

# Early enteral nutrition in the major trauma patient requiring intensive care: An overview of the evidence.

---

Dr. Gordon S. Doig  
Associate Professor in Intensive Care  
Northern Clinical School Intensive Care Research Unit,  
University of Sydney, Sydney, Australia  
[www.EvidenceBased.net](http://www.EvidenceBased.net)  
[gdoig@med.usyd.edu.au](mailto:gdoig@med.usyd.edu.au)

© 2017, University of Sydney, Not for reproduction or distribution.





## *Summary of this talk*

---

- Provide a context.
- Review the most recent clinical evidence.
- Generate concise clinical recommendations.
- Summarize.



## *Background: Review of the Guidelines*

---

- The concept of 'early' enteral feeding was popularized in the mid '80s.

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study.  
*J Trauma* 1986;26:874–881



## *Background: Review of the Guidelines*

---

- The concept of 'early' enteral feeding was popularized in the mid '80s.
- Five major ICU CPGs recommend *early* EN.

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study.  
*J Trauma* 1986;26:874–881



## Background: Review of the Guidelines

- The concept of ‘early’ enteral feeding was popularized in the mid ‘80s.
- Five major ICU CPGs recommend *early* EN.
  - *Canadian guideline,*
  - *ACCEPT guideline (also Canadian),*
  - *Australian and New Zealand guideline,*
  - *European (ESPEN) guideline and*
  - *American (ASPEN and SCCM) guideline*

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study. *J Trauma* 1986;26:874–881

Heyland DK, *et al.* The 2015 Canadian critical care nutrition guideline. [www.CriticalCareNutrition/cpg](http://www.CriticalCareNutrition/cpg).

Martin CM, Doig GS, Heyland DK, Morrison T and Sibbald WJ. Multicentre, cluster randomized clinical trial of algorithms for critical care enteral and parenteral therapy (ACCEPT). *CMAJ* 2004;170(2):197-204.

Doig GS and Simpson F. Evidence-based guidelines for nutritional support of the critically ill: Results of a bi-national guidelines development conference. First Edition, EvidenceBased.net, Sydney, Australia, 2005.

Kreymann KG, Berger MM, Deutz NE, *et al.* ESPEN Guidelines on Enteral Nutrition: Intensive care. *Clinical Nutrition* 2006;25: 210–223.

McClave SA, Taylor BE, Martindale RG, *et al.* Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: : Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). *J Parenter Enteral Nutr* 2016;40(2):159-211.



## *Background: Review of the Guidelines*

---

- The concept of 'early' enteral feeding was popularized in the mid '80s.
- Five major ICU CPGs recommend *early* EN.
- One major trauma CPG recommends *early* EN.



## *Background: Review of the Guidelines*

---

- The concept of 'early' enteral feeding was popularized in the mid '80s.
- Five major ICU CPGs recommend *early* EN.
- One major trauma CPG recommends *early* EN.

*“enteral feeding can be instituted in most patients after resuscitation is complete and hemodynamic stability has been gained.”*

The Eastern Association for the Surgery of Trauma. Nutritional Support: Timing (Early versus Delayed Enteral Feedings). *J Trauma*. 57(3):660-679.



## *Background: Review of the Guidelines*

---

- The concept of ‘early’ enteral feeding was popularized in the mid ‘80s.
- Five major ICU CPGs recommend *early* EN.
- One major trauma CPG recommends *early* EN.

*“enteral feeding can be instituted in most patients **after resuscitation is complete and hemodynamic stability has been gained.**”*

The Eastern Association for the Surgery of Trauma. Nutritional Support: Timing (Early versus Delayed Enteral Feedings). *J Trauma*. 57(3):660-679.





# *Early EN in trauma: Direct evidence*

---



# Early EN in trauma: Direct evidence



Contents lists available at ScienceDirect

## Injury

journal homepage: [www.elsevier.com/locate/injury](http://www.elsevier.com/locate/injury)



## Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials

Gordon S. Doig<sup>a,\*</sup>, Philippa T. Heighes<sup>b</sup>, Fiona Simpson<sup>a</sup>, Elizabeth A. Sweetman<sup>b</sup>

<sup>a</sup> Intensive Care, Northern Clinical School, University of Sydney, Sydney, NSW 2006, Australia

<sup>b</sup> Royal North Shore Hospital, Intensive Care Unit, St. Leonards, NSW 2065, Australia

### ARTICLE INFO

#### Article history:

Accepted 11 June 2010

#### Keywords:

Early enteral nutrition  
Trauma  
Intensive care unit  
Critical care

### ABSTRACT

**Introduction:** To determine whether the provision of early standard enteral nutrition (EN) confers treatment benefits to adult trauma patients who require intensive care.

**Materials and methods:** MEDLINE and EMBASE were searched. Hand citation review of retrieved guidelines and systematic reviews was undertaken and academic and industry experts were contacted.

Methodologically sound randomised controlled trials (RCTs) conducted in adult trauma patients requiring intensive care that compared the delivery of standard EN, provided within 24 h of injury, to standard care were included.

Doig GS, Heighes PT, Simpson F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.

