

**EFFECT OF MODIFIED PARTIAL PARENTERAL NUTRITION
(PPN) ADMINISTRATION TECHNIQUES ON THE PREVENTION
OF THROMBOPHLEBITIS, THE NUTRITIONAL STATUS AND
PATIENTS' PSYCHO-SOMATIC IMPACT**

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Noree Chongwilaikasem

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ABSTRACT

Peripheral parenteral nutrition (PPN) is the method of nutrition support to avoid the risks of central venous catheterization. The problem with PPN, however, is thrombophlebitis; for instance, in a previous study it occurred within 40 hours in 100% of patients at Ramathibodi hospital who had received PPN via a peripheral vein. This problem brings about patient suffering and increases nursing workload in giving care and inserting new catheters. This study was designed to prove that a new cyclic infusion technique – as compared to the standard continuous PPN of 1,430 kcal/d and 804 mOsmol/L– can prevent or delay the onset of thrombophlebitis without compromising the nutritional status of patients. It was also designed to investigate the psycho-somatic impact of cyclic infusion on patients. A prospective control trial was conducted in 32 patients who suffered from major gastrointestinal problems and required PPN support. Patients in the control group (n=16) were continuously fed PPN over 24 hours for five days, whereas patients in the experimental group (n=16) were fed PPN over 16 hours for five days except for 8 hours at nights. There was no difference between groups in the severity of disease (APACHE II score) and nutritional status (SGA) at the beginning of the study. The onset of thrombophlebitis was 38 hours in the continuous group and 84 hours in the cyclic group ($P<0.001$). After five days of infusion, prealbumin levels ($P<0.001$), vitamin B1, B2 and vitamin C status ($P<0.05$) were significantly increased in both groups. However, there was no significant difference in levels of the two groups. All patients in the cyclic group preferred the cyclic technique because they could have adequate sleep at night as well as freedom of movement. The nurses said that the cyclic method reduced their work load during the night. In conclusion, infusion duration is an important factor in the development of thrombophlebitis. The cyclic technique significantly delays the onset of thrombophlebitis without affecting nutritional status.

KEY WORD: PERIPHERAL PARENTERAL NUTRITION / PARTIAL PARENTERAL NUTRITION / NUTRITIONAL STATUS CYCLIC TECHNIQUE / THROMBOPHLEBITIS / PSYCHO-SOMATIC IMPACT

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ผลของการตัดแปลงวิธีการให้อาหารทางหลอดเลือดดำแบบไม่สมบูรณ์ทางหลอดเลือดดำส่วนปลายเพื่อลดอัตราการอักเสบของหลอดเลือด, และปรับปรุงภาวะทางโภชนาการ และผลกระทบต่อสภาวะร่างกายและจิตใจของผู้ป่วย (EFFECT OF MODIFIED PARTIAL PARENTERAL NUTRITION (PPN) ADMINISTRATION TECHNIQUES ON THE PREVENTION OF THROMBOPHLEBITIS, THE NUTRITIONAL STATUS AND PATIENTS' PSYCHO-SOMATIC IMPACT)

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บทคัดย่อ

การให้อาหารทางหลอดเลือดดำแบบไม่สมบูรณ์ทางหลอดเลือดดำส่วนปลายมักจะก่อให้เกิดปัญหา หลอดเลือดดำส่วนปลายอักเสบเสมอการศึกษาการเกิดหลอดเลือดดำอักเสบในโรงพยาบาลรามารชิบัติที่ผ่านมาพบว่า 100% ของผู้ป่วยที่ได้รับอาหารทางหลอดเลือดดำส่วนปลาย เกิดภาวะหลอดเลือดดำอักเสบภายใน 40 ชม. ดังนั้นในการศึกษานี้จึงได้ดำเนินการเพื่อพิสูจน์ให้เห็นว่าการให้สารอาหารแบบไม่สมบูรณ์ทางหลอดเลือดดำส่วนปลายโดยมีระยะพักสามารถป้องกันการเกิดภาวะอักเสบของหลอดเลือดดำ, และไม่ทำให้สภาวะทางโภชนาการลดลงเมื่อเทียบกับการให้อาหารทางหลอดเลือดดำแบบไม่สมบูรณ์โดยวิธีมาตรฐานที่ไม่มีระยะพัก ตลอดจนศึกษาผลกระทบต่อร่างกายและจิตใจของผู้ป่วยเมื่อได้รับอาหารทางหลอดเลือดดำโดยมีระยะพัก การศึกษานี้ได้ทำในผู้ป่วยที่เข้าพักในหอผู้ป่วยศัลยกรรม โรงพยาบาลรามารชิบัติที่ป่วยด้วยโรคทางเดินอาหารที่รุนแรงและต้องได้รับอาหารทางหลอดเลือดดำจำนวน 32 คนซึ่งถูก แบ่งเป็น 2 กลุ่ม กลุ่มละ 16 คน ได้แก่ กลุ่มที่ได้รับอาหารทางหลอดเลือดดำแบบต่อเนื่องใน 24 ชั่วโมง และแบบมีระยะพัก 8 ชั่วโมงในช่วงกลางคืนเป็นเวลา 5 วัน (804 mOsmol/l) ก่อนการให้สารละลายอาหารทางหลอดเลือดดำพบว่าไม่มีความแตกต่างระหว่างความรุนแรงของโรคและสภาวะทางโภชนาการระหว่างทั้ง 2 กลุ่ม ผลการศึกษาพบว่าระยะเวลาก่อนการเกิดการอักเสบของหลอดเลือดดำในกลุ่มที่ได้แบบหยุดพัก (84 ชั่วโมง) ยาวนานกว่ากลุ่มที่ได้แบบต่อเนื่อง (38 ชั่วโมง) อย่างมีนัยสำคัญทางสถิติ หลังการให้อาหารทางหลอดเลือดดำเป็นเวลาวันพบว่าค่า prealbumin ($p < 0.0001$) และสภาวะทางโภชนาการของวิตามินบีหนึ่ง, บีสอง และวิตามินซี ($p < 0.0001$) ในผู้ป่วยทั้งสองกลุ่มสูงขึ้นอย่างมีนัยสำคัญทางสถิติ อย่างไรก็ตามไม่มีความแตกต่างระหว่างกลุ่มในเรื่องของสภาวะทางโภชนาการ และในการศึกษานี้ยังพบว่าผู้ป่วยที่ได้รับอาหารทางหลอดเลือดดำโดยมีระยะพักทุกคนพึงพอใจกับวิธีดังกล่าวเนื่องจากสามารถหลับได้สนิทและเคลื่อนไหวได้สะดวกในช่วงกลางคืนเมื่อหยุดให้อาหารทางหลอดเลือด นอกจากนั้นยังพบว่าวิธีให้อาหารทางหลอดเลือดดำโดยมีระยะพักในช่วงกลางคืนสามารถลดภาระงานของพยาบาลในช่วงเวรดึกได้อีกด้วย จากการศึกษาพบว่าระยะเวลาที่หลอดเลือดสัมผัสกับสารละลายเป็นปัจจัยสำคัญในการเกิดภาวะหลอดเลือดดำอักเสบ ดังนั้นวิธีการให้อาหารหลอดเลือดดำโดยมีระยะพักสามารถชะลอระยะเวลาการเกิดหลอดเลือดดำอักเสบได้อย่างมีนัยสำคัญทางสถิติโดยไม่ส่งผลกระทบต่อสภาวะโภชนาการของผู้ป่วย

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LIST OF ABBREVIATIONS

AC	Activity coefficient
APACHE II Score	Acute physiology and chronic health evaluation II score
BMI	Body mass index
BUN	Blood urea nitrogen
CA	Cancer
CBC	Complete blood count
EGRA	Erythrocyte glutathione reductase activity
ETKA	Erythrocyte transketolase activity
g	Gram
HAD	Hospital Anxiety and Depression
Hct	Hematocrit
hr	Hour
IU	International unit
IV	Intravenous
kcal	Kilocalorie
L	Liter
mEq	Milliequivalent
mg	Milligram
ml	Milliter
mmol	Millimole
MAC	Mid arm circumference

LIST OF ABBREVIATIONS (cont.)

