Enteral and parenteral nutrition: evidence-based approach

Khursheed N. Jeejeebhoy

University of Toronto and St Michael’s Hospital, Toronto, Ontario M5B 1W8, Canada

Nutrition support for patients in hospital has become an essential form of therapy. Total parenteral nutrition (TPN) was the preferred way of giving nutrition to hospital patients for many years but enteral nutrition (EN) is now the preferred route. EN is believed to promote gut function and prevent translocation of intestinal bacteria, thus reducing the incidence of sepsis in critically ill patients. In consequence, the use of TPN has been discouraged as a dangerous form of therapy. Critical review of the data suggests that in the human subject TPN does not cause mucosal atrophy or increase translocation of bacteria through the small intestine. However, overfeeding, which is easy with TPN, can explain the results of studies which have shown that TPN increases sepsis. Furthermore, the risks of TPN-induced complications have been exaggerated. When there is risk of malnutrition and EN is not tolerated, or there is gut failure, TPN is an equally effective and safe alternative.

Total parenteral nutrition: Enteral nutrition

The role of malnutrition as a risk factor for increased morbidity was recognized about 40 years ago in hospitalized patients. Malnutrition in hospital patients was treated by the use of total parenteral nutrition (TPN). It was widely accepted that if some nutrition is good, more must be better and the term ‘hyperalimentation’ was coined and practised. However, this enthusiasm gave way to reality that TPN not only did not reduce morbidity, but also increased complications under certain circumstances.

It was hypothesised that TPN by not feeding the intestinal tract caused atrophy of the intestine, increased bacterial translocation and promoted sepsis in critically-sick patients resulting in multi-system organ failure. Feeding nutrients through the intestinal tract prevented this sepsis and resulted in less morbidity and mortality than TPN. In the present review it is proposed to critically examine the relative merits of enteral nutrition (EN) and TPN.

Parenteral nutrition v. standard care

Gut failure

In patients with extensive intestinal resection, unless TPN is given severe malnutrition was documented, leading to increased morbidity and mortality. TPN at home prolongs life and reduces complications (Jeejeebhoy et al. 1973; Howard & Hassan, 1998; Messing et al. 1999).

Critical illness

Heyland et al. (1998) performed a meta-analysis of twenty-six randomised controlled trials involving 2211 patients in which TPN was compared with standard care. They found that in patients undergoing surgery and in those with burns or pancreatitis and in the intensive care unit TPN did not reduce mortality and overall morbidity. However, TPN significantly reduced morbidity in patients who were malnourished (risk ratio 0·52 (95 % CI 0·3, 0·91)).

In order to show that TPN reduces complications it has to be studied in those patients where there are increased complications. Naber et al. (1997) have shown that the presence of malnutrition increases the risk of morbidity in hospital patients. Thus, it is not surprising that TPN was of benefit only in malnourished patients.

Peri-operative total parenteral nutrition

Twomey and colleagues (Klein et al. 1997), by data pooling in patients receiving pre-operative TPN, showed that there was a 10 % risk reduction of complications, but post-operative TPN increased complications by 10 %. In patients undergoing hepatectomy, pre-operative TPN reduced the incidence of overall complications, sepsis and diuretic use (Fan et al. 1994). In contrast, in the Veterans’ Association trial (VA TPN Cooperative Study, 1991) the use of

Abbreviations: EN, enteral nutrition; TPN, total parenteral nutrition.
Corresponding author: Dr K. N. Jeejeebhoy, fax +1 416 864 5882, email khush.jeejeebhoy@utoronto.ca
pre-operative TPN giving 4180 kJ (1000 kcal) above requirements increased the risk of sepsis, especially in those patients who were not malnourished at entry. Clearly, it is had to feed excess energy to well-nourished individuals. Bozzetti et al. (2000) had found that TPN reduced non-infectious complications and did not increase sepsis.

**Table 1. Total parenteral nutrition (TPN) and intestinal atrophy in human subjects**

<table>
<thead>
<tr>
<th>Reference</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>Guedon et al. (1986)</td>
<td>No atrophy after 21 d of NPO</td>
</tr>
<tr>
<td>Rossi et al. (1993)</td>
<td>Atrophy after 9 months of NPO</td>
</tr>
<tr>
<td>Pironi et al. (1994)</td>
<td>Atrophy after 2–3 months of TPN</td>
</tr>
<tr>
<td>Sedman et al. (1995)</td>
<td>No atrophy with TPN v. enteral for ≥10 d</td>
</tr>
<tr>
<td>Groos et al. (1996)</td>
<td>Atrophy after 7–12 weeks of TPN</td>
</tr>
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NPO, nil per os (nothing fed by mouth).