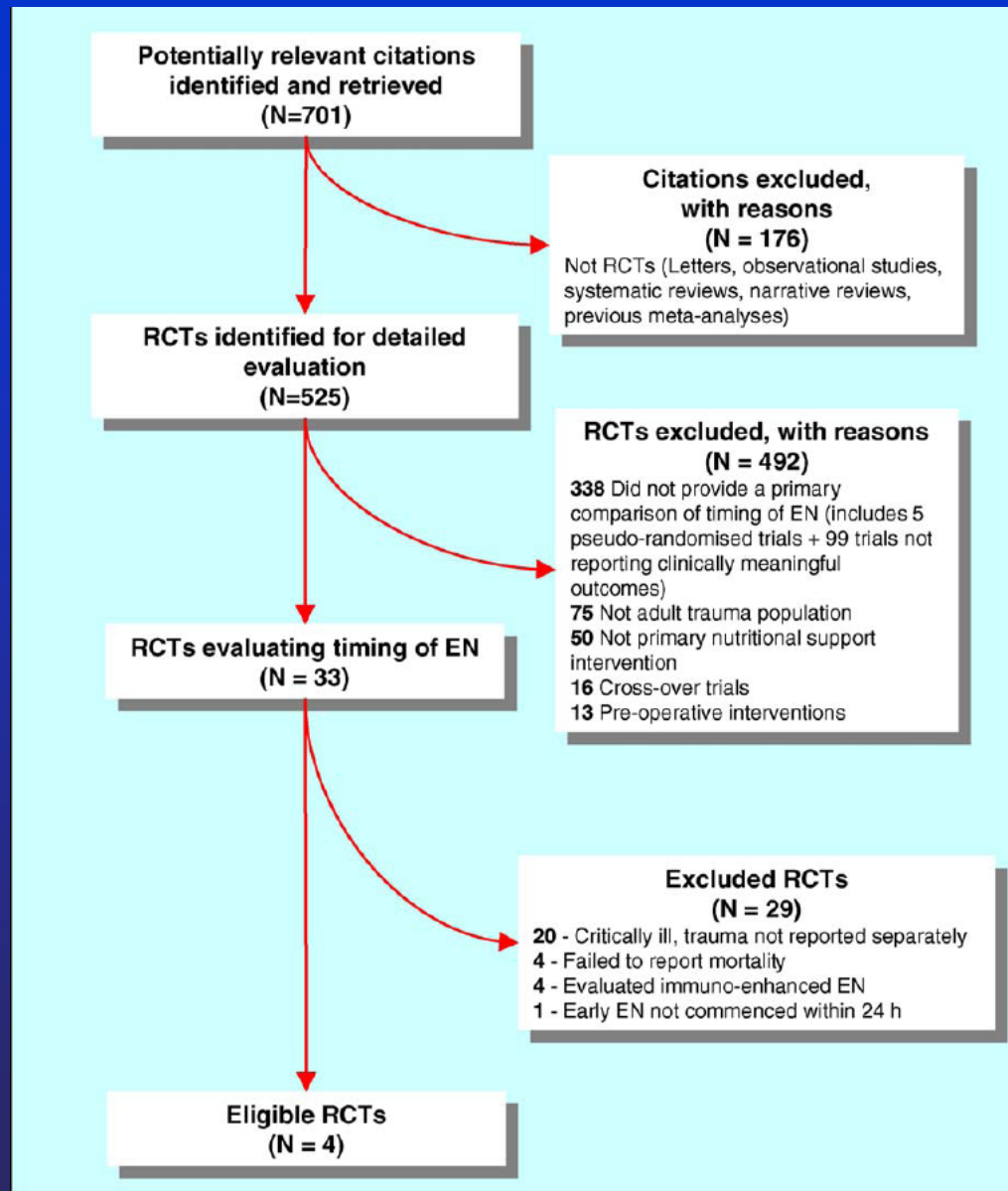


## *Early EN in trauma: Direct evidence*

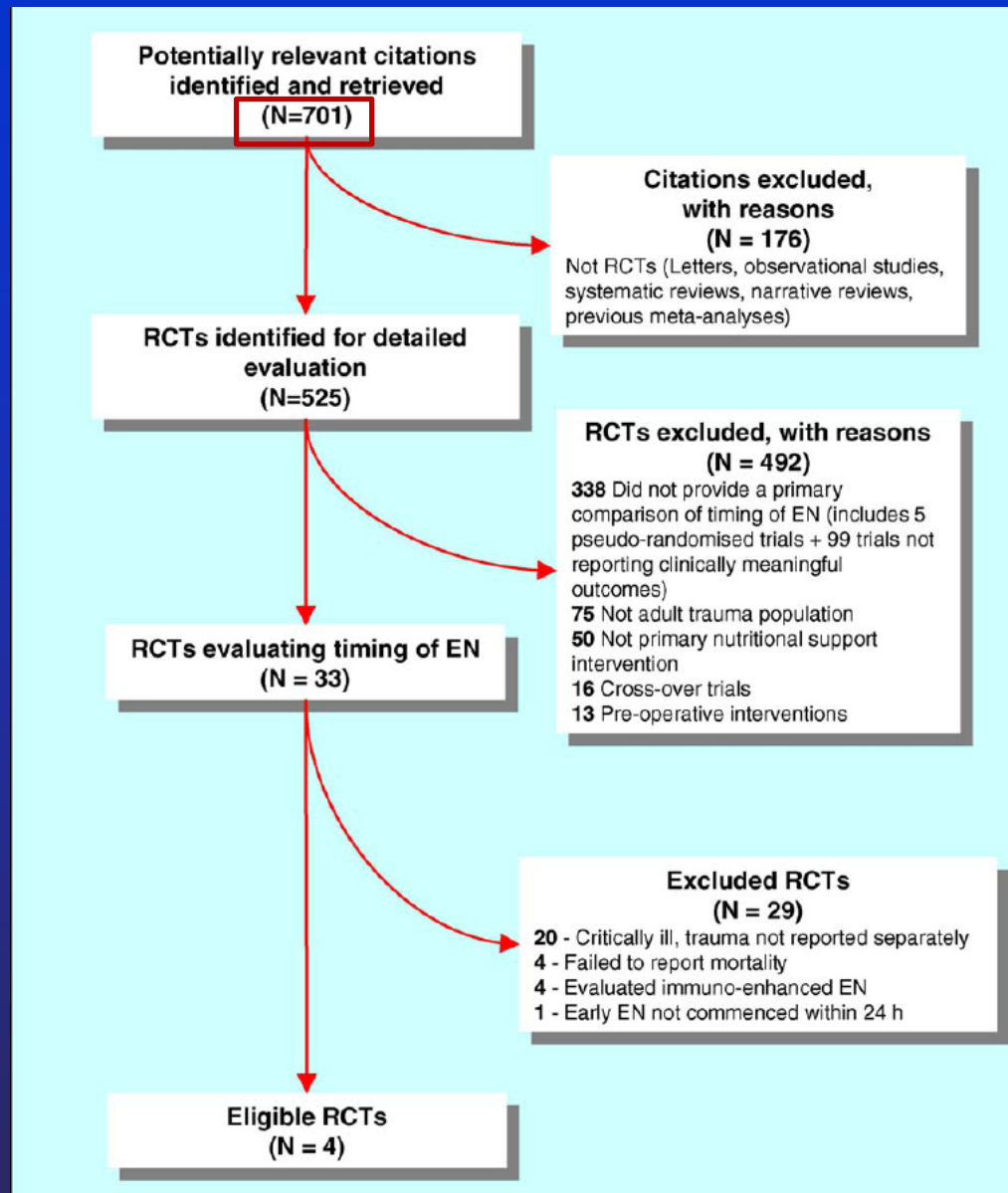
---

- RCT's conducted in:
  - adult trauma patients requiring intensive care and;
  - standard EN begun within 24hrs of injury compared to standard care (oral intake upon return of bowel sounds, TPN, or TPN + delayed EN);
  - conducted an extensive electronic literature search

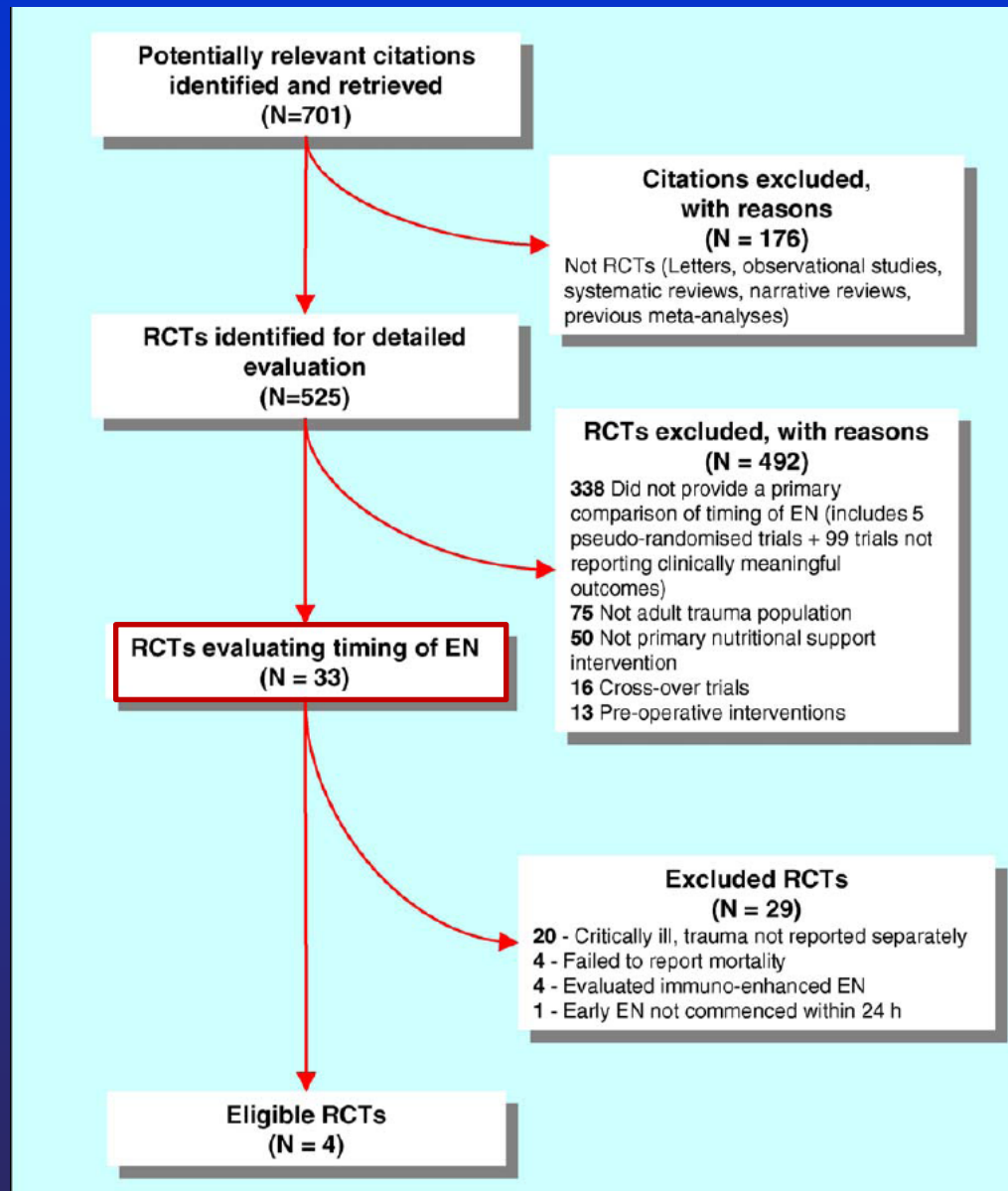
Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



