

The Use of Parenteral Nutrition in an Acute Care Hospital

Sai Wei Chuah, ¹*MBCChB (Glasgow), MRCP (UK)*, Doris HL Ng, ¹*MBBCh BAO (UK), MRCP (UK), PhD (UK)*, Peiyun Liu, ²*MBBS (Spore)*, Huimin Liu, ²*MBBS (Spore), MRCS (Edinburgh)*, Jia Lin Ng, ²*MBBS (Spore), MRCS (Edinburgh)*, Khoon Lin Ling, ¹*MRCP (UK), MMed (Int Med), DPhil (Oxon)*

Abstract

Introduction: Parenteral nutrition (PN) is an important supportive therapy. However, it is expensive and associated with significant complications. Our aim is to describe the patients given PN in 2006, to compare with the 2001 cohort and determine if PN had been prescribed for the appropriate indications. **Materials and Methods:** A retrospective cohort study of adult patients receiving PN between January and December 2006 was undertaken in a single institution. Appropriateness of indications for PN was based on the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) guidelines 2002. **Results:** One hundred and eighty-two patients received 194 courses (102 males, 92 females) of PN. Median age was 62 years (range, 16 to 100). Eighty-two percent were surgical patients and 18% were medical patients. Median PN duration was 9 days (range, 2 to 115). Common indications were surgeons' anticipation of non-functioning gut postoperatively [47 (24.2%) courses], postoperative complications [33 (17.0%) courses] and postoperative ileus [31 (16.1%) courses]. Indications for PN met A.S.P.E.N. guidelines in 93.3% of cases compared to 78.3% in 2001. In 1.5% of cases, we were unable to determine if the indications met the guidelines. Ten courses did not meet the guidelines; 3 had PN for <7 days preoperatively, 6 had PN because the managing team thought the patients were critically ill and 1 was given PN for refusal to eat because of depression. **Conclusion:** Since 2001, there has been an increase in the proportion of PN given for appropriate indications. However, physician education with respect to the benefit of PN for preoperative and critically ill patients with functioning guts needs reinforcing.

Ann Acad Med Singapore 2013;42:395-400

Key words: American Society for Parenteral and Enteral Nutrition (A.S.P.E.N) guidelines, Indications of Parenteral Nutrition, Inappropriate use of Parenteral Nutrition

Introduction

Malnutrition is a common problem affecting more than 50% of hospitalised patients, resulting in medical complications, longer hospital stays, and frequent readmissions to the hospital.^{1,2} For patients who cannot meet their nutritional requirements orally, nutrition support therapy is required. Specialised nutritional support consists of both enteral nutrition (EN) and parenteral nutrition (PN).

The first report of intravenous (IV) feeding in 1968 signalled a breakthrough in medical care.³ Since then, the use of PN has become an accepted form of nutritional support in patients admitted to hospital, and there has been a dramatic increase in its use over the past 30 years. PN is an important supportive therapy for patients who are unable to meet their nutritional requirements via the enteral route. Before initiating PN, patient factors such as gastrointestinal function, nutrition status, and overall clinical status should be

evaluated. Enteral nutrition (EN) is generally preferred to PN largely due to the known cost and complications associated with PN, which include hyperglycemia, electrolyte derangements, liver dysfunction, and bacteraemia from central line infection.⁴ EN also plays a major role in the maintenance of gut function and allows stimulation of gut immunity. Advances in minimally invasive endoscopic and laparoscopic techniques of tube placement and the composition of enteral nutrition formulations have improved the ability to use the gastrointestinal tract for nourishment. PN, however, is an essential feeding alternative for patients who cannot meet their nutrition requirements via oral intake or enteral tube feedings.

The guidelines for the appropriate use of PN have been developed by the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.),^{5,6} with the objective of identifying the most common and reasonable indications for

¹Department of Gastroenterology and Hepatology, Singapore General Hospital

²Yong Loo Lin School of Medicine, National University of Singapore

Address for Correspondence: Dr Sai Wei Chuah, Department of Gastroenterology and Hepatology, Singapore General Hospital, Outram Road, Singapore 169608.
Email: chuah.sai.wei@sgh.com.sg

the use of PN (Table 1). Many hospitals have implemented hospital-based nutrition support teams (NSTs) to ensure compliance with these guidelines, thereby reducing inappropriate use of PN. Their roles include identification of patients at medical risk from malnutrition, determination of the appropriate mode of nutrition therapy, and providing expert monitoring to reduce or avoid nutrition therapy-related complications.