PG	Prostaglandin
PPN	Partial parenteral nutrition
SGA	Subjective global assessment
TPPE	Thiamin pyrophosphate effect
TSF	Triceps skinfold thickness
WBC	White blood cell

CHAPTER 1

INTRODUCTION

Malnutrition causes a negative outcome in hospitalized patient by increasing morbidity, mortality, length of stay and costs (1-5). Recently, Correia et al in 2003 (6) reported the prevalence of hospital malnutrition in Latin America to be 50.2 percent (ELAN study). In 1980, Tanphaichitr et al (7) showed that 73.2 percent of hospitalized patients in Ramathibodi Hospital were malnourished. However, 15 years later, Komindr et al in 1995 (8) also found that the prevalence of hospital malnutrition in Ramathibodi hospital was still high though it had decreased to 52.6 when compared with the previous study. Unfortunately, most patients admitted under stress conditions have been given only simple volume replacement with 5-10% Dextrose in a half-strength physiological solution without adding any amino acids. Therefore, it is anticipated that a great number of these patients may have poor outcome.

Malnutrition in surgical patients is associated with delayed wound healing and increased risk of morbidity and mortality. Many studies showed that good preoperative nutritional status helped to prevent early and late postoperative complications and reduce the length of hospital stay (1-5,9). Parenteral nutrition, a way of nutrition support, is necessary for gastrointestinal dysfunctioned patients. The use of parenteral nutrition is important for the prevention and treatment of many disease states. It refers to provision of partial or total nutrient requirements through the venous system. Total parenteral nutrition (TPN) is the infusion of a parenteral nutrition that contains high concentrations of dextrose, amino acids, electrolytes, vitamin and trace elements, delivered through a central venous catheter into a large vein (10-11). Unfortunately, TPN administration causes many serious complications, for examples, catheter malposition, air embolism, pneumothorax, subclavian or superior vena cava thrombosis and septic complications (12-16). Peripheral parenteral nutrition (PPN) refers to a partial nutritional solution that involves the infusion of low osmolarity dextrose, amino acids, electrolytes, vitamin and trace elements that infused through

peripheral vein. However, PPN may only meet partial nutritional requirements and is used for short-term (i.e., less than 14 days) or supplemental nutrition support (11,17-18). PPN can be used as a holding regimen to avoid the risks of central venous catheterization, to simplify the nursing care, to reduce cost and may also prevent delay in the initiation of nutrition support.; but PPN is not routinely suggested in hypercatabolic patients with increased energy requirements, or in long-term nutritional support patients.

The advantages of PPN are that (19)

- 1) Venous access can be obtained at bedside by standard venepuncture methods.
- 2) The complications tend to be less serious than those associated with central venous catheter.

However, the uses of this form of nutrition support are not without problems. Thrombophlebitis is the most common local complication and a major problem in PPN. Kocharsanee et al in 2002 (20) reported the prevalence of thrombophlebitis in PPN patient in Ramathibodi hospital to be 100% (score 1⁺ of Maddox criteria) within forty hours. Therefore, this study were designed to investigate the technique to reduce or delay thrombophlebitis.

Not only thrombophlebitis but nutritional status were investigated also. Plenty of evidence have showed the benefit of TPN, however, only little benefit on nutrition have been showed in PPN. This study delineated the benefit of 5 days PPN administration on the nutritional status. Quality of life in PPN patients are also interesting, no other reports investigated the psycho-somatic impact of PPN patients. However, many patients receiving home total parenteral nutrition during the night often complained of fatigue ability and daytime somnolence. It is possible that the infusion of TPN during nocturnal sleep hours may interfere with normal sleep patterns (21). Consequently, this study investigated to the effect of cyclic method on the quality of sleep and mobility during the night in cyclic patients.

Objectives

1. To prove that the cyclic technique of PPN with intravenous cannula *in situ* can prevent or delay the onset of thrombophlebitis.
2. To compare the nutritional consequence between cyclic PPN and continuous PPN group.
3. To investigate the impact of the cyclic infusion technique on the patients' psycho-somatic status.

CHAPTER 2

LITERATURE REVIEW

Thrombophlebitis

Thrombophlebitis is characterized by pain and tenderness along the course of the vein, erythema and inflammatory swelling with a feeling of warmth at the site of catheter insertion. An inflammation of a vein relates to a chemical or mechanical irritation, or both (12,22-24).

Pathophysiology of thrombophlebitis

When the vein wall is injured, platelet phospholipase A₂ will be stimulated to prostaglandin PGE₂ and PGD₂ which increase vascular permeability and hydroxyeicosatetraenoic acid (HETE) and thromboxane B₂ (TXB₂) which are chemotactic for PMN leucocytes. PGG₂, PGH₂ and thromboxane A₂ are other platelet-produced arachidonic acid metabolites which are active as platelet aggregating or releasing agents and involved at endothelial surface. The mediators released in response to venous irritation may stimulate vasoconstriction. Based on vasoconstriction, the flow blood in the vein is decreased. The irritant infusates are not rapidly diluted, together with stasis, this would induce thrombophlebitis (11-14,22,24).

Predisposing factors

The aetiology of peripheral thrombophlebitis appears to be a combination of factors.

1. Chemical factor

Duration of infusion

Bier in 2000 (25) confirmed the effect of infusion duration on the development of thrombophlebitis. He suggested that osmolarity of the infusion can approach 1000

mOsm/l if the duration of infusion was only a few hours. Moreover, the infusion should be diluted to reduce the osmolarity, even if an increase in infusion rate was necessary.

Flow rate

Many authors suggested that the rate of infusion is important, with it being advantageous to give irritant solutions quickly. Kuwahara et al, 1997 (26) concluded that a hypertonic solutions should be infused in clinically acceptable high rate because increasing the infusion rate reduced the rate of thrombophlebitis.

Osmolarity

The incidence of thrombophlebitis is related to the osmotic content of infused solutions. Early studies of PPN using crystalline amino acid and glucose-based solutions found 100% of thrombophlebitis rates when the osmolarity is increased above 600 mOsm/l. Many authors suggest that the osmolarity should not exceed 800-1000 mOsm/l (23-24,26).

pH

The pH of solutions is an important factor. Kuwahara et al (27) suggested the tolerable pH for the peripheral vein to be 6.49, and this pH did not cause thrombophlebitis. Acid is produced by amino acids and the degradation products of glucose formed during heat sterilization. There is experimental evidence demonstrating an association between increased acidity and the phlebotic potential of a variety of infusates (28).

2. Physical factors

Catheter (13,29-31)

Properties of the infusion catheter that influence the development of thrombophlebitis include diameter, length and material.

Type of catheter: The catheter material is also important. With polyurethane catheters, the incidence of phlebitis is reduced significantly compared with polyethylene. Williams et al, 1996 (31) investigated that a 22 or 23G 'ultrafine' catheter was associated with a low incidence of thrombophlebitis(15 percent). Polyurethane

catheters might be slightly superior to silicone catheters because they are stronger and have a larger internal diameter for the same external diameter. Large-gauge catheters are associated with the thrombophlebitis compared with small-gauge catheters.

Catheter placement-site: There are high incidence of thrombophlebitis at the flexures of veins. Placement across joints made the cannula moving within the vein during flexion and extension causing endothelial damage (32-33).

Vein size

Vein size is an equally important factor as cannula size to develop the thrombus. The larger vein has a greater blood flow around the insertion site, then the infused fluids will be dispersed quickly. Based on this reason, the appropriate vein of choice for PPN are the basilic and cephalic veins of the arm (34).

Particulate matter

It was thought that the increased incidence of thrombophlebitis was caused by the presence of particles in the solution. Therefore, some authors recommended the use of filters in the infusion tubing. However, Rypins et al (35) showed the effect of chemical properties in parenteral nutrition solution to be more important than bacteria or particulates.

3. Mechanical factors

Trained nurse

Laundgren et al (32) found reduction of complications in handling of peripheral intravenous lines such as thrombophlebitis rate and infection problem after the nurses had finished their education programme.