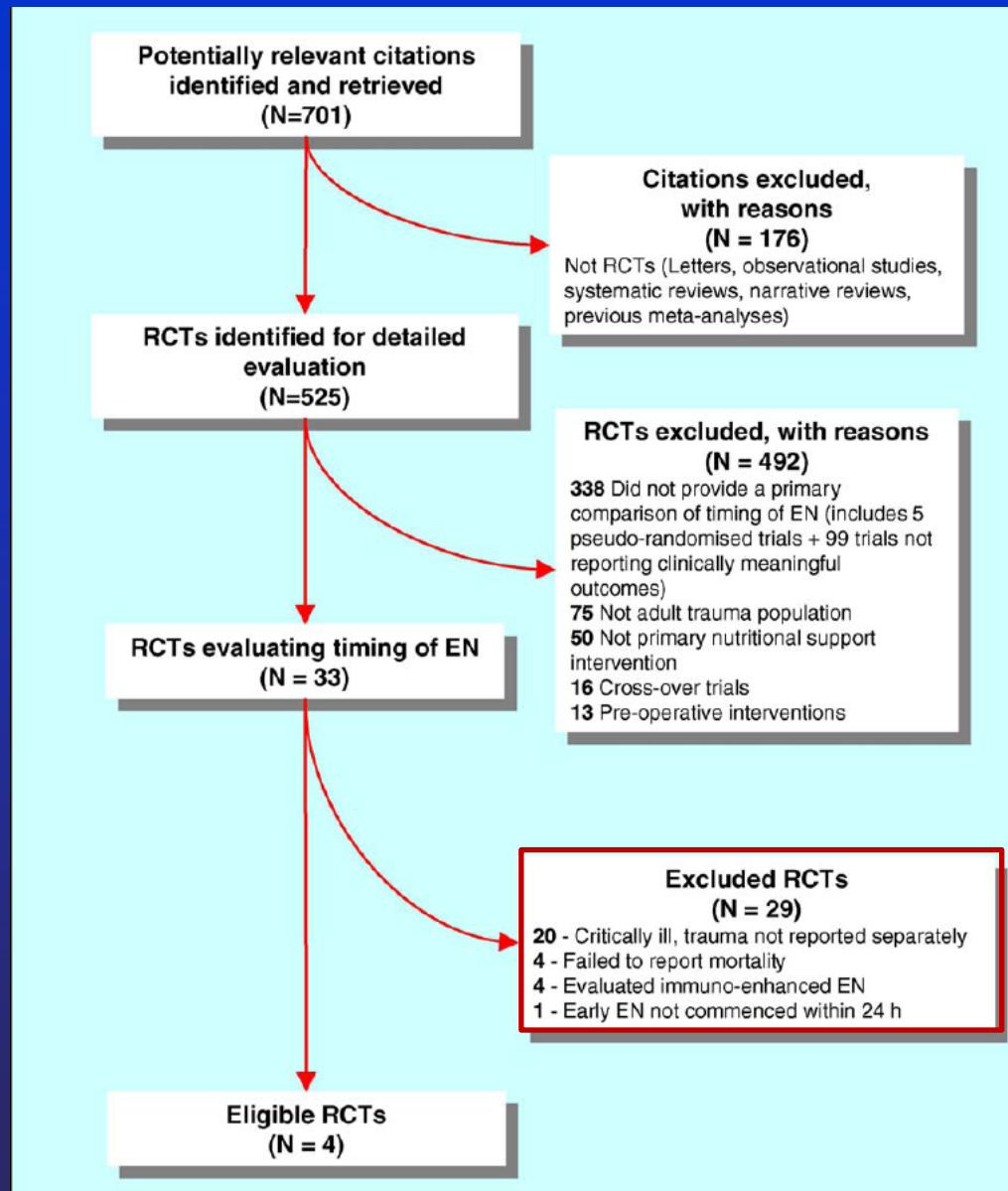
Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.