Despite these efforts, recent published reports indicate that doctors continue to inappropriately prescribe PN.^{7,8} Inappropriately prescribed PN not only carries a clinical risk but places a substantial economic burden on the hospital.^{9,10} PN therapy requires input from multiple individuals, which affects its end-user cost. Examples of these components include a central catheter line or peripherally inserted central catheter line for PN infusion, pharmacy personnel hours and ingredients required to compound the PN solution, and delivery of intravenous supplies and equipment. Ancillary professional time and costs required to safely monitor clinical status, deliver the therapy, and manage complications are additional expenses. Optimal implementation of PN is, therefore, warranted to reduce the risk of complications and optimise clinical outcome and cost-efficiency ratio.

The NST in our hospital is responsible for the provision of PN outside the intensive care units. A previous audit showed that 15.9% of the PN prescriptions in 2001¹¹ were given for inappropriate indications: 45.5% of these were started because of surgeons' anticipation of prolonged postoperative ileus. It was also observed that 65.2% of these patients who were expected to have prolonged postoperative ileus were in fact able to resume adequate oral/enteral nutrition within 7 days of surgery and hence received PN for <7 days. The use of PN in these patients could, therefore, have been avoided with more aggressive attempts at oral/enteral feeding with the use of prokinetics. Subsequent to this audit, the NST made a concerted effort to educate doctors in the proper indications for PN.

The purpose of this study was to determine the indication and measure the rate of inappropriate PN use in hospitalised adults in Singapore General Hospital in 2006 based on the A.S.P.E.N. guidelines, and to compare the results with the 2001 audit. This will help us to determine if the educational efforts of the NST had helped reduce the number of inappropriate PN prescriptions.

Materials and Methods

All medical records and PN order forms of adult inpatients in Singapore General Hospital (SGH) who were prescribed PN between January and December 2006 were reviewed. Data collected included patient demographics, comorbidities, underlying diagnoses, indication and

duration of PN. The PN indication was classified as appropriate, inappropriate or indeterminate based on the A.S.P.E.N. 2002 guidelines (Table 1).

PN was classified as appropriate if (i) patients were unable to use gastrointestinal tract or expected not to be able to eat adequately for >7 days, or (ii) if patients had postoperative ileus as defined by nasogastric (NG) aspirates of >100 mls/day for 3 days or (iii) if malnourished patients were given preoperative parenteral nutritional support for ≥7 days. We considered those with a body mass index (BMI) of <18.5 or unintentional weight loss of >10% over the previous 3 months as malnourished.

PN was considered inappropriate if nutrition support was not indicated or if both of the following were true: (i) No evidence of GI malfunction or absence of a diagnosis consistent with need for PN, (ii) Patient could reasonably have been fed enterally.

PN use was considered indeterminate if any of the following were true: (i) Inadequate information to make a judgment, (ii) Debatable use of PN vs enteral feeding, (iii) Functional gastrointestinal (GI) tract, which was not accessed because of an unusual risk, potential complication, or delay in obtaining access.

The data were coded and entered using SPSS for analysis. Descriptive data on the patient demographics, details

Table 1. 2002 A.S.P.E.N. Guidelines: Indications for Nutrition Support Therapy⁶

1.	SNS should be used in patients who cannot meet their nutrient requirement by oral intake. (B)
2.	When SNS is required, EN should generally be used in preference to PN. (B)
3.	When SNS is indicated, PN should be used when the GI tract is not functional or cannot be accessed and in patients who cannot be adequately nourished by oral diets or EN. (Such conditions warranting PN are paralytic ileus, mesenteric ischemia, small bowel obstruction, GI fistula, except when enteral access may be placed distal to the fistula or volume of output (<200mL/d), diffuse peritonitis, intestinal obstruction, intractable vomiting or diarrhoea, and GI ischaemia.) (B)
4.	SNS should be initiated in patients with inadequate oral intake for 7 to 14 days or in patients in whom inadequate oral intake is expected over a 7- to 14-day period. (B)

A.S.P.E.N.: American Society for Parenteral and Enteral Nutrition; B, there is fair research-based evidence to support the guidelines (well-designed studies without randomisation), EN: enteral nutrition; GI, gastrointestinal, PN: parenteral nutrition, SNS: specialised nutrition support.