**Theory of the benefits of enteral nutrition**

**Prevents mucosal atrophy**

This concept was developed from animal studies which showed that giving TPN resulted in significant intestinal villus atrophy within a few days (Miura et al. 1992). However, human studies have not shown any intestinal atrophy with complete bowel rest and TPN even after 1 month of withdrawing food by mouth (Table 1).

**Prevents bacterial translocation**

Rigorous studies were performed in human subjects, in which bacterial translocation from the intestine was identified by culturing the same organism in the blood as well as in the intestine and the mesenteric lymph nodes. These studies showed that translocation occurs, especially with intestinal obstruction, but its incidence is no different between patients receiving TPN or EN (Sedman et al. 1994). Even the majority of patients suffering from trauma did not have septicaemia from organisms found in the gut and only two patients of 132 had translocation (Moore et al. 1992).

**Nutrients and sepsis**

Progressive starvation will ultimately lead to death and malnutrition is associated with an increased risk of complications. Furthermore, it is not as well recognized that in the presence of sepsis an increased intake of energy (carbohydrates or fats) increases the risk of complications (Zaloga & Roberts, 1994). The risk of complications with increased energy intake is especially associated with the development of hyperglycaemia (Golden et al. 1999) and hyperglycaemia is prone to occur in patients with sepsis who are insulin resistant. In septic guinea-pigs, increased intake of energy caused an increase in mortality (Yamazaki et al. 1986). In tumour necrosis factor-infused animals simply feeding sufficient energy to promote normal growth caused increased complications (Matsui et al. 1993).

The trials comparing EN and TPN should be examined with a view to determining whether they were comparable in terms of energy intake. Excess energy intake with EN or TPN influences the risk of sepsis.

**Enteral nutrition v. total parenteral nutrition: outcome analysis**

**Pancreatitis**

McLave et al. (1997) randomized thirty-two patients to receive either TPN or EN and did not observe any difference in rates of infection or morbidity. Windsor et al. (1998) randomized thirty-four patients with acute pancreatitis to either TPN or EN and did not observe any difference in incidence of sepsis, length of hospital stay, computed tomography score or organ failure. Kalfarentzos et al. (1997) randomized thirty-eight patients to either EN or TPN and showed that patients receiving TPN had a higher incidence of sepsis but did not increase the stay in the intensive care unit or the hospital. In this study, also, TPN did not increase the need for antibiotics or ventilator support.

**Inflammatory bowel disease**

A randomized controlled trial comparing TPN with EN or TPN given together with an oral diet in Crohn’s disease did not show any increased complications due to TPN, and the rate or remission between the two modalities of Crohn’s disease was the same (Greenberg et al. 1998). In acute colitis it was shown that patients receiving TPN had an increased rate of sepsis; however, the rate of colectomy or remission of disease activity were not different between the two groups (Gonzalez-Huix et al. 1993).

**Trauma**

Moore et al. (1989) randomized twenty-nine patients to EN and thirty patients to TPN. There was significantly increased incidence of sepsis in patients receiving TPN ($P = 0.03$). However, patients on TPN received significantly more energy ($P = 0.01$), higher levels of insulin and had numerically higher levels of plasma glucose. They were overfed as compared with EN patients. Kudsk et al. (1992) randomized ninety-eight patients to either EN or TPN; again the patients on TPN received significantly more energy ($P = 0.02$). The patients randomized to TPN who had high injury severity score or high abdominal trauma index scores had increased sepsis. Despite the increased sepsis they did not receive more antibiotics nor did they remain longer in hospital.

**Sepsis**

Cerra et al. (1988) randomized sixty-six patients who were septic and hypermetabolic to EN or TPN and found that there was no difference in the incidence of multi-system organ failure or death between the two groups.

**Procedure-related complications**

The general belief is that procedure-related complications are greater in patients receiving TPN because of catheter
related problems. In contrast to belief, the facts are that in seven of nine randomized trials of EN v. TPN where procedure-related complications were reported, the incidence was higher during EN (Lipman, 1998).

Conclusion

TPN is the form of nutritional support most suited to patients with gut failure in whom it is life-saving and beneficial when there is malnutrition. Unfortunately, overfeeding easily occurs with TPN and increases the risk of sepsis. There is little evidence that intestinal atrophy and increased bacterial translocation occur in human subjects on TPN. TPN is associated with less procedure-related complications than EN. In short, where indicated because of the inability to give EN, TPN is beneficial in the treatment of malnutrition but is not a cure for all illnesses. These conclusions have received support from a recent 562 patient trial of EN which concluded that TPN did not increase sepsis, EN delivered less than the target nutritional intake and the procedure-related complications were greater with EN (Woodcock et al. 2000).

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References