4. Others

Hematocrit

There is only one report about the relationship between higher hemoglobin levels and the risk of thrombophlebitis which was published in 1999 by Monreal et al (36). They hypothesized that by lowering the blood flow in the veins, a high hematocrit would reduce the dilution of irritant solution. Nevertheless, they suggested that further studies were needed.

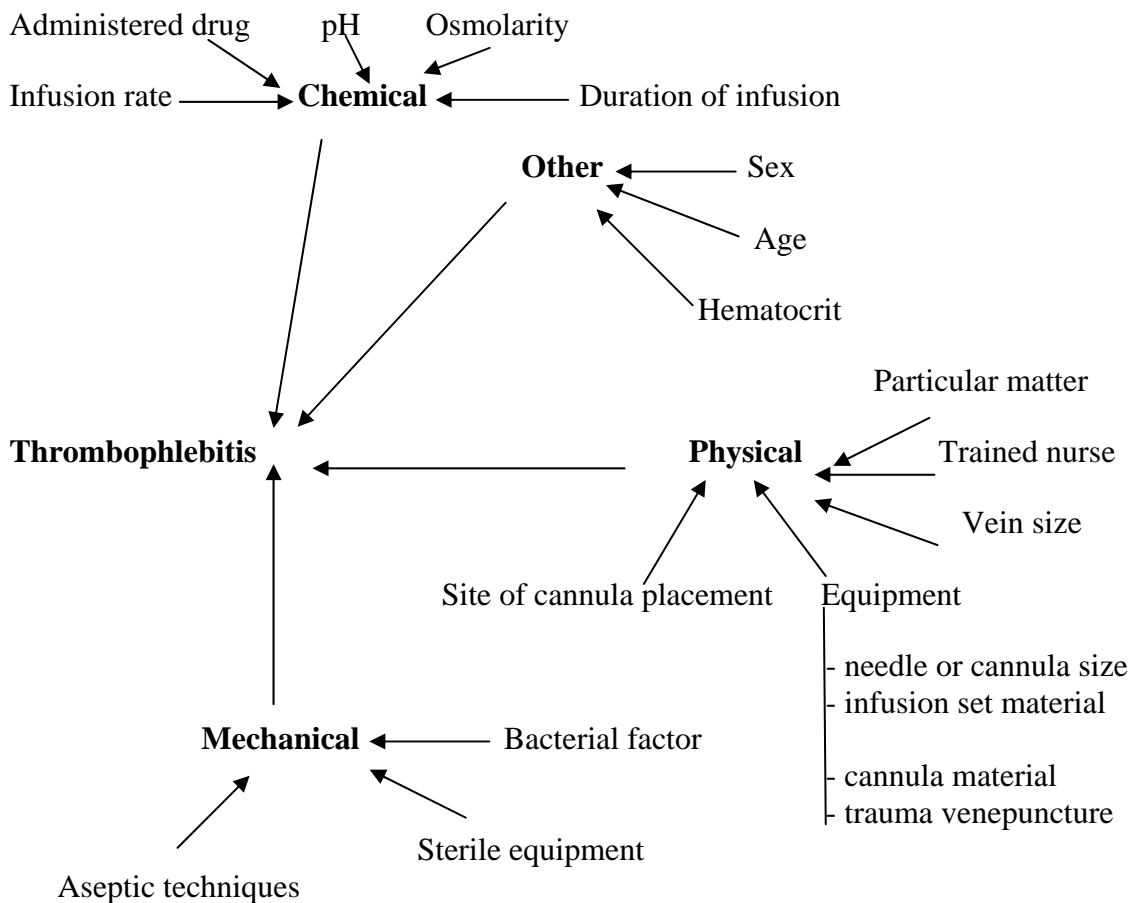
Sex

Female has poor-quality peripheral veins than male (13,37).

Age

Hastbacka et al in 1965 showed a tendency for the incidence to lower in younger age groups, whereas Aldman and Garsten in 1996, Swanson and Aldrete in 1969, Dinley in 1976 were unable to show a consistent trend between age and incidence of thrombophlebitis (13).

Factors implicated in development of thrombophlebitis.(12-16,23,26,38)



Prophylactic measures against thrombophlebitis. (13,18,20,24,33,39-40)

1. Buffering

Buffer solutions such as sodium bicarbonate can reduce the risk of thrombophlebitis. Since sodium bicarbonate is included to neutralize the solution pH

to nearly physiologic conditions. Although the solutions have theoretic and some clinical value, risk of physiochemical incompatibilities is increased. The addition of sodium bicarbonate to increase the solution pH, changes the solubility of calcium and phosphate and the precipitation reaction is enhanced.

2. Topical glyceryl trinitrate

Glyceryl trinitrate ointment applied over the site of infusion can reduce the incidence of thrombophlebitis. It promoted an *in situ* vasodilation and stimulated the synthesis of prostacyclin which was a potent inhibitor of platelet aggregation. Nevertheless, glyceryl trinitrate have been reported to cause skin reaction and headache.

3. Topical Nonsteroidal Anti-inflammatory drugs

Prostaglandins and related compounds are involved in the process of thrombophlebitis. Aspirin, indomethacin and phenylbutazone inhibit prostaglandin synthesis, so NSAIDs are used as an antithrombogenic agent. However, no trial has proved the use of topical NSAIDs in patients receiving PPN. Therefore, some authors concluded that there was insufficient evidence to warrant the routine use of either treatment at present.

4. Other topical agents

Aloe vera gel is used for preventing and reducing thrombophlebitis. Therapeutic abilities of Aloe vera gel are penetrate tissue, dilate capillaries and enhance blood flow. It can be anti-inflammatory agent via the inhibitory action of arachidonic acid cyclooxygenase pathway.

5. Hydrocortisone

Hydrocortisone is selected as an additive to PPN for its ability to produce an anti-inflammatory effect on epithelial cell. The effect of inhibiting the action of phospholipase and eicosanoid synthesis, produced fewer inflammatory stimuli. Nevertheless, the side effect of steroid is very harmful so steroid is not appropriate for long term used.

6. Heparin

Heparin is added to prevent the formation of a fibrin clot around the tip of the cannula in the vein. It may also alter the surface property of the venous

endothelium and impair the development of thrombophlebitis. The systematic review and meta-analysis of randomised controlled trials in 1998 (41) evaluated the effect of heparin on duration of catheter patency. Randolph et al concluded that keeping the peripheral venous catheter patent by 10 IU/ml of heparin did not reduce the incidence of thrombophlebitis. When 1 IU/ml of continuous infusion heparin was given, however, the risk of thrombophlebitis decreased and the duration of patency was increased. However, the admixture of heparin to a PPN solution containing lipid may alter the stability of lipid emulsion, leading to flocculation of PPN solution and formation of a complex with calcium.

Nevertheless, there were some evidences showing the synergistic effect of heparin and corticosteroids in reducing thrombophlebitis. Messing in 1986 (42) showed the beneficial effect of heparin 1000 (IU/l) and hydrocortisone (5 mg/l) on 960 mOsm/l of PPN solution. The thrombophlebitis incidence were reduced from 82% to 6% within 48 hours. Whereas heparin 1000 IU/l, thrombophlebitis were reduced to 42%. Madan et al, 1991 (24) showed a reduction in the incidence of thrombophlebitis by adding the IV infusate with heparin and hydrocortisone. They found that the addition of heparin (500 IU/l) and hydrocortisone (5 mg/l) significantly reduced the daily risk of thrombophlebitis from 0.43 to 0.11 episodes per patient. Kane et al in 1996 (43) investigated the effect of 500 IU/l of heparin in parenteral nutrition, found no significant difference between groups of normal osmolarity (1200 mOsmol/l) and higher osmolarity (1700 mOsmol/l). However, the infusion of heparin or hydrocortisone cannot be routinely recommended for PPN unless physical and chemical stability studies have been undertaken with nutrient formulation.

7. Lipid

The incidence of thrombophlebitis is reduced by lipid. Lipid is added directly to the PPN solutions. It can protect the lining of the vein because it promotes improved tolerance from the buffering and dilutional effects of the isoosmolar lipid with the higher pH of the amino acid solution. Many *in vivo* studies performed with the soybean oil fat emulsion indicate that some medicine, electrolytes, vitamins and amino acid solutions may be added to fat emulsions. These results are not conclusive enough to be referred to clinical practice.