Adapted from A.S.P.E.N. Board of Directors and the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. JPEN J Parenter Enteral Nutr 2002;26(suppl 1): ISA-138SA.

pertaining to PN utilisation and appropriateness of PN prescription were generated.

Results

A total of 182 adult patients were prescribed PN in 2006. Twelve patients were started on PN on 2 separate admissions for different indications and these were considered as 2 different courses for each patient. This audit was based on 182 patients and their 194 courses of PN. The demographic data is shown in Table 2. Overall, a total of 2720 days of PN were prescribed in 2006.

Parenteral nutrition was used predominantly in surgical patients (82%). Among medical patients, the predominant indication for PN was for complications from hematopoietic stem cell transplantation (10.8%). Diagnoses consistent with the need for PN included non-functioning gut (ileus), postoperative complications, chemotherapy or radiation induced mucositis, preoperative or perioperative nutritional support for malnutrition, severe pancreatitis, advanced cancer with GI obstruction, short bowel syndrome, gastrointestinal fistula, critical illness, intestinal obstruction, high output enterocutaneous fistula, ischemic or perforated bowel and severe enterocolitis.

The indication for PN with comparison between the 2006 audit and previous audit in 2001 is shown in Table 3. The most common indication among surgical patients is for a

non-functioning gut. Thirty-one courses of PN were started for postoperative ileus. For patients with ileus, the median duration of ileus was 8 days (range, 3 to 20 days). Another 47 courses were started because the primary surgeon had expected to keep the patient nil-by-mouth for at least 7 days. The number of patients given PN for this indication doubled between 2001 and 2006, accounting for almost a quarter of all PN given. Compared with 2001, almost all patients who were started on PN because the surgeon expected to keep the patient nil-by-mouth for at least 7 days, did receive PN for at least 7 days.

The most common indication for PN in medical patients was mucositis after haematopoietic stem cell transplant. In the miscellaneous group, there were 5 patients with chylous leak, 4 patients with neutropenic enterocolitis, 4 patients with oesophageal tear and perforation, 1 patient with adjustment disorder and depression who refused oral intake, 1 patient with dysphagia due to oesophageal stricture, 1 patient with capecitabine induced enterocolitis, 1 patient with graft-versus-host disease of stomach, 1 patient with blocked J-tube, 1 patient with possible perforated gallbladder but patient opted for conservative management and kept fasted for 1 week and 1 patient with ileus secondary to severe CMV infection.

The median duration of PN was 9 days (range, 2 to 115 days). The distribution of appropriateness of PN use

Table 2. Patients Baseline Demographics

Baseline Demographics	
Male: Female (No.)	96:86
Age (years)—median (range)	62 (range, 16 to 100)
Duration of PN use (days)—median (range)	9 (range, 2 to 115)
Referring departments	No. (%)
(a) Surgical	
General Surgery	104 (53.6)
Colorectal Surgery	41 (21.1)
Cardiothoracic	11 (5.7)
Orthopaedic	2 (1.0)
Urology	1 (0.5)
(b) Medical	
Haematology	21 (10.8)
Oncology	6 (3.1)
Gastroenterology	3 (1.5)
Renal	2 (1.0)
Internal Medicine	1 (0.5)
Dermatology	1 (0.5)
Endocrinology	1 (0.5)

Table 3. Indications for Parenteral Nutrition and Comparison with Previous Audit in 2001