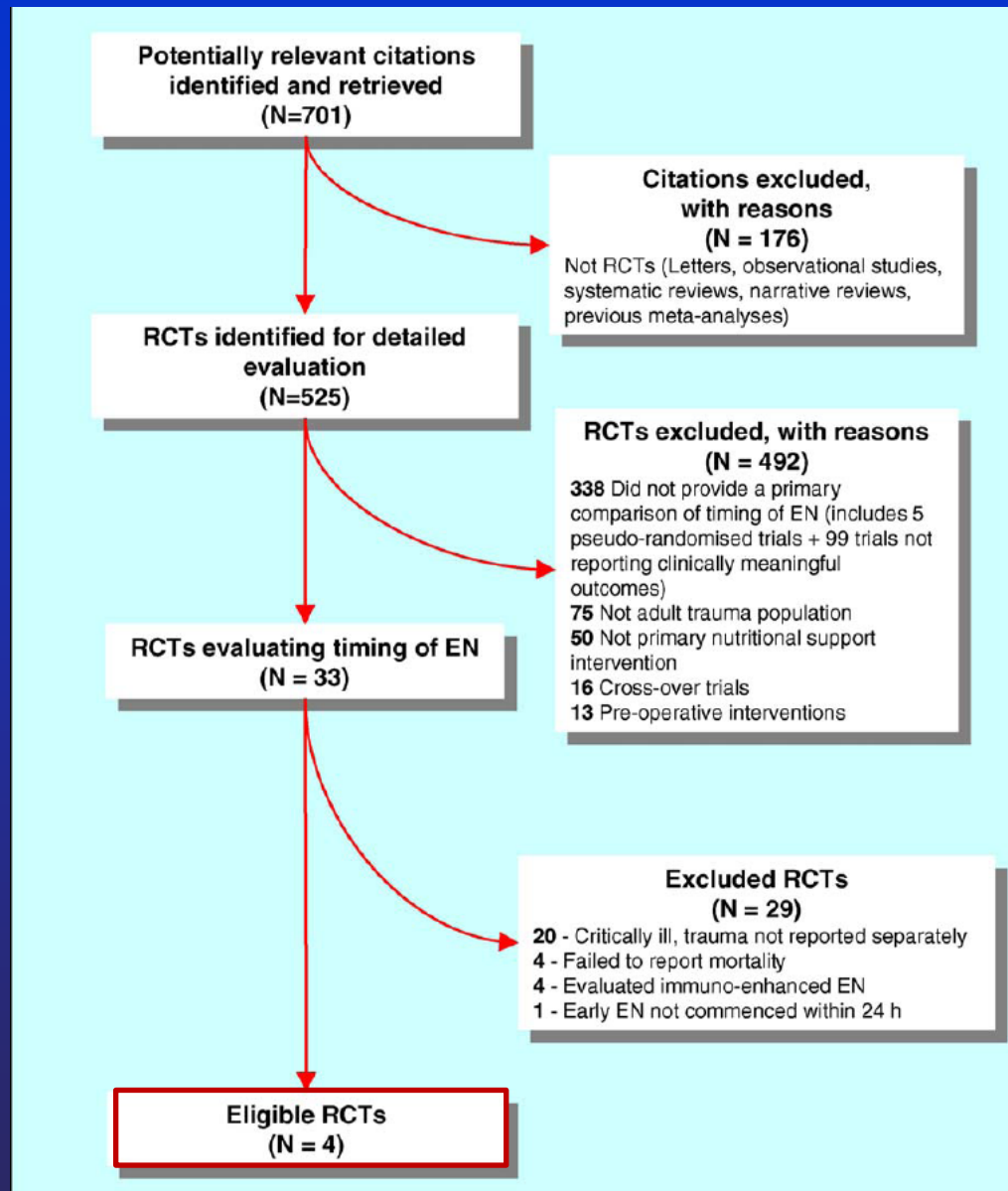


Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.





Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.





## Early EN in trauma: Direct evidence

**Table 2**

Characteristics of eligible studies.

Study	Patient population	Early EN intervention	Control intervention
Chuntrasakul 1996	Severe trauma (ISS >20 and <40) Mean ISS 29 ± 1.5	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	5% dextrose/NSS for maintenance. Oral intake commenced upon return of bowel sounds
Kompan 1999	Multiple trauma (ISS > 25) Mean ISS 33.6 ± 10 Mean APACHE II 11.5 ± 5.8	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	Same protocol as Early EN except EN begun a median 41.4 (33.9–53.6 range) hours after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Kompan 2004	Multiple trauma (ISS > 20) Mean APACHE II 11.3 ± 4.8	Immediately after resuscitation: Same protocol as Kompan 1999 except goal set at an average of 25 nonprotein kcal/kg	Same protocol as Early EN except EN begun 38.5 ± 15.6 h after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time

Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



## Early EN in trauma: Direct evidence

**Table 2**

Characteristics of eligible studies.

Study	Patient population	Early EN intervention	Control intervention
Chuntrasakul 1996	Severe trauma (ISS >20 and <40) Mean ISS 29 ± 1.5	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	5% dextrose/NSS for maintenance. Oral intake commenced upon return of bowel sounds
Kompan 1999	Multiple trauma (ISS > 25) Mean ISS 33.6 ± 10 Mean APACHE II 11.5 ± 5.8	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	Same protocol as Early EN except EN begun a median 41.4 (33.9–53.6 range) hours after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Kompan 2004	Multiple trauma (ISS > 20) Mean APACHE II 11.3 ± 4.8	Immediately after resuscitation: Same protocol as Kompan 1999 except goal set at an average of 25 nonprotein kcal/kg	Same protocol as Early EN except EN begun 38.5 ± 15.6 h after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time

Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



## *Early EN in trauma: Direct evidence*

---

- Primary analysis is based on RCTs that do not have major flaws:

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Early EN in trauma: Direct evidence

- Primary analysis is based on RCTs that do not have major flaws:

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study. *J Trauma* 1986;26:874–881

Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time
------------	-----------------------------------	---	---

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Early EN in trauma: Direct evidence

- Primary analysis is based on RCTs that do not have major flaws:
  - Moore et al *enrolled 75 patients, but 12 were excluded from analysis within the first 72 hr post-injury because of reoperation (six), death (four), or transfer to another hospital (two).*

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study. *J Trauma* 1986;26:874–881

Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time
------------	-----------------------------------	---	---

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Early EN in trauma: Direct evidence

- Primary analysis is based on RCTs that do not have major flaws:
  - Moore et al enrolled 75 patients, but 12 were excluded from analysis within the first 72 hr post-injury because of reoperation (six), death (four), or transfer to another hospital (two).
  - We do not know which group these 12 patients were randomised to.

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study. *J Trauma* 1986;26:874–881

Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time
------------	-----------------------------------	---	---

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56





## Early EN in trauma: Direct evidence

- Primary analysis is based on RCTs that do not have major flaws:
  - Moore et al *enrolled 75 patients, but 12 were excluded from analysis within the first 72 hr post-injury because of reoperation (six), death (four), or transfer to another hospital (two).*
  - *We do not know which group these 12 patients were randomised to.*
  - *Excessive loss to follow-up is a major validity flaw.*

Moore EE, Jones TN. Benefits of immediate jejunostomy feeding after major abdominal trauma—a prospective, randomized study. *J Trauma* 1986;26:874–881

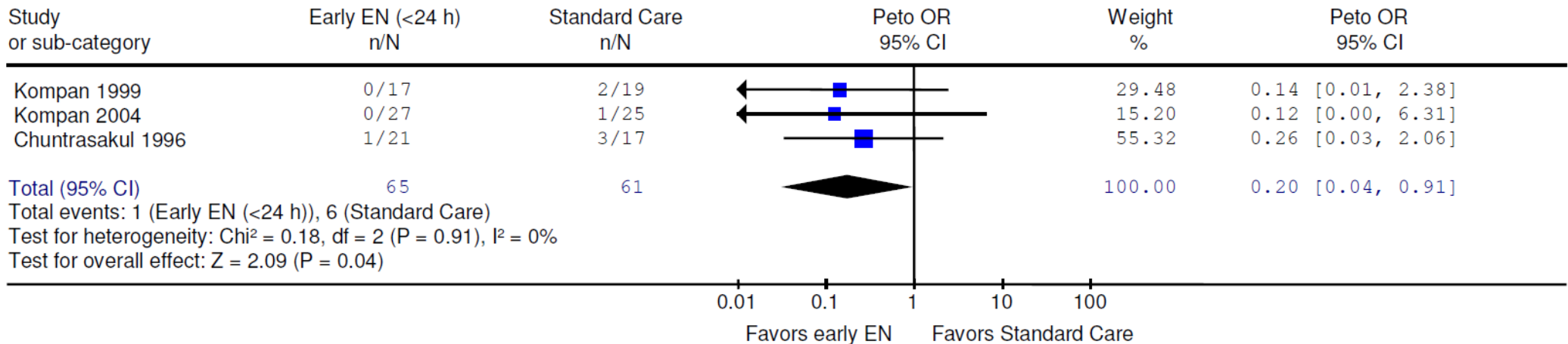
Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time
------------	-----------------------------------	---	---

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Primary analysis: RCTs without major flaws

Review: Early EN (<24h) vs Standard Care (TRAUMA - Primary)  
 Comparison: 01 Early (<24 h) EN vs Standard Care  
 Outcome: 01 Mortality, Intention to treat analysis