8. Rotation of venous access sites

The incidence of infusion phlebitis is minimized when PPN is administered with rotation of venous access sites. Kerin et al in 1991 (44) compared continuous with rotation techniques in 51 PPN patients. By resiting the catheter arm every 24 hours, the thrombophlebitis incidence was reduced from 41% to 18%. Weiss et al in 1975 (40) investigated the effect of infusion duration on thrombophlebitis incidence. The results of their study demonstrated clearly that the incidence of thrombophlebitis can be significantly decreased by rotating the veins used.

9. Rotation with cyclic techniques

When a vein is exposed to the solution for a shorter duration the incidence of thrombophlebitis should be reduced especially when there is a rest period when no solution is given. Nordenstrom et al, 1991 (45) were the first to explain the effect of infusion techniques on incidence of thrombophlebitis. Their recommendations were to use a short, thin plastic cannula and completed the daily nutrition within 12-h, removed the cannula immediately after completing the infusion. The contralateral arm was used in the next 12-h. They reported the incidence of thrombophlebitis to be 18% with a mean duration of 5 days of PPN. Kerin et al in 1991 (44) compared the incidence of thrombophlebitis under difference techniques. The continuous infusion in 24-h had a higher rate of the incidence(41%) in 7.5 day whereas rotation with cyclic infusion in 12-h (reinsertion) had 17.6% of thrombophlebitis in 8.2 day. May et al in 1996 (29) randomized 60 patients to four groups. They found the effect of infusion time in rotation with cyclic technique of venous access sites. There was no incidence of thrombophlebitis during 7.5 days of PPN admission (0%). This technique was 12-h infusion at night, and immediately removed postinfusion. Then, PPN was restarted 12-h later through a contralateral arm. While 'heparin-locked and left cannula *in situ* technique', to solve the complaint of patients in reinsertion problem, had 33% of thrombophlebitis incidence. The control group in this study were 24-h PPN infusion. There were 62% of thrombophlebitis in control group in this study. (Osmolarity of PPN was 640 mOsmol/l). Palmer et al in 1996 (30) compared two methods of PPN administration (the same PPN regimen in May ,1996). PPN via 18G teflon over 12-h at night, immediately removed catheter postinfusion, PPN was recommended 12-h later in the contralateral arm, so allowing

each forearm a 36-h period free from nutrient solution. There was no incidence of thrombophlebitis in this group within 7.9 days. The other group received 24-h continuous PPN via 23-G flexane catheters showed 17% occurrence of thrombophlebitis within 8.6 days (the same group of May,1996 report).

Consequently, many authors agreed that the low incidence of thrombophlebitis was due to the limited periods of exposure of the veins to the cannula and its infusate. In addition, patients felt free during the rest period between intravenous infusions. The quality of life of patients was improved (30). The combination between intermittent intravenous infusion and rotation of venous access sites would be beneficial.

Nutritional status

Malnutrition is a disorder of body composition characterized by macro- and/or micro-nutrient deficiencies and resulting from an insufficiency intake or an increased demand for, or altered use of nutrients. Malnutrition leads to reduced organ function, abnormal results of blood chemistry tests, reduced body mass, poor clinical outcomes and higher mortality.

According to the literature, 50-70% of hospitalized patients in Thailand have some degree of malnutrition (7,8). Malnutrition in hospitalized patients is a consequence of several factors eg. previous nutrient deficiencies due to socio-economical problems, the underlying disease and lack of awareness of the patient's nutrient requirements and the importance of nutritional therapy of the medical teams (1).

Nutritional assessment have been defined as a comprehensive approach to defining nutritional status such as physical examination, anthropometric measurements, laboratory data; and professional judgment. A comprehensive nutritional assessment would include evaluation of the patient's history of eating patterns, dietary restrictions, weight changes and any influences on nutrient intake, physical assessment for body composition, fluid status, and signs and symptoms of

nutritional deficiencies; biochemical tests, such as for albumin, prealbumin, and analysis of body composition such as grip strength (46).

Subjective global assessment (SGA) (1,46)

Subjective global assessment is a clinical method of assessing the nutritional status of patients. It covers a patient's nutritional history from body weight changes to functional capacity alterations. SGA composes of these information:

1. Loss of body weight.
2. Altered food intake.
3. Changes in gastrointestinal symptoms.
4. Functional capacity.
5. The disease and its relation to nutritional requirements.
6. Physical examination.
7. Nutrition status rank.

Furthermore, SGA correlates with anthropometric and biochemistry data in hospitalized patients. Sungurtekin in 2004 (47) suggested that SGA techniques can be used for nutritional assessment in hospitalized patients.

Anthropometry

Body weight and weight loss

Body weight is a simple measure of total body mass. It is used to calculate body mass index (BMI). BMI is obtained by dividing the weight (in kilograms) by the height squared (in meters). BMI and weight loss are recommended and widely used to assess the nutrition of patients entering the hospital. The normal values for BMI are 18.5-24.99 kg/m². Loss of body weight has been related with poor nutritional status, morbidity, and mortality. A loss of more than 10% of usual body weight suggests malnutrition. However, weight loss alone may not have any nutritional significance, since it is influenced by a wide range of confounding factors, mainly changes in hydration status (1,48).

Skinfolds and circumferences

Anthropometry measured as skin folds and arm circumferences represent body compartment measurements of adipose tissue and muscles. The

measurements of body composition are relatively fast, noninvasive, and require the minimum of equipment compared to laboratory techniques. Indices of body composition are used in clinical settings to identify hospital patients with chronic under- or overnutrition, and to monitor long-term changes in body composition during nutritional support (1,49). Skinfold thickness measurements are said to provide an estimate of the site of the subcutaneous fat depot, which in turn provide an estimate of the total body fat. This measurements are best made using precision skinfold thickness calipers. The site most frequently used to obtain a single direct measure of body fat is the triceps skinfold. The measurement of the triceps skinfold is performed at the midpoint of the upper left arm, between the acromion process and the tip of the olecranon, with the arm hanging relaxed (49).

On the other hand, the fat-free mass is a mixture of water, protein, and minerals, with muscle serving as the major protein stores. Assessment of muscle protein can therefore provide an index of the protein reserves of the body. The decrease in mid-upper arm circumference may reflect either a reduction in muscle mass, a reduction in subcutaneous tissue, or both. Changes in mid-upper-arm circumference measurements can also be used to monitor progress during nutritional therapy, correlating positively with changes in weight. Arm circumference changes are easy to detect and require a minimal amount of time and equipment. The measurement is taken at the midpoint of the upper left arm, between the acromion process and the tip of the olecranon (49). Powell-Tuck (48) compared mid-upper arm circumference, body mass index and weight loss as indicator of undernutrition in the hospitalized patients. They found that the mid-upper arm circumference correlated closely with BMI and was easier to measure and gave a better prediction of poor outcome. Moreover, Butter in 1996 (50) suggested that the relationship among a physical examination and anthropometric measurements of subcutaneous fat tissue by calipers should be performed. If any changes in body weight are noted, a determination of the laboratory parameter (such as prealbumin, albumin and creatinine levels) can confirm the state of nutritional deficiency.

Functional tests

Functional tests assess the nutritional status by examining the muscle. The handgrip dynamometry are used as tools of nutritional assessment. The muscle

activities is linked to cell energetics and it has been showed that the skeletal muscle function can be rapidly altered by undernutrition (1).

Biochemical tests

Hepatic proteins such as albumin, transferrin, retinol binding protein and prealbumin have been used as nutritional markers.

Albumin is one of the most extensively studied proteins. Several studies have shown the correlation between a low albumin concentration and an increased morbidity and mortality. Serum albumin represents an equilibrium between hepatic synthesis and albumin degradation and losses from the body. Once albumin is released into the plasma, its half life is about 21 days. In a steady state, a total of 14g (200 mg/kg) albumin are synthesized and degraded, everyday. The normal range for serum albumin is 3.5-5 g/dl. Albumin might be altered due to factors other than malnutrition, such as in hepatic disorders protein losses and acute infection or inflammation. Therefore, albumin is a poor tool to assess nutritional deficiencies or to measure the effectiveness of nutritional support (1).