Indications	2006 Audit		2001 Audit	
	No.	%	No.	%
Non-functioning gut	78	40.0	52	37.7
Postoperative ileus	31	16.0	29	21.0
Surgeons' expectation of ileus	47	24.2	23	16.7
Postoperative complications	33	17.0	20	14.5
Mucositis	20	10.3	12	8.7
Preoperative/Perioperative nutritional support for malnutrition	8	4.1	12	8.7
Pancreatitis	6	3.1	5	3.6
Advanced cancer with GI obstruction	4	2.1	16	11.6
Short bowel syndrome	2	1.0	3	2.2
Gastrointestinal fistula	1	0.5	2	1.4
Critical illness	14	7.4	11	8.0
Intestinal obstruction	8	4.3	1	0.7
Miscellaneous	20	10.3	4	2.9
Total	194	100	138	100

GI: gastrointestinal

Table 4. Distribution of Appropriateness of PN Use Based on PN Duration

Duration of PN	No.	Appropriate No. (%)	Inappropriate No. (%)	Indeterminate No. (%)
<7 Days	29	17 (8.8)	9 (4.6)	3 (1.5)
7 to 14 Days	67	67 (34.5)	0	0
15 to 21 Days	43	42 (21.6)	1 (0.5)	0
>21 Days	55	55 (28.4)	0	0

based on PN duration is shown in Table 4. Twenty-nine PN courses were given for <7 days. Of which 17 were deemed appropriate as the duration of patient being kept nil by mouth prior to PN, in addition to the duration of the PN was more than 7 days in total. Three courses were indeterminate: 2 patients died within 4 and 6 days of starting PN, and 1 patient who was started on PN preoperatively decided not to proceed with the operation and PN was terminated prematurely. The remaining 9 courses were inappropriate. Of which 3 had PN for <7 days preoperatively and 6 had PN for <7 days because the managing team thought the patients were critically ill and PN was started without first determining if the patients could be fed enterally. These patients should have been put on nasogastric or nasojejunal tube feeding. Forty-three PN courses were given for 15 to 21 days. Of which 1 was given PN for refusal to eat due to depression and this was deemed inappropriate as there was no GI malfunction. Sixty-seven PN courses and 55 PN courses were given appropriately for 7 to 14 days and >21 days, respectively.

As shown in Table 5, the indications for PN met ASPEN guidelines in 93.3% of cases compared to 78.3% in 2001. Ten courses did not meet the guidelines and 3 courses were indeterminate.

Since 2001, there has been an increase in the use of PN. However, the proportion of PN given for appropriate indications has also increased. Education of physicians with respect to the benefit of PN for preoperative and critically ill patients with functioning guts needs reinforcing. Preoperative PN was shown to decrease postoperative complications by about 10%, with benefits seen mainly in severely malnourished patients given for at least 7 days.⁶ In the critically ill patients with functioning gut, enteral feeding is preferred.

Discussion

The use of PN is often an automatic response to the perceived or actual need for a nutrition intervention, perhaps resulting from inadequate medical training, years of habitual practice decisions, or hospital culture. Although PN has a role in nutrition support, inappropriate use can lead to

Table 5. Appropriateness of PN and Comparison with 2001 Audit

	2006 Audit		2001 Audit	
	No.	%	No.	%
Appropriate	181	93.3	108	78.3
Inappropriate	10	5.2	22	15.9
Indeterminate	3	1.5	8	5.8

both economic issues and complications. The application of evidence-based practice in nutrition support therapy continues to be a challenge. Although guidelines such as those developed by A.S.P.E.N. are helpful in providing an evidence-based approach to defining the appropriate use of PN, they are not designed to specify care pathways based on each patient's unique medical circumstance.

The findings of our study are in line with the results of other studies indicating that inappropriate usage of PN still persists despite the establishment of rigorous, peer-reviewed A.S.P.E.N. guidelines for appropriate PN use. However, it is encouraging that there is improvement from the previous study after the educational efforts of the nutrition support team.¹¹ This improvement is in keeping with the findings that showed a significant improvement in appropriateness of PN indications comparatively to those early reported rates.^{12,13}