**Mortality reduced by 8.3%,  $p=0.04$**

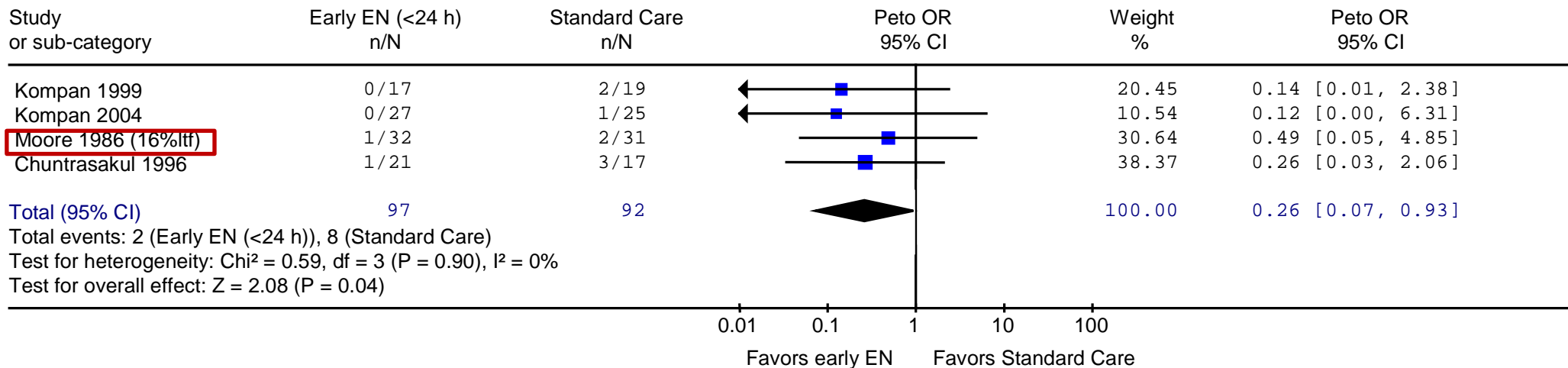
Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56





## Sensitivity analysis: Including Moore et al.

Review: Early EN (<24h) vs Standard Care (TRAUMA - Sensitivity)  
 Comparison: 01 Early (<24 h) EN vs Standard Care  
 Outcome: 01 Mortality, Sensitivity Analysis



*Mortality reduced by 6.7%,  $p=0.04$*

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Early EN in trauma: Direct evidence

---

- Early EN also resulted in:
  - Reduced incidence of pneumonia (33% eEN vs 64%,  $p=0.050$ )
  - A trend towards a reduction in the *severity* of MODS (2.5 vs 3.1 organ failures per patient,  $p=0.057$ )



## *Early EN in trauma: Direct evidence*

---

- Early EN also resulted in:
  - Reduced incidence of pneumonia (33% eEN vs 64%,  $p=0.050$ )
  - A trend towards a reduction in the *severity* of MODS (2.5 vs 3.1 organ failures per patient,  $p=0.057$ )

*There were no signs of any harms.*



## *Early EN in Upper GI Sx: Indirect evidence*

---



## Early EN in Upper GI Sx: Indirect evidence

---

- A Meta-analysis comparing RCT's of early feeding (within 24h) versus no feeding in patients undergoing **gastrointestinal surgery**.
- 13 studies, 1,173 patients

Lewis SJ, Andersen HK, Thomas S. Early enteral nutrition within 24 h of Intestinal Surgery versus later commencement of feeding: A systematic review and Meta-analysis. *J Gastrointest Surg* 2009;13:569-575.



## Early EN in Upper GI Sx: Indirect evidence

---

- A Meta-analysis comparing RCT's of early feeding (within 24h) versus no feeding in patients undergoing gastrointestinal surgery.
- 13 studies, 1,173 patients
- Early feeding resulted in a significant decrease in:
  - Mortality (2.4% eEN vs 6.9%,  $p=0.03$ )

Lewis SJ, Andersen HK, Thomas S. Early enteral nutrition within 24 h of Intestinal Surgery versus later commencement of feeding: A systematic review and Meta-analysis. *J Gastrointest Surg* 2009;13:569-575.



## Early EN in Upper GI Sx: Indirect evidence

---

- A Meta-analysis comparing RCT's of early feeding (within 24h) versus no feeding in patients undergoing gastrointestinal surgery.
- 13 studies, 1,173 patients
- Early feeding resulted in a significant decrease in:
  - Mortality (2.4% eEN vs 6.9%,  $p=0.03$ )
- Early feeding was **not** associated with **any harms**:
  - Wound infections (7.1% eEN vs 9.3%,  $p=0.26$ )
  - Anastomotic dehiscence (2.8% eEN vs 4.3%,  $p=0.27$ )
  - Pneumonia (2.3% eEN vs 3.3%,  $p=0.46$ )



## Early EN in Upper GI Sx: Indirect evidence

---

- A Meta-analysis comparing RCT's of early feeding (within 24h) versus no feeding in patients undergoing gastrointestinal surgery.
- 13 studies, 1,173 patients
- Early feeding resulted in a significant decrease in:
  - Mortality (2.4% eEN vs 6.9%,  $p=0.03$ )
- Early feeding was **not** associated with **any harms**:
  - Wound infections (7.1% eEN vs 9.3%,  $p=0.26$ )
  - Anastomotic dehiscence (2.8% eEN vs 4.3%,  $p=0.27$ )
  - Pneumonia (2.3% eEN vs 3.3%,  $p=0.46$ )

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

Lewis SJ, Andersen HK, Thomas S. Early enteral nutrition within 24 h of Intestinal Surgery versus later commencement of feeding: A systematic review and Meta-analysis. *J Gastrointest Surg* 2009;13:569-575.





## *A special case: The Open Abdomen*

---

*“deliberately leaving a laparotomy wound open is now the **standard of care** in clinical situations that require either planned reoperations or decompression of intra-abdominal hypertension”*



## *A special case: The Open Abdomen*

---

*“deliberately leaving a laparotomy wound open is now the **standard of care** in clinical situations that require either planned reoperations or decompression of intra-abdominal hypertension”*

- **Planned re-operation:** Damage control surgery or management of severe abdominal infection
- **Decompression of intra-abdominal hypertension:** Repair of a ruptured abdominal aortic aneurysm or decompressive laparotomy for abdominal compartment syndrome
- **Less commonly:** septic dehiscence of a laparotomy incision or partial loss of the abdominal wall prohibit definitive closure, resulting in an open abdomen



## *A special case: The Open Abdomen*

---

*“deliberately leaving a laparotomy wound open is now the **standard of care** in clinical situations that require either planned reoperations or decompression of intra-abdominal hypertension”*

- ***Planned re-operation:*** Damage control surgery or management of severe abdominal infection
- ***Decompression of intra-abdominal hypertension:*** Repair of a ruptured abdominal aortic aneurysm or decompressive laparotomy for abdominal compartment syndrome
- ***Less commonly:*** septic dehiscence of a laparotomy incision or partial loss of the abdominal wall prohibit definitive closure, resulting in an open abdomen



# *Feeding the Open Abdomen: Dogma?*

---

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Feeding the Open Abdomen: Dogma?*

---

- Fear of bowel oedema and ileus, with subsequent aspiration pneumonia.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Feeding the Open Abdomen: Dogma?*

---

- Fear of bowel oedema and ileus, with subsequent aspiration pneumonia.
- Fear of inducing small bowel necrosis by stressing an underperfused bowel.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Feeding the Open Abdomen: Dogma?*

---

- 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.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Feeding the Open Abdomen: Dogma?*

---

- 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?*

---



## *Should we fear enteral nutrition?*

---

Burlew CC, Moore EE, Cuschieri J et al. Who should we feed? A Western Trauma Association multi-institutional study of enteral nutrition in the open abdomen after injury. *J Trauma Acute Care Surg* 2012;73(6):1380-1388.