Prealbumin, also referred to as transthyretin, is a transport protein for thyroid hormone. It is synthesized by the liver and partly catabolized by the kidneys. Normal serum prealbumin concentrations range from 16 to 40 mg/dl; values of < 16 mg/dl are associated with malnutrition. Prealbumin levels will be increased in the case of renal dysfunction, steroid therapy or dehydration whereas physiological stress, infection, liver dysfunction and overhydration can decrease prealbumin levels. The half-life of prealbumin (two to three days) is much shorter than that of albumin, making it a more favorable marker of acute change in nutritional status (46).

The deficiencies of water soluble vitamin such as vitamin B1, B2, and C are frequently found in hospitalized patients. They are used in metabolism of macro-nutrient, especially, in TCA cycle. When carbohydrate is administered, the utilization of vitamin is increased. Lemoine in 1980 (51) found 25% of patients were vitamin B1 deficiency, 11% of B2 and 14% for vitamin C. The results of thiamin deficiency are beriberi, acute heart failure with high cardiac output, anemia and severe lactic acidosis. Clinical symptoms of riboflavin deficiency (52) are oral mucosal and tongue alterations, glossitis, ocular changes, dermatological changes, neurological alterations,

hematological dyscrasia. Clinical manifestations of ascorbic acid are scurvy, weakness, potential hemorrhages in the skin, ecchymoses, gingival and subperiosteal hemorrhages (49).

Psycho-somatic impact

There are many quality of life studies in home TPN, however, less studies have been done in PPN. Palmer et al in 1996 (30) reported the result of the hospital anxiety and depression scale (HAD) scoring method in rotation with cyclic technique PPN. They found no difference between control and rotation with cyclic groups. However, they suggested that fewer patients who had rotation of venous access sites complained of mobility restrictions.

The severity of illness was evaluated with the acute physiology and chronic health evaluation (APACHE II) score. An APACHE II score is determined from points based upon the patient's chronic health history, age, Glasgow Coma Score (GCS) and 11 physiological variables (38,54) This model can be used to predict mortality for groups of patients. Apostolopoulou et al in 2002 (53) showed that an increasing APACHE II score at admission are associated with increased ICU mortality.

CHAPTER 3

MATERIALS AND METHODS

This study was conducted in 32 patients who admitted in surgical wards, Ramathibodi hospital, Mahidol University during the period of the 1st January, 2004 to 31st July, 2004. All patients were matched according to APACHE II scoring system. They were sampling, according to the following criteria.

Inclusion criteria

1. Patients who were admitted in the surgical wards, Ramathibodi hospital, Mahidol University.
2. Patients who required parenteral nutrition via peripheral vein.
3. Patients who consented to participate and follow the procedure of this study.

Exclusion criteria

1. Patients on TPN.
2. Unconscious and unable to speak patients.
3. Patients under the age of 15 years.
4. Pregnant patients.
5. Patients with severe hepatic disorder and decompensation. (Total bilirubin >2 , more than three folds of hepatic enzyme elevation, hepatic encephalopathy)
6. Patients with severe renal disorder. (Serum creatinine > 2.2 mg/dl)
7. Patients with uncontrolled diabetes.
8. Patients with bleeding disorders.
9. Patients on long-term corticosteroid.
10. Patients with burn $> 20\%$.
11. Patients with pancreatitis (severe hypercatabolic).
12. Patients with uncontrolled sepsis or circulatory condition and judged to be unsuitable for the experimental by the attending physicians.
13. Patients with terminal illness.
14. Patients with heart disease.

Discontinuation criteria

1. Leaks at the site of administration.
2. Patients suffered from severe side effects.

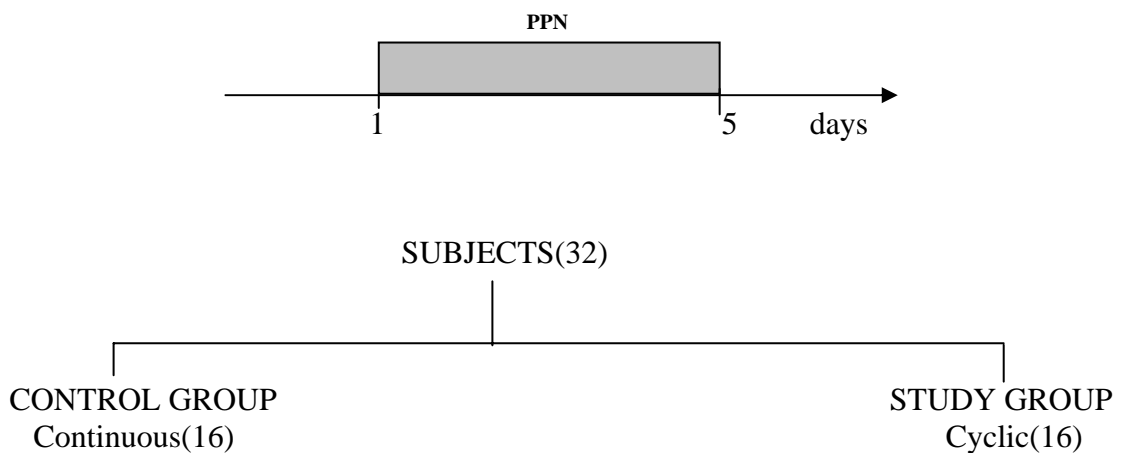
Side effects: Any clinical symptom including fluid and electrolyte disturbances observed during the experiment in patients who received PPN and could not be clearly negated by the attending physicians (suspected or confirmed) will be regarded as side effect caused by the study protocol.

3. Change of the treatment regimens by any reason.
4. Evidence of thrombophlebitis of degree 2⁺ of Maddox’s criteria.

If the thrombophlebitis developed, the cannula was removed as soon as possible.

Method of study

This study was a controlled trial comparing two methods of intravenous nutrient delivery into patients who required partial parenteral nutrition support. Randomly placed into continuous group and cyclic group after age and severity of disease (APACHE II scoring system) were well matched. All patients or their relatives gave informed consent to participate, and the Institutional Ethics Committee approved the study protocol.



Control group: CL-group

Participants received 2 bottles of Ramathibodi Standard Adult PPN formula (rate=83 ml/hr) and 500 ml of 10% lipid emulsion (rate=21 ml/hr) daily by continuous intravenous dripping over a 24 hour period for 5 days.

Study group: CY-group

Participants received the same solution as in the control group by a cyclic method into a forearm vein over a 16-hour period and was off for 8 hours during 10 PM- 6 AM everyday. The total infusion rate was 156 ml/hr, consisted of Ramathibodi formula 125 ml/hr and lipid emulsion 31 ml/hr. There was no change in the site of infusion. The catheter was kept patent with a single dose of 3 ml of a diluted heparin (10 u/ml). The PPN site of both groups were separated from the medication site.

Ramathibodi Standard Adult PPN formula The prescribed parenteral solution is shown. Each bottle (1,000 ml) contained:

Composition	Amount
Amino acid (g)	25
Dextrose (g)	100
Sodium (mEq)	50
Potassium (mEq)	30
Chloride (mEq)	50
Phosphate (mM)	7.5
Calcium (mEq)	5
Magnesium (mEq)	8
Acetate (mM)	45
Osmolarity (mOsmol)	925
pH	6.9
<i>Total calorie</i>	440

The formula was prepared by a Ramathibodi Hospital Pharmacy department and freshly added vitamin C 500 mg and vitamin B complex 2 ml per 1 bottle (each ml of

vitamin B complex contained: vitamin B1 100 mg, B2 5 mg and B6 5 mg) at surgical ward. Total osmolarity was 804 mOsm/l (included fat emulsion).

IV team

Nurses who administered PPN and provided catheter care had been standardized on the following issues:

1. Catheter insertion criteria*
2. Method and timing of each infusion regimen

* The criteria for catheter insertion and maintenance were as followed:

- Starting large veins in the upper extremities, beginning from the most distal to the proximal veins.
- A contralateral extremity veins were used, when the insertion site was lost
- The PPN veins were separated from medication vein.
- The daily care of infusion sites, infusion bag changes and the monitoring of each patient's fluid and electrolyte balance was supervised by a researcher team.
- The access site was changed if thrombophlebitis occurred.