This improvement is contributed by the increased awareness of healthcare professionals on the proper use of nutrition support and the availability of the NSTs in the hospital. The NST consists of a physician, dietician, nurse, and pharmacist as core members. The team is consulted to manage PN or enteral nutrition and serves the primary responsibility of assuring that the patient receives nutrition support by the appropriate route. The available evidence suggests that preventable PN, short-term PN utilisation and metabolic complications are less likely to occur and there are financial benefits from consultations by a NST.^{14,15} Kennedy and Nightingale et al showed a major reduction of catheter complication, a decrease in in-hospital mortality and substantial cost savings after the introduction of a NST in their hospital.¹⁴ Trujillo et al also found that metabolic and monetary costs associated with PN use were reduced when it was provided by a NST as compared to individual clinicians prescribing the therapy.¹⁶ Specifically, there was better compliance (82% vs 56%) with appropriate PN use according to the A.S.P.E.N. guidelines, fewer complications (34% vs 66%), and therapies with duration <5 days (16% vs 35%) between the study and control groups.¹⁶ O'Brien et al also showed that NST promote cost containment.¹⁰ Hence, it is important to realise that inappropriate or avoidable use of PN has a negative effect on the budget of a hospital.

Although the NST approach to appropriate PN ordering has published success, it is by no means an accepted nationwide practice. NSTs that are consulted on a voluntary basis will not have success in reducing inappropriate therapy compared with NSTs where approval is mandatory for all PN orders before implementation.¹⁷ It may be that the only effective means of controlling inappropriate PN use is with an NST that has the absolute authority to approve or reject a PN order. However, mandated NST approval of PN is not an accepted practice at many medical centers, because of a wide variety in physician experience, attitude, motivation, core knowledge, and perceived authority level.

To further improve the appropriateness of PN prescription, better methods of decision-making regarding the initiation of PN support need to be developed. The purpose was to have a clear set of criteria for the decision to initiate PN support to eliminate inappropriate use. It is important to realise that no algorithm can provide the ultimate correct decision for PN use in every patient or be a substitute for appropriate clinical judgment. However, an algorithm can be used as a framework to analyse the decision and formally explicate the issues. Many hospitals adopted policies to control the PN ordering process by integrating a “flagging” tool in the medical chart that would require physicians to indicate which A.S.P.E.N. guideline justifies their decision to order PN.^{9,18} In our hospital, we have recently introduced a PN referral form to be filled in to indicate the justification for PN referral.

When PN was used without an appropriate indication, it was typically because it was ordered when patients had an inadequate trial of enteral tube feeding, and were transitioned to either enteral feeding or to an oral diet within 5 days of therapy. To reduce short-term use of PN, the healthcare team should recognise the transitory nature of many gastrointestinal disorders and avoid a narrow focus on the current nutritional state of the patient. Surgeons ought to assess the patient’s potential postoperative nutritional needs at the time of laparotomy and should recognise that the need for postoperative PN may be avoided by the use of a feeding jejunostomy.^{19,20} Although there are risks involved in the placement and use of feeding tubes, these are generally less than the risks of PN.

In addition, nutrition training programs should be incorporated into medical school curricula, physician residency programs, physician fellowship curricula, and postgraduate physician education programs to bolster knowledge and practice of general nutrition and nutrition support.²¹⁻²³

In this study, adequacy of PN administration was not assessed. This is important as both unjustified PN prescription and inadequate calorie, macro- and micronutrient provision is known to be associated with morbidity (metabolic and

infectious risks) and mortality.⁴ The main goal of PN is to deliver a nutrient mixture closely related to requirements safely and to avoid complications. Hence, future audits should not just study the appropriateness of PN prescriptions but also the adequacy of calorie and macronutrient provision. Future studies designed to identify the barriers and enablers to implementing the A.S.P.E.N. guidelines for nutrition support therapy are also needed.

Conclusion

In summary, optimal implementation of PN is required to promote clinical outcome and costs control. Although clinical practice guidelines provide a basis for consistent care, it is possible to improve the safety of PN further by using standardised procedures and involving healthcare professionals who are knowledgeable about this complex form of therapy. The evidence-based standard for optimising treatment outcomes for administering nutrition support effectively and safely is the interdisciplinary team approach. The processes used to support evidence-based practice must be designed to match organisational culture. An increased awareness through education program together with empowerment of a multi-disciplinary nutrition consult service may help to continue to increase the trend of appropriate use of hospital PN therapy.