## *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



## 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

**92%** (549/597) after damage control surgery, **8%** (48/597) after abdominal compartment syndrome



## 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

**92%** (549/597) after damage control surgery, **8%** (48/597) after abdominal compartment syndrome

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



## 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

92% (549/597) after damage control surgery, 8% (48/597) after abdominal compartment syndrome

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*



## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients.*

Burlew CC, Moore EE, Cuschieri J et al. Who should we feed? A Western Trauma Association multi-institutional study of enteral nutrition in the open abdomen after injury. *J Trauma Acute Care Surg* 2012;73(6):1380-1388.





## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients*.
- Controlling for hospital, ISS, mechanism of injury, closure at second laparotomy, total 24-hr infused volume and presence of bowel injury, patients who received EN before first attempt at closure experienced:

Burlew CC, Moore EE, Cuschieri J et al. Who should we feed? A Western Trauma Association multi-institutional study of enteral nutrition in the open abdomen after injury. *J Trauma Acute Care Surg* 2012;73(6):1380-1388.



## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients*.
- Controlling for hospital, ISS, mechanism of injury, closure at second laparotomy, total 24-hr infused volume and presence of bowel injury, patients who received EN before first attempt at closure experienced:
  - Significantly higher ultimate fascial closure rates (OR 2.1,  $p < 0.01$ );



## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients.*
- Controlling for hospital, ISS, mechanism of injury, closure at second laparotomy, total 24-hr infused volume and presence of bowel injury, patients who received EN before first attempt at closure experienced:
  - Significantly higher ultimate fascial closure rates (OR 2.1,  $p < 0.01$ );
  - There was no difference in complication rates (OR 0.9,  $p = 0.68$ ) and;



## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients.*
- Controlling for hospital, ISS, mechanism of injury, closure at second laparotomy, total 24-hr infused volume and presence of bowel injury, patients who received EN before first attempt at closure experienced:
  - Significantly higher ultimate fascial closure rates (OR 2.1,  $p < 0.01$ );
  - There was no difference in complication rates (OR 0.9,  $p = 0.68$ ) and;
  - Significantly lower mortality (OR 0.4,  $p = 0.01$ ).

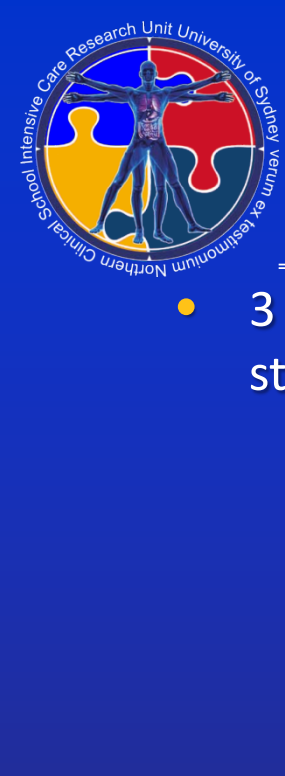


## *Should we fear enteral nutrition?*

---

- Intention to treat analysis *for all 597 patients.*
- Controlling for hospital, ISS, mechanism of injury, closure at second laparotomy, total 24-hr infused volume and presence of bowel injury, patients who received EN before first attempt at closure experienced:
  - Significantly higher ultimate fascial closure rates (OR 2.1,  $p < 0.01$ );
  - There was no difference in complication rates (OR 0.9,  $p = 0.68$ ) and;
  - Significantly lower mortality (OR 0.4,  $p = 0.01$ ).

*Receiving EN before first attempt at closure resulted in significant improvements in outcome.*



## *Should we fear enteral nutrition?*

---

- 3 other smaller observational studies in open abdomen patients, comparing EN started prior to fascial closure with delayed nutrition

Dissanaike S, Pham T, Shalhub S et al. Effect of immediate enteral feeding on trauma patients with an open abdomen: Protection from nosocomial infections. *J Am Coll Surg* 2008;207:690-697.

Collier B, Guillamondegui O, Cotton B et al. Feeding the open abdomen. *JPEN* 2007;31(5):410-415.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Should we fear enteral nutrition?*

---

- 3 other smaller observational studies in open abdomen patients, comparing EN started prior to fascial closure with delayed nutrition
- 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

Dissanaike S, Pham T, Shalhub S et al. Effect of immediate enteral feeding on trauma patients with an open abdomen: Protection from nosocomial infections. *J Am Coll Surg* 2008;207:690-697.

Collier B, Guillaumondegui O, Cotton B et al. Feeding the open abdomen. *JPEN* 2007;31(5):410-415.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.





## *Should we fear enteral nutrition?*

---

- 3 other smaller observational studies in open abdomen patients, comparing EN started prior to fascial closure with delayed nutrition
- 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*

Dissanaike S, Pham T, Shalhub S et al. Effect of immediate enteral feeding on trauma patients with an open abdomen: Protection from nosocomial infections. *J Am Coll Surg* 2008;207:690-697.

Collier B, Guillaumondegui O, Cotton B et al. Feeding the open abdomen. *JPEN* 2007;31(5):410-415.

Byrnes MC, Reicks P, Irwin E. Early enteral nutrition can be successfully implemented in trauma patients with an “open abdomen”. *The American Journal of Surgery* 2010;199:359-363.



## *Physiology: Why should patients benefit?*

---

Trauma, including isolated head trauma, triggers a hypermetabolic and catabolic state, severely impairing nitrogen (protein) balance.



## *Physiology: Why should patients benefit?*

---

Trauma, including isolated head trauma, triggers a hypermetabolic and catabolic state, severely impairing nitrogen (protein) balance.

Characterized by disproportional pro-inflammatory cytokine production (e.g., tumor necrosis factor- $\alpha$ , interleukin-1 and interleukin-6) and release that is associated with increased counter-regulatory hormones (e.g., cortisol, glucagon and catecholamines) release.



## *Physiology: Why should patients benefit?*

---

Trauma, including isolated head trauma, triggers a hypermetabolic and catabolic state, severely impairing nitrogen (protein) balance.

Characterized by disproportional pro-inflammatory cytokine production (e.g., tumor necrosis factor- $\alpha$ , interleukin-1 and interleukin-6) and release that is associated with increased counter-regulatory hormones (e.g., cortisol, glucagon and catecholamines) release.

