tr>
<tr>
<td>Renal replacement therapy</td>
<td>0.99 (0.82 to 1.81)</td>
<td>0.80 (0.67 to 0.96)</td>
<td>.25</td>
</tr>
<tr>
<td>Length of Stay</td>
<td>(n = 682)</td>
<td>(n = 681)</td>
<td>P Value</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------------</td>
<td>-----------------</td>
<td>---------</td>
</tr>
<tr>
<td>ICU stay, mean (95% CI), d</td>
<td>9.3 (8.9 to 9.7)</td>
<td>8.6 (8.2 to 9.0)</td>
<td>.06</td>
</tr>
<tr>
<td>Hospital stay, mean (95% CI), d</td>
<td>24.7 (23.7 to 25.8)</td>
<td>25.4 (24.4 to 26.6)</td>
<td>.50</td>
</tr>
</tbody>
</table>
Daniel C., 42 years, Motor accident

- 186 cm, 72 kg
- Dx:
  - cerebral hematoma
  - multiple rib fractures, rupture of pulmonary artery
  - blunt abdominal trauma, splenic rupture
  - pelvic fracture, massive blood loss
- Op:
  - drainage of hematoma, repair of pulmonary artery
  - spleen resection, abdominal revision
  - pelvic osteosynthesis
- 5 hours postoperative
  - open abdomen, scheduled for review next day
  - no post pyloric feeding tube
  - mechanically ventilated, FIO$_2$ 0.6
  - Temp. 39.2 °C
  - Chest-X-ray:
    - bilateral infiltrates
Could we consider enteral nutrition?

Could we consider enteral nutrition?

- 597 patient observational study,
  - Significantly higher fascial closure rates;
  - No difference in complication rates and;
  - Significantly lower mortality.
- 39% received EN before closure of the abdomen, started 3.6 days after injury.

Could we consider enteral nutrition?

He could be fed enterally

**Could we consider early enteral nutrition?**

He could be fed enterally

Could we consider early enteral nutrition?

He could be fed enterally

- Significantly lower mortality
- Reduced pneumonia and severity of MODS
- No signs of harm


Could we consider early enteral nutrition?

He could be fed enterally
He could be fed *early* (< 24 h from injury) enterally


What is the role of Early PN?

He could be fed enterally
He could be fed early (< 24 h from injury) enterally


What is the role of Early PN?

He could be fed enterally
He could be fed *early* (<24 h from injury) enterally

- No impact on mortality


What is the role of Early PN?

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• No impact on mortality
• No impact on infectious complications

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- No impact on infectious complications
- Significant reduction in duration of mechanical ventilation (1.1 days, p = 0.009)

What is the role of Early PN?

He could be fed enterally
He could be fed early (< 24 h from injury) enterally

- No impact on mortality
- No impact on infectious complications
- Significant reduction in duration of mechanical ventilation (1.1 days, p = 0.009)
- Strong trend towards reduction in ICU stay (0.75 days, p=0.06).


What is the role of Early PN?

He could be fed enterally

He could be fed early (< 24 h from injury) enterally

- No impact on mortality
- No impact on infectious complications
- Significant reduction in duration of mechanical ventilation (1.1 days, p = 0.009)
- Strong trend towards reduction in ICU stay (0.75 days, p=0.06).
- Does not delay eventual EN start time


What is the role of Early PN?

He could be fed enterally
He could be fed *early* (< 24 h from injury) enterally
If he is *not going to be fed early enterally*, he could be fed *early* parenterally!

Nutrition with an open abdomen

He could be fed enterally

He could be fed *early* (< 24 h from injury) enterally

If he is *not going to be fed early* enterally, he could be fed *early* parenterally!

*We are unaware of any published evidence that demonstrates short term fasting (or starvation) is beneficial to any group of critically ill patients.*