REFERENCES

1. Braunschweig CA. Creating a clinical nutrition registry: prospects, problems, and preliminary results. *J Am Diet Assoc* 1999;99:467-70.
2. Gallagher-Allred CR, Voss AC, Finn SC, McCamish MA. Malnutrition and clinical outcomes: the case for medical nutrition therapy. *J Am Diet Assoc* 1996;96:361-6.
3. Wilmore DE, Dudrick SJ. Growth and development of an infant receiving all nutrients exclusively by vein. *JAMA* 1968;203:860-4.
4. Jeejeebhoy KN. Total parenteral nutrition: potion or poison? *Am J Clin Nutr* 2001;74:160-3.
5. Galica LA. Parenteral nutrition. *Nurs Clin North Am* 1997;32:705-17.
6. A.S.P.E.N. Board of Directors and the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *JPEN J Parenter Enteral Nutr* 2002;26(1 suppl):1SA-138SA.
7. DeLegge MH, Basel MD, Bannister C, Budak AR. Parenteral nutrition (PN) use for adult hospitalized patients: a study of usage in a tertiary medical center. *Nutr Clin Pract* 2007;22:246-9.
8. Saalwachter AR, Evans HL, Willcutts KF, O'Donnell KB, Radigan AE, McElearney ST, et al. A nutrition support team led by general surgeons decreases inappropriate use of total parenteral nutrition on a surgical service. *Am Surg* 2004;70:1107-11.
9. Maurer J, Weinbaum F, Turner J, Brady T, Pistone B, D'Addario V, et al. Reducing the inappropriate use of parenteral nutrition in an acute care teaching hospital. *JPEN J Parenter Enteral Nutr* 1996;20:272-4.

10. O'Brien DD, Hodges RE, Day AT, Waxman KS, Rebello T. Recommendations of nutrition support team promote cost containment. *JPEN J Parenter Enteral Nutr* 1986;10:300-2.
 11. Chan SL, Luman W. Appropriateness of the use of parenteral nutrition in a local tertiary-care hospital. *Ann Acad Med Singapore* 2004;33:494-8.
 12. Katz SJ, Oye RK. Parenteral nutrition use at a university hospital: factors associated with inappropriate use. *West J Med* 1990;152:683-6.
 13. DeLegge MH, Basel MD, Bannister C, Budak AR. Parenteral nutrition (PN) use for adult hospitalized patients: a study of usage in a tertiary medical centre. *Nutr Clin Pract* 2007;22:246-9.
 14. Kennedy JF, Nightingale JM. Cost savings of an adult hospital nutrition support team. *Nutrition* 2005;21:1127-33.
 15. Roberts MF, Levine GM. Nutrition support team recommendations can reduce hospital costs. *Nutr Clin Pract* 1992;7:227-30.
 16. Trujillo EB, Young LS, Chertow GM, Randall S, Clemons T, Jacobs DO, et al. Metabolic and monetary costs of avoidable parenteral nutrition use. *JPEN J Parenter Enteral Nutr* 1999;23:109-13.
 17. DeLegge MH. Changes in Medicare reimbursement policy may restrict nutrition therapy options. *Nutrition* 1997;13:926-7.
 18. Duggan C, Rizzo C, Cooper A, Klavon S, Fuchs V, Gura K, et al. Effectiveness of a clinical practice guideline for parenteral nutrition: a 5-year follow-up study in a pediatric teaching hospital. *JPEN J Parenter Enteral Nutr* 2002;26:377-81.
 19. Nehme EA. Nutritional support of the hospitalized patient: the team concept. *JAMA* 1980;243:1906-8.
 20. Fisher GG, Opper FH. An interdisciplinary nutrition support team improves quality of care in a teaching hospital. *J Am Diet Assoc* 1996;96:176-8.
 21. Touger-Decker R. Nutrition education of medical and dental students: innovation through curriculum integration. *Am J Clin Nutr* 2004;79:198-203.
 22. Deen D, Spencer E, Kolasa K. Nutrition education in family practice residency programs. *Fam Med* 2003;35:105-11.
 23. Heimburger DC; Intersociety Professional Education Consortium (IPNEC). Training and certifying gastroenterologists as physician nutrition specialists. *J Clin Gastroenterol* 2002;34:505-8.
-