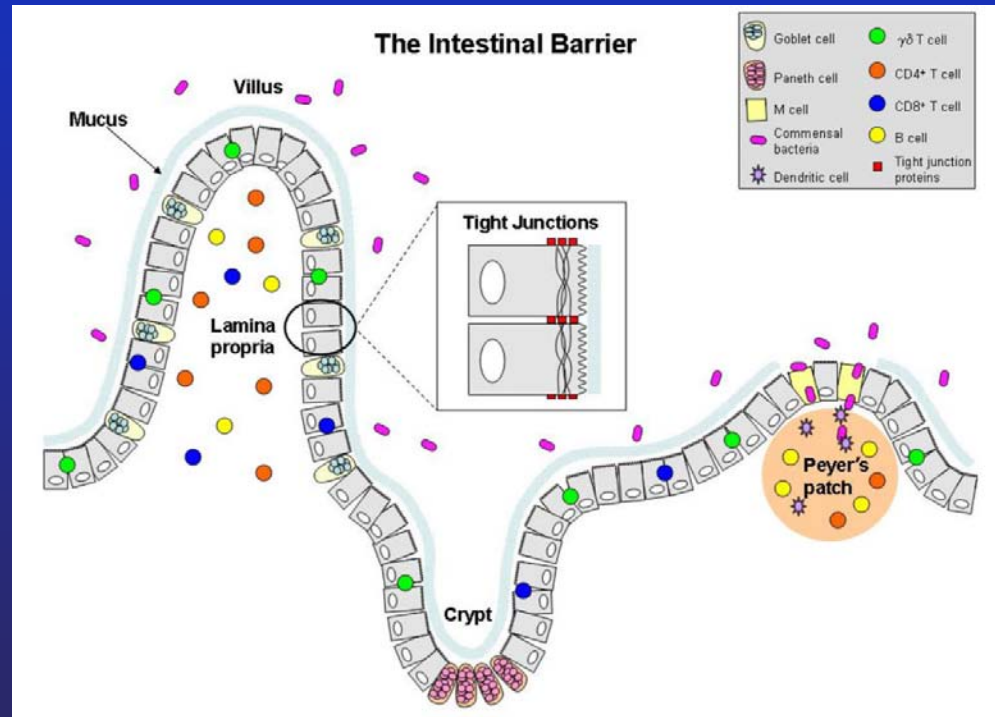
This process leads to increased nutrient needs, which begins early and may persist throughout recovery and rehabilitation.



# The gut as the motor of MODs

With the onset of shock and critical illness:

- Loss of functional and structural integrity of the intestinal epithelium.



Clark JA and Coopersmith CM. Intestinal crosstalk – a new paradigm for understanding the gut as the “motor” of critical illness. *Shock* 2007;28(4):384-393.



## *The gut as the motor of MODs*

---

With the onset of shock and critical illness:

- Loss of functional and structural integrity of the intestinal epithelium.
- Reduced contractility promotes bacterial overgrowth.



## *The gut as the motor of MODs*

---

With the onset of shock and critical illness:

- Loss of functional and structural integrity of the intestinal epithelium.
- Reduced contractility promotes bacterial overgrowth.
- Gut stasis, bacterial overgrowth *and* loss of structural integrity leads to bacterial translocation (*even more* bacterial cross intestinal barrier!!!).





## *The gut as the motor of MODs*

---

With the onset of shock and critical illness:

- Loss of functional and structural integrity of the intestinal epithelium.
- Reduced contractility promotes bacterial overgrowth.
- Gut stasis, bacterial overgrowth *and* loss of structural integrity leads to bacterial translocation (*even more* bacterial cross intestinal barrier!!!).
- Gut neutrophils become 'primed' and release cytokines into lymphatic drainage and also may travel to distant sites
  - Increases overall oxidative stress, predisposing to infection and MODs

# Summary

---





## Summary

---

- **Direct evidence** (RCTs in Trauma patients), **indirect evidence** (RCTs in upper GI Sx), **observational studies** and **physiology** supports *the benefits of early EN for trauma patients*



## Summary

---

- Direct evidence (RCTs in Trauma patients), indirect evidence (RCTs in upper GI Sx), observational studies and physiology supports *the benefits of early EN for trauma patients*
  - Significant reduction in mortality, VAP and severity of MODs



## Summary

---

- Direct evidence (RCTs in Trauma patients), indirect evidence (RCTs in upper GI Sx), observational studies and physiology supports *the benefits of early EN for trauma patients*
  - Significant reduction in mortality, VAP and severity of MODs
- EN should begin within 24 h of injury, as soon as shock is stabilised:

The Eastern Association for the Surgery of Trauma. Nutritional Support: Timing (Early versus Delayed Enteral Feedings). J Trauma. 57(3):660-679.



## Early EN in trauma: Direct evidence

**Table 2**

Characteristics of eligible studies.

Study	Patient population	Early EN intervention	Control intervention
Chuntrasakul 1996	Severe trauma (ISS >20 and <40) Mean ISS 29 ± 1.5	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	5% dextrose/NSS for maintenance. Oral intake commenced upon return of bowel sounds
Kompan 1999	Multiple trauma (ISS > 25) Mean ISS 33.6 ± 10 Mean APACHE II 11.5 ± 5.8	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	Same protocol as Early EN except EN begun a median 41.4 (33.9–53.6 range) hours after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Kompan 2004	Multiple trauma (ISS > 20) Mean APACHE II 11.3 ± 4.8	Immediately after resuscitation: Same protocol as Kompan 1999 except goal set at an average of 25 nonprotein kcal/kg	Same protocol as Early EN except EN begun 38.5 ± 15.6 h after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time

Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.



## Early EN in trauma: Direct evidence

**Table 2**

Characteristics of eligible studies.

Study	Patient population	Early EN intervention	Control intervention
Chuntrasakul 1996	Severe trauma (ISS >20 and <40) Mean ISS 29 ± 1.5	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	5% dextrose/NSS for maintenance. Oral intake commenced upon return of bowel sounds
Kompan 1999	Multiple trauma (ISS > 25) Mean ISS 33.6 ± 10 Mean APACHE II 11.5 ± 5.8	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	Same protocol as Early EN except EN begun a median 41.4 (33.9–53.6 range) hours after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Kompan 2004	Multiple trauma (ISS > 20) Mean APACHE II 11.3 ± 4.8	Immediately after resuscitation: Same protocol as Kompan 1999 except goal set at an average of 25 nonprotein kcal/kg	Same protocol as Early EN except EN begun 38.5 ± 15.6 h after trauma. <i>Note:</i> 50% of goal received via TPN for first 24 h before EN was begun
Moore 1986	Major abdominal trauma (ATI > 15)	Within 12–18 h of surgery: EN (Vivonex HN at 1/4 strength) via NJT at 50 ml/h. Rate and concentration increased at 8 h intervals to target (full strength solution 125ml/h) at 72 h	5% dextrose (approx. 100 g/day) during first 5 days post-op and then TPN if not tolerating oral diet at that time

Doig GS, Heighes PT, Simpson, F, Sweetman EAS. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42:50-56.





## Summary

---

- Direct evidence (RCTs in Trauma patients), indirect evidence (RCTs in upper GI Sx), observational studies and physiology supports *the benefits of early EN for trauma patients*
  - Significant reduction in mortality, VAP and severity of MODs
- EN should begin within 24 h of injury, as soon as shock is stabilised:
  - Shock Index  $\leq 1$  (Heart rate / SBP) for one hour or
  - SBP  $> 100$  mmHg without need for *increasing* doses of vasoactive agents for one hour.

*Stable shock is not defined by weaning or removing all vasoactive agents.*

The Eastern Association for the Surgery of Trauma. Nutritional Support: Timing (Early versus Delayed Enteral Feedings). J Trauma. 57(3):660-679.

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



# *Assorted loose ends*

---



## *Assorted loose ends*

---

- Rates and Targets



## Assorted loose ends

---

- Rates and Targets
  - In general, start slow and achieve reasonable goals within 3 to 7 days.
  - Use indirect calorimetry or equations to set goals on Day 3.

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Assorted loose ends

---

- Rates and Targets
  - In general, start slow and achieve reasonable goals within 3 to 7 days.
  - Use indirect calorimetry or equations to set goals on Day 3.
- Head Trauma

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56



## Assorted loose ends

---

- Rates and Targets
  - In general, start slow and achieve reasonable goals within 3 to 7 days.
  - Use indirect calorimetry or equations to set goals on Day 3.
- Head Trauma
  - Mounting evidence suggests we create gut dysmotility by feeding late.
  - If you are concerned, start with post-pyloric feeding.

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56

Acosta-Escribano J, Fernández-Vivas M, Grau Carmona T et al. Gastric versus transpyloric feeding in severe traumatic brain injury: a prospective, randomized trial. *Intensive Care Med.* 2010 Sep;36(9):1532-9.