Data collection

Thrombophlebitis : The data consisted of site of infusion, starting time of catheter insertion, symptoms and signs of thrombophlebitis and rate of infusion. All complications and reasons for the changing of lines or venous access sites and degree of thrombophlebitis were recorded by the researcher. The thrombophlebitis grading was done by only one observer. Criteria for evaluation of thrombophlebitis were based on Maddox's criteria.

Criteria for judging phlebitis (Maddox, 1977)

Severity	Criteria
0	No pain at intravenous site, no erythema, no swelling, no induration, no palpable venous cord
1+	Painful intravenous site, no erythema, no swelling, no induration, no palpable venous cord
2+	Painful intravenous site with erythema or some degree of swelling, or both, no induration, no palpable venous cord
3+	Painful intravenous site with erythema and swelling and with induration or a palpable venous cord less than three inches above intravenous site
4+	Painful intravenous site, erythema, swelling, induration and a palpable venous cord greater than three inches above intravenous site
5+	Frank vein thrombosis along with all signs of 4+; intravenous may have stopped running due to thrombosis.

Nutrition assessment : The nutrition record included anthropometric measurement, biochemical measurement and functional assessment.

1. Subjective global assessment (SGA)

The nutritional status of patients was assessed by the Subjective global assessment technique (SGA) before PPN administration and re-evaluated on day 5 (end of study).

2. Anthropometric measurement

The anthropometric data collection included weight, height, body mass index, mid-arm circumference (MAC), triceps skinfold (TSF) and hand-grip strength by dynamometer. The assessment of MAC and TSF were done on the PPN free arm, using the average of three readings.

Height and weight were used to determine body mass index(BMI). BMI was calculated by using this formula.

$$\text{BMI} = \frac{\text{weight (kg)}}{\text{height (m}^2\text{)}}$$

Mid-arm circumference was measured with a non-stretch measuring tape, midway between the acromion and olecranon of the non-dominant arm. Triceps skinfold

thickness was measured with a skin calipers on the posterior upper arm, midway between the acromion and olecranon process.

3. Biochemical measurement

Laboratory tests including serum electrolyte, calcium, sodium and potassium levels were monitored closely according to the protocol. Clotting blood was collected for measurements of prealbumin, CBC, P1 screening, serum vitamin B1, B2, and vitaminC were measured.

Psycho-somatic impact : The psychological status was performed by the patients while they were placed on PPN.

Nurses' work load : The questionnaire relating to the nurses' workload during the night was collected since there was a change in the PPN related activity during 10 pm and 6 am. Variables were the activity on reinsertion, patients' care, intake documentation, rate of infusion checking, and PPN preparing. The answers of nurse in surgical ward were showed by percentage.

Protocol schedule

Thirty-two patients hospitalized in surgical ward were studied. The research team assessed nutritional status and laboratory parameters in patients on admission.

Procedure	Screening / baseline (Start PPN)	Treatment period (days)			
		2	3	4	5
Physical examination	×	×	×	×	×
Check for inclusion Criteria	×	×	×	×	×
Written Informed Consent Forms sign	×				
Patient randomization	×				
General data record	×				×
SGA record	×				×
Psycho-somatic impact record	×		×		×
Anthropometric measurement	×				×
Vital sign record	×	×	×	×	×
Laboratory tests P ₁ screening <i>Glucose, BUN, Creatinine, Na, K, Cl, CO₂, Ca, P, Uric acid, Direct bilirubin, Total bilirubin, AST, ALT, Alkaline phosphatase, Albumin, Cholesterol, Triglyceride</i>	×				×
Vitamin B1, B2, and C	×				×
CBC, Prealbumin	×				×
Thrombophlebitis record	×	×	×	×	×
Nurses' workload record					×

Research Tools and Instruments

The instruments of this study were composed of

1. Catheter (Introcan[®]) 22 G 1", with an outer diameter of 0.9 mm
2. IV fluid set
3. Extension line (LS connector-CT)
4. Povidone-iodine
5. PPN Solution
 - Ramathibodi Standard Adult PPN
 - 10% lipid emulsion
 - Vitamin C 500 mg
 - Vitamin B complex
6. Calipers
7. Thrombophlebitis record
8. SGA record
9. Nutrition assessment record
10. Laboratory record sheet
11. Psycho-somatic impact record
12. Nurses' workload record

Data analysis

1. The statistical analysis of thrombophlebitis was performed on the difference between 2 groups by Mann-Whitney U test.
2. Nutritional status, electrolyte, prealbumin, vitamin B,C levels, SGA, and APACHE II score were compared between two groups by Mann-Whitney U test, and compared before/after treatment by paired t-test.
3. Psycho-somatic impact and nurses' work load questionnaire were reported in percentage.

CHAPTER 4

RESULTS

Thirty-two patients who admitted in surgical ward, Ramathibodi hospital consisted of 28 cancer patients and 4 cancer-free patients (Figure 4-1). Their surgical status were 23 postoperative, 6 preoperative and 3 without operative. A total of 32 patients were entered into this study, 16 being allocated to each group. There were no significant differences in age, gender, weight, BMI, APACHE II score and SGA between the groups (Table 4-1). Seventy-two percent of the patients had undergone an abdominal surgery. All patients were considered to have peripheral veins that were suitable for PPN and no patient required central venous feeding because of poor peripheral access.

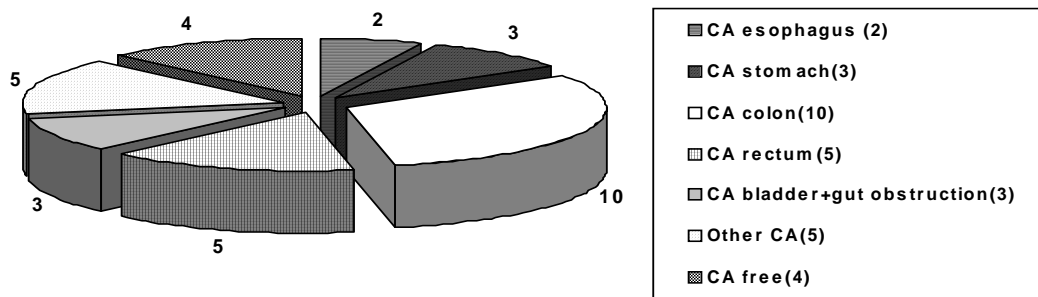


Figure 4-1 Diseases in 32 surgical patients

Table 4-1 Patient characteristics at base-line

Parameter	Control group	Cyclic group
Age, year*	61.5 (37,74)	59.5 (35,72)
Gender; M:F**	7:9	10:6
Weight; kg*	49.0 (40,82)	56.7 (40,74)
BMI*;	21.7 (15,26)	22.1 (15,31)
APACHE II Score*	5 (0,10)	4 (0,9)
SGA A:B:C**	1:11:4	3:11:2

*Median (min, max), ** Number

There was no significant difference between 2 groups

4.1 Thrombophlebitis

The onset of thrombophlebitis was collected. Thrombophlebitis study was terminated when 2+ of thrombophlebitis score by Maddox' s criteria (32) was detected. Patients tolerated the cannulas well and did not complain of undue discomfort at the time of insertion. Median time to onset of thrombophlebitis was 38 hours in the continuous group and 84 hours in the cyclic group. On the other hand, mode of the time to onset of thrombophlebitis was 36 hours in the control group and 84 hours in the cyclic group. The cyclic method significantly delayed the occurrence of thrombophlebitis at $p < 0.0001$ by Log-rank test (Figure 4-2). Thrombophlebitis were occurred within 36 hours in 50% of continuous patients, whereas 0% in cyclic patients. One-hundred percent of continuous groups had thrombophlebitis within 84 hours, on the contrary, only 62.5 percent of cyclic groups was evident. Thrombophlebitis slowly occurred in cyclic group from 60 to 120 hours (Table 4-2). Distribution of the occurrence of thrombophlebitis in different administration techniques was showed in Table (Table 4-3).

