- In the past 15 years there has been a move away from providing nutrition support intravenously (parenteral nutrition, PN) to providing it nasogastrically or jejunally (enteral nutrition, EN).
- The underlying basis in favour of EN is that a failure to maintain normal oral nutrition is associated with metabolic changes and impairment of the gut associated lymphatic system (GALT) that leads to the intestine, through lymphatic drainage, becoming the source of activated cells and proinflammatory stimulants during gut starvation.
- Other secondary abnormalities such as permeability changes and occasionally even bacterial translocations increase the immune challenge to the GALT but their contribution is secondary.

**Enteral vs Parenteral Nutrition**

**Indirect Calorimetry**

- Many patients admitted in emergency may have been suffering an illness and have had poor nutrition before admission to intensive care. The best assessment of prior nutritional status is a detailed history of prior illness and nutritional intake combined with clinical examination of fat and muscle distribution.
- Body mass index (BMI = weight in kg/height in m2) is useful but weight can be difficult to obtain accurately and may be distorted by resuscitative fluid administration.
- We know that ICU patients suffering from under-nutrition with a limited nutrition reserve have a poorer outcome and that having a low BMI has been shown to be an independent predictor of excess mortality in multiple organ failure.
- Indirect calorimetry results are derived from measurements of oxygen consumption and CO2 production in ventilated patients.
  - an RQ <0.85 may indicate underfeeding while and RQ>1 may indicate overfeeding although these findings are neither sensitive nor specific.
  - the RQ for fat is 0.7, for protein is 0.8 and for carbohydrate is 1.0.
  - patients failing to wean from ventilation who have high RQs and are receiving feeds high in carbohydrate may theoretically benefit from feeds with a lower RQ such as those with a higher ratio of fat to carbohydrate.
  - potential errors from indirect calorimetry include:
    1. measurements are not taken when patients are in a steady state
    2. presence of air leaks (eg circuit, endotracheal tube cuff, pneumothorax with IVC)
    3. high FIO2
    4. high respiratory rate
    5. water is in the circuit

**Recognition of Prior Nutritional Status**

- One of the largest meta-analysis of 27 studies in 1828 surgical patients confirms that enteral feeding does carry a lower infective risk than PN RR 0.66 (95% CI 0.56 to 0.79), but with overall no advantageous effect on mortality risk RR 0.96 (95% CI 0.55 to 1.65).
- Short term standard intravenous fluids regimen used in the normally nourished surgical patient has a lower risk of infection RR 0.77 (95% CI 0.65 to 0.91) than the inappropriate early use of PN in these patients. In contrast the malnourished patient unable to tolerate enteral feeding not giving parenteral feed significantly increases the mortality risk threefold. RR 3.0 (95% CI 1.99 to 4.65).
- A 14 hospital cluster study from Canada, the ACCEPT study, showed that survival from intensive care was improved when an evidence based guideline for nutrition was followed and more nutrition was delivered more consistently. This was achieved by earlier introduction and more complete EN delivery without any decline in the use of PN or in supplementation.
- In a well designed randomised, controlled study in a French mixed general ICU population (n=120) it was shown that achieving a higher nutrition intake with parenteral supplements led to a faster recovery of plasma protein markers, their primary end point. They also showed a reduction in length of hospital stay of 2.5 days but it is doubtful if the power of the study was sufficient to convincingly prove this.

**Advantages of Enteral vs Parenteral Nutrition**

(i) enteral feeding is cheaper
(ii) there is more efficient utilisation of nutrients
(iii) stimulates intestinal blood flow
(iv) maintains GI mucosal barrier, preventing bacterial translocation & portal endotoxaemia
(v) reduces stress hormones, the GI tract occurs rapidly without enteral feeding
(vi) post-operative enteral feeding reduces septic complications compared with parenteral feeding
(vii) avoids complications of central venous cannulation
(viii) avoids TPN induced immunosuppression

**Nasogastric Feeding**

- Aspiration can occur during many nursing procedures and turning but it is unclear how much the complication of pneumonia is related to direct feed aspiration (incidence 22% range 0%-94%) rather than changed pharyngeal colonisation secondary to feed regurgitation (incidence 31% range 0%-94%).

- A recent study in France of 153 nasogastrically fed patients showed that upper digestive intolerance is a frequent event in the critically ill and associated with pneumonia (43% v 24% p=0.01), longer ICU stay (23 v 15 days p=0.007), and increased mortality (41% v 25% p=0.03).30 Even corrected for illness severity the risk of death was significantly increased in patients with pneumonia (OR 1.68 (95% CI 1.04 to 2.10).
- This increased risk for intolerance is correlated with sedation use (RR 1.78 95% CI 1.17 to 2.71) and catecholamine use (RR 1.81, 95% CI 1.21 to 2.70) both features of high risk intensive care patients, particularly those with sepsis and shock.
- The evidence that using motility agents or nasojejunal (NJ) feeding rather than nasogastric (NG) feeding significantly changes these risks is lacking.

**Parenteral Nutrition**

- A multicentre study from Spain confirms that NJ feeding does not reduce the incidence of pneumonia. In 101 randomised ICU patients there was no difference in feeding duration, length of stay, or mortality (NG 43% v 32%). Although the NJ group had lower gastrointestinal complications there was a similar incidence of nosocomial pneumonia (NG 40% v NJ 32%).
- While a study from Melbourne suggested improved tolerance with NJ feeding and a low requirement for PN another study in USA medical patients showed that NG fed patients reached their target goal earlier.
- A rare but often fatal complication of non-occlusive bowel necrosis has been reported in critically ill trauma patients fed into the small bowel. As this complication cannot be detected early there is no overwhelming risk free evidence supporting NJ feeding in preference to NG feeding for the reduction in infective risk.

**Summary**

- Feed the malnourished and plan for those soon to be malnourished.
- Start some enteral feeding if safe and as soon as practical.
- Use standard complete regimens, decisions over volumes of fluid dominate.
- Modest targets based on patient size bands are easier to achieve (25 kcal/kg/day with 1.5 g protein/kg/day).
- Use protocols, monitor delivery, note deficits, and act to meet targets.
- Use parenteral to complement or replace if delivery fails.
- Give sufficient insulin for glycaemic control using established protocols.
- Do not exacerbate glycaemic deficiency, include in all PN preparations.
- Don't miss feeding because it is harder to catch up.