## Assorted loose ends

---

- Rates and Targets
  - In general, start slow and achieve reasonable goals within 3 to 7 days.
  - Use indirect calorimetry or equations to set goals on Day 3.
- Head Trauma
  - Mounting evidence suggests we create gut dysmotility by feeding late.
  - If you are concerned, start with post-pyloric feeding.
- Role of Parenteral Nutrition

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56

Acosta-Escribano J, Fernández-Vivas M, Grau Carmona T et al. Gastric versus transpyloric feeding in severe traumatic brain injury: a prospective, randomized trial. *Intensive Care Med.* 2010 Sep;36(9):1532-9.



## Assorted loose ends

---

- Rates and Targets
  - In general, start slow and achieve reasonable goals within 3 to 7 days.
  - Use indirect calorimetry or equations to set goals on Day 3.
- Head Trauma
  - Mounting evidence suggests we create gut dysmotility by feeding late.
  - If you are concerned, start with post-pyloric feeding.
- Role of Parenteral Nutrition
  - Patients with contraindications to early EN may benefit from early PN.
  - PN does *not* increase infectious complications.

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56

Acosta-Escribano J, Fernández-Vivas M, Grau Carmona T et al. Gastric versus transpyloric feeding in severe traumatic brain injury: a prospective, randomized trial. *Intensive Care Med*. 2010 Sep;36(9):1532-9.

Doig GS, Simpson F, Sweetman EA et al. Early parenteral nutrition in critically ill patients with short-term relative contraindications to early enteral nutrition: a randomized controlled trial. *JAMA*. 2013 May 22;309(20):2130-8





## Key papers

---

MAJ (P) James D. Frizzi, MC, USA, MAJ Peter D. Ray, MC, USAR, and CAPT John B. Raff, MC, USNR. Enteral Nutrition by a Forward Surgical Team in Afghanistan. *Southern Medical Journal* 2005;98(3):273-278.

- *Demonstrates strength of acceptance of the importance of early feeding by military trauma surgeons.*

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56.

- *Extensive search and systematic review of best available evidence for early EN in trauma.*

Burlew CC, Moore EE, Cuschieri J et al. Who should we feed? A Western Trauma Association multi-institutional study of enteral nutrition in the open abdomen after injury. *J Trauma Acute Care Surg* 2012;73(6):1380-1388.

- *Major multi-centre observational study demonstrating patients often assumed to be 'most difficult to feed' benefit from early EN.*

Doig GS, Simpson F, Sweetman EA et al. Early parenteral nutrition in critically ill patients with short-term relative contraindications to early enteral nutrition: a randomized controlled trial. *JAMA*. 2013 May 22;309(20):2130-8

- *Major RCT demonstrating PN does NOT increase infections and improves patient outcomes.*



## Key papers

MAJ (P) James D. Frizzi, MC, USA, MAJ Peter D. Ray, MC, USAR, and CAPT John B. Raff, MC, USNR. Enteral Nutrition by a Forward Surgical Team in Afghanistan. *Southern Medical Journal* 2005;98(3):273-278.

- *Demonstrates strength of acceptance of the importance of early feeding by military trauma surgeons.*

### Original Article

# Enteral Nutrition by a Forward Surgical Team in Afghanistan

MAJ (P) James D. Frizzi, MC, USA, MAJ Peter D. Ray, MC, USAR, and CAPT John B. Raff, MC, USNR

**Objectives:** The modern practice of trauma surgery is a global physiologic approach to caring for the injured patient. Included in that approach is consideration of the traumatized patient's nutritional needs and implementing early enteral feeding. This is routine practice in the United States but logistically impractical when using commercial enteral feeding formulas in the austere environment of a Forward Operating Base in Afghanistan.

hospitals, now is pushed forward to the edge of the battlefield to augmented Forward Surgical Teams (FSTs). At the FST facility, the injured receive urgent surgical and/or orthopaedic care to preserve life, limb, or eyesight. Traditionally, the wounded soldier is treated by the FST only to control bleeding and contamination of his wounds, then is immediately evacuated to a higher-echelon facility en route to the conti-



## Key papers

MAJ (P) James D. Frizzi, MC, USA, MAJ Peter D. Ray, MC, USAR, and CAPT John B. Raff, MC, USNR. Enteral Nutrition by a Forward Surgical Team in Afghanistan. *Southern Medical Journal* 2005;98(3):273-278.

- *Demonstrates strength of acceptance of the importance of early feeding by military trauma surgeons.*

### Original Article

## Enteral Nutrition by a Forward Surgical Team in Afghanistan

MAJ (P) James D. Frizzi, MC,  
and CAPT John B. Raff, MC,

**Objectives:** The modern practice of trauma surgery is a biologic approach to caring for the injured patient. A key approach is consideration of the traumatized patient's needs and implementing early enteral feeding. This approach was used in the United States but logistically impractical when using commercial enteral feeding formulas in the austere environment of a Forward Operating Base in Afghanistan.

### Key Points

- Feeding access can be safely placed in a Forward Surgical Team facility.
- Reasonable enteral nutrition formulas for US soldiers can be assembled from available foods on a Forward Operating Base.
- Properly selected local food can be formulated into an equivalent enteral feed for local nationals treated at US military facilities.

...battlefield  
...the FST  
...orthopaedic  
...nally, the  
...rol bleed-  
...ing and contamination of his wounds, then is immediately  
evacuated to a higher-echelon facility en route to the conti-



## Key papers

---

MAJ (P) James D. Frizzi, MC, USA, MAJ Peter D. Ray, MC, USAR, and CAPT John B. Raff, MC, USNR. Enteral Nutrition by a Forward Surgical Team in Afghanistan. *Southern Medical Journal* 2005;98(3):273-278.

- *Demonstrates strength of acceptance of the importance of early feeding by military trauma surgeons.*

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56.

- *Extensive search and systematic review of best available evidence for early EN in trauma.*

Burlew CC, Moore EE, Cuschieri J et al. Who should we feed? A Western Trauma Association multi-institutional study of enteral nutrition in the open abdomen after injury. *J Trauma Acute Care Surg* 2012;73(6):1380-1388.

- *Major multi-centre observational study demonstrating patients often assumed to be 'most difficult to feed' benefit from early EN.*

Doig GS, Simpson F, Sweetman EA et al. Early parenteral nutrition in critically ill patients with short-term relative contraindications to early enteral nutrition: a randomized controlled trial. *JAMA*. 2013 May 22;309(20):2130-8

- *Major RCT demonstrating PN does NOT increase infections and improves patient outcomes.*





## Questions?

---

- Direct evidence (RCTs in Trauma patients), indirect evidence (RCTs in upper GI Sx), observational studies and physiology supports *the benefits of early EN for trauma patients*
  - Significant reduction in mortality, VAP and severity of MODs
- EN should begin within 24 h of injury, as soon as shock is stabilised:
  - Shock Index  $\leq 1$  (Heart rate / SBP) for one hour or
  - SBP  $> 100$  mmHg without need for *increasing* doses of vasoactive agents for one hour.

*Stable shock is not defined by weaning or removing all vasoactive agents.*

The Eastern Association for the Surgery of Trauma. Nutritional Support: Timing (Early versus Delayed Enteral Feedings). J Trauma. 57(3):660-679.

Doig GS, Heighes PT, Simpson F and Sweetman EA. Early enteral nutrition reduces mortality in trauma patients requiring intensive care: A meta-analysis of randomised controlled trials. *Injury* 2011;42(1):50-56