Cumulative probability

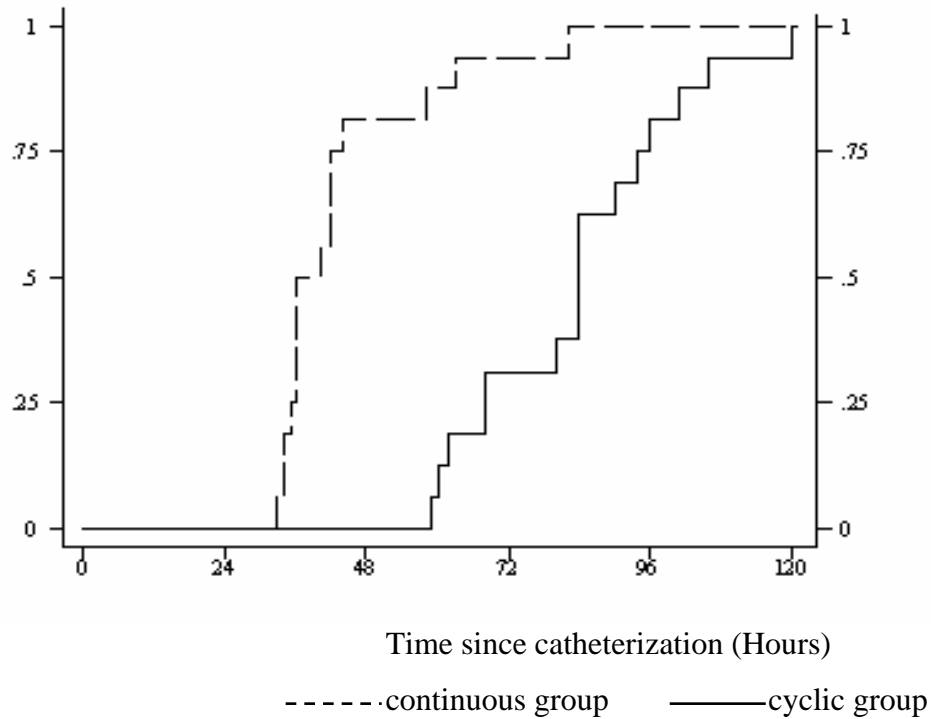


Figure 4-2 Kaplan-Meier of the cumulative probability of the occurrence of thrombophlebitis, from the time since catheterization of the peripheral vein

Table 4-2 Cumulative incidence(%)of thrombophlebitis in both techniques according to 12 hour-interval.

Group/hour	12	24	36	48	60	72	84	96	108	120
Continuous group	0	0	50	81.3	87.5	93.8	100	100	100	100
Cyclic group	0	0	0	0	6.3	31.3	62.5	81.3	93.8	100

Table4-3 Distribution of the onset of thrombophlebitis, n (%) in different administration techniques

Duration (day)	Control group	Cyclic group
1	0	0
2	13 (81.3)	0
3	2 (12.5)	5 (31.3)
4	1 (6.3)	8 (50)
5	0	3(18.8)

4.2 Nutritional status

Nutritional status of patients was collected on day 0 and day 5 of PPN administration. There was no significant difference between 2 techniques on the SGA, anthropometry, dynamometry, and biochemical data (Table 4-4). Normal nutritional status was changed to mildly malnourished. Whereas, severe malnutrition was unchanged (Figure 4-3). Anthropometric data (Mid-upper arm circumference, and triceps skinfold) were no significant difference after 5 days of PPN administration. However, BMI was significantly decreased after 5 days of PPN administration. On the other hand, handgrip strength was significantly increased after PPN administration (Table 4-5). There were significant changes in visceral protein levels. After 5 days of PPN administration, prealbumin was significantly increased from 13.25 to 18.38 g/l. Nevertheless, albumin and total protein were significantly decreased from 36.15 to 31.60 g/l and 68.29 to 65.71 g/l (Table 4-6). The changes of percentage of low prealbumin were improved (Figure 4-4). Especially, prealbumin levels were significantly increased in the postoperative group (Table 4-7). Most serum electrolyte and macro element levels were not abnormal after PPN administration, except potassium levels (Table 4-8). Cholesterol and creatinine was significantly decreased, however, triglyceride levels were significantly increased. According to GGT levels, this enzyme were significantly increased (Table 4-9). Serum vitamin B1, B2 and C were improved after 5 days of PPN administration (Table 4-10 and Figure 4-5).

Table 4-4 Nutritional status parameters between 2 groups after PPN administration

Parameter	% Change in Continuous group	% Change in Cyclic group	P-value
Weight, kg	-3.15 ± 3.1	-2.29 ± 3.5	0.57
BMI, kg/m ²	15.63 ± 0.4	17.38 ± 0.5	0.60
APACHE II	10.21 ± 55.6	-11.63 ± 3.2	0.28
SGA	7.71 ± 19.7	8.16 ± 21.7	0.79
TSF, mm	-0.32 ± 2.3	-0.23 ± 2.6	0.81
MAC, cm	0.45 ± 1.2	-0.11 ± 0.8	0.54
Handgrip strength, kg	8.74 ± 17.9	7.98 ± 23.0	0.64
Prealbumin, g/l	42.49 ± 59.7	69.43 ± 94.9	0.55
Albumin, g/l	-13.92 ± 13.5	-9.1 ± 10.8	0.19
Total protein, g/l	-6.04 ± 9.9	-0.27 ± 11.3	0.17
BUN, g/l	30.46 ± 89.2	11.19 ± 45.0	1.00
Creatinine, g/l	-14.71 ± 22.4	-10.42 ± 17.0	0.55
Sodium, mmol/l	-0.85 ± 4.0	-0.15 ± 3.9	0.46
Potassium, mmol/l	22.9 ± 20.6	21.65 ± 31.3	0.45
Chloride, mmol/l	-1.05 ± 7.6	-1.31 ± 5.8	0.81
CO ₂ , mmol/l	-2.74 ± 18.5	-4.75 ± 19.9	0.58
Calcium, mg/dl	0.12 ± 6.2	3.56 ± 8.1	0.26
In. phosphate mg/dl	8.77 ± 61.5	17.86 ± 77.8	0.84
T. bilirubin, g/l	0.51 ± 76.7	-28.19 ± 34.6	0.28
D. bilirubin, g/l	27.04 ± 89.1	25.81 ± 66.3	0.82
AST, u/l	72.3 ± 176	46.72 ± 60.8	0.25
ALT, u/l	6.4 ± 67.1	-0.57 ± 49.4	0.87
GGT, u/l	78.49 ± 146	81.74 ± 87.6	0.27
ALP, u/l	46.94 ± 150	10.21 ± 60.9	0.86
Cholesterol, mg/dl	-17.99 ± 22.1	-10.59 ± 18.3	0.42
Triglyceride, mg/dl	38.29 ± 67.8	59.13 ± 71.1	0.36

There was no significant difference between the two groups after PPN administration in terms of nutritional status.

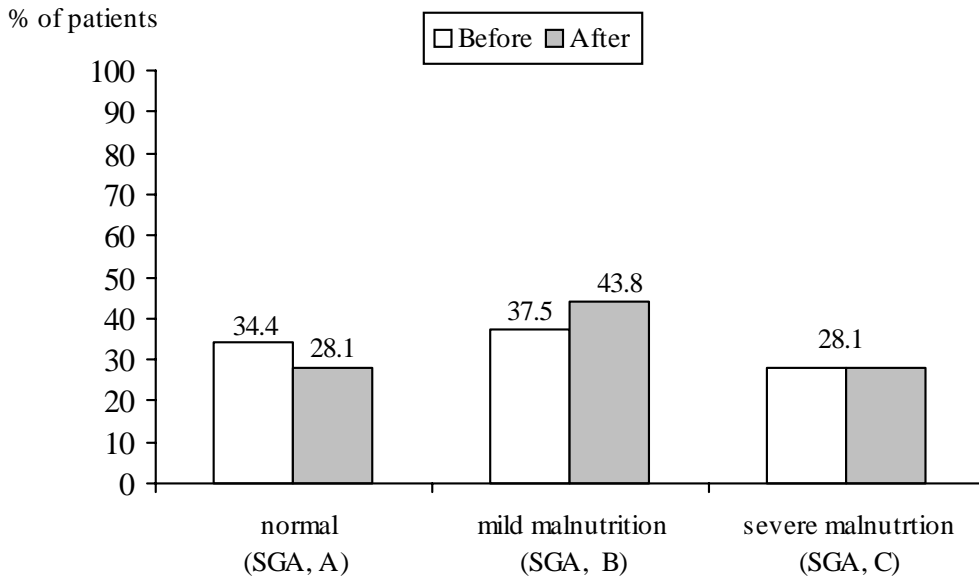


Figure 4-3 Nutritional status classified by Subjective Global Assessment (SGA).

Table 4-5 Anthropometric data (Mean±SD.) of 32 surgical patients before and after PPN administration

Parameter	Before	After
BMI, kg/m ²	21.3 ± 3.9	20.7 ± 3.9 ^a
MUAC, cm	26.0 ± 3.9	25.9 ± 3.9
TSF, mm	14.5 ± 10.4	5.14 ± 10.6
Handgrip strength, kg	17.3 ± 9.0	18.8 ± 10.6 ^a

^a Significantly different from before PPN administration; p< 0.005

No significant difference among preoperative, postoperative and no operative groups.

Table 4-6 Status of visceral proteins (Mean \pm SD.) in 32 surgical patients before and after PPN administration

Parameter, g/l	Before	After
Prealbumin	13.25 \pm 6.4	18.38 \pm 7.2 ^a
Albumin	36.15 \pm 7.2	31.60 \pm 5.9 ^a
Total protein	68.29 \pm 9.7	65.71 \pm 9.6 ^b

^a Significantly different from before PPN administration; $p < 0.0001$

^b Significantly different from before PPN administration; $p < 0.05$

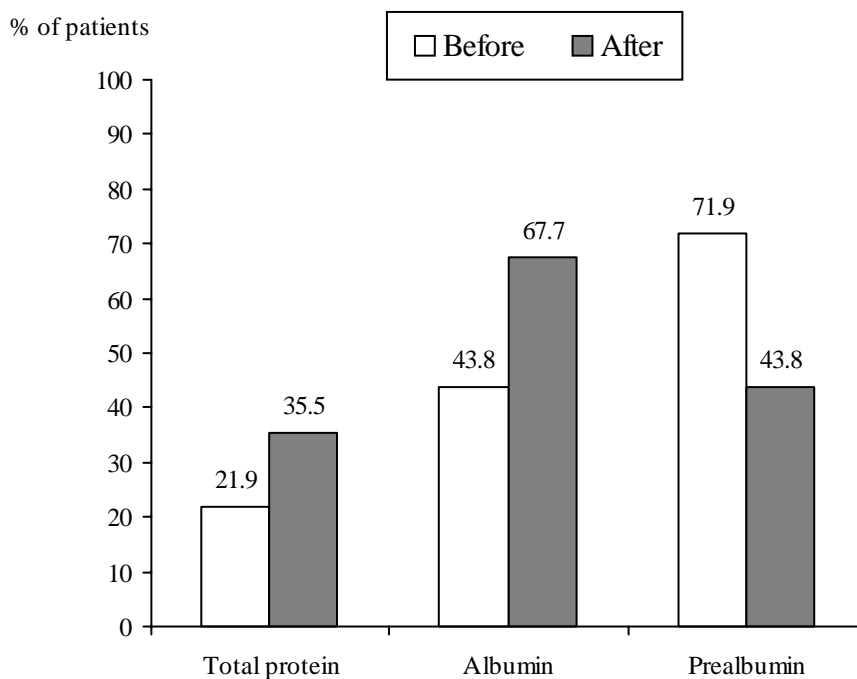


Figure 4-4 Changes of percentage of low albumin, total protein and prealbumin levels of 32 patients after given PPN.

Table 4-7 Prevalence (%) of low prealbumin levels (< 16 mg/dl) among patients with different surgical status.

Surgical status	Prealbumin level n(%)	
	Before	After
No operation* (n=9)	6 (66.67)	5 (55.56)
Post operation(n=23)	17 (73.91)	9 (39.13) ^a

* included 6 preoperative and 2 inoperable cases

^a Significantly different from before PPN administration by Exact McNemar’s test for each operative category (p< 0.005)

Table 4-8 Serum electrolyte and macro element levels (Mean±SD.) of patients (before and after PPN administration)

Parameters	Day of PPN			Reference ranges, mmol/l*
	Day -1	Day 1	Day 5	
Na	137.74± 4.4	136.93 ± 4.5	137.39 ± 4.7	135-145
K	3.85 ± 0.4	4.42 ± 1.0 ^a	4.73 ± 1.1 ^{a,b}	3.5-5.0
Cl	101.64 ± 4.8	100.26 ± 5.4	99.74 ± 4.9	97-110
CO ₂	25.83 ± 8.4	24.39 ± 4.6	24.36 ± 4.5	24-30

^a Significantly different from day1; p<0.05

^b Significantly different from day -1; p<0.05

* Reference ranges: Russell M K and Mcadams M P, *Laboratory monitoring of nutrition status*, in *Contemporary nutrition support practice*, Matarese L E and Gottschlich M M, Editors. 1998, W.B. Saunders company: Pennsylvania. p. 47-63

Table 4-9 Serum lipid, liver enzymes, and renal function tests (Mean \pm SD) of patients before and after PPN administration.

Parameters	Before		After		Reference ranges
Lipid profiles					
Cholesterol (mg/dl)	175.00	\pm 40.3	144.61	\pm 33.0 ^a	140 - 270
Triglyceride (mg/dl)	119.48	\pm 59.9	171.22	\pm 125.5 ^b	30 - 90
Liver function tests					
AST (u/l)	52.97	\pm 94.6	92.74	\pm 312.4	5 - 40
ALT (u/l)	43.30	\pm 38.8	45.35	\pm 62.1	5 - 40
GGT (u/l)	77.71	\pm 103.2	107.00	\pm 98.2 ^c	15 - 85
AP (u/l)	117.24	\pm 147.6	115.61	\pm 97.5	40 - 105
T. bilirubin (g/l)	1.60	\pm 5.0	0.99	\pm 2.4	0.2 - 1.2
D. bilirubin (g/l)	1.11	\pm 4.5	0.71	\pm 2.0	0.1 - 0.5
Renal function tests					
BUN (g/l)	11.18	\pm 5.0	11.64	\pm 4.7	7 - 17
Creatinine (g/l)	0.90	\pm 0.3	0.78	\pm 0.2 ^b	0.6 - 1.2

AST: Aspartate aminotransferase, ALT: Alanine aminotransferase

GGT: Gamma- Glutamyl transferase, AP: Alkaline phosphatase,

BUN: Blood urea nitrogen

^aSignificantly different from before PPN administration; $p < 0.0001$

^bSignificantly different from before PPN administration; $p < 0.01$

^cSignificantly different from before PPN administration; $p < 0.05$

Table 4-10 Blood vitamin levels (mean±SD) in surgical patients before /after added vitamin B complex*, vitamin C 500 mg/day in PPN.

Parameter	Cut-off value**	Before	After
Vitamin B₁			
ETKA, IU	< 131	226 ± 95	298 ± 109 ^a
TPPE, %	> 15	12.9 ± 17.8	3.1 ± 8.2 ^b
Vitamin B₂			
EGRA, IU	< 1314	3247 ± 1096	3730 ± 1367
AC, %	≥ 1.2	0.99 ± 0.1	0.95 ± 0.1
Vitamin C			
S. ascorbate, mg/dl	< 0.2	0.56 ± 0.3	2.03 ± 0.6 ^a

* Vitamin B complex 2 ml: VitaminB₁ 200 mg, B₂ 10 mg, B₆ 10 mg

** Cut-off value: Modified from Lawrence J Machin, Handbook of vitamins 2nd Ed.,1991

^aSignificantly different from before PPN administration; p< 0.0001

^bSignificantly different from before PPN administration; p< 0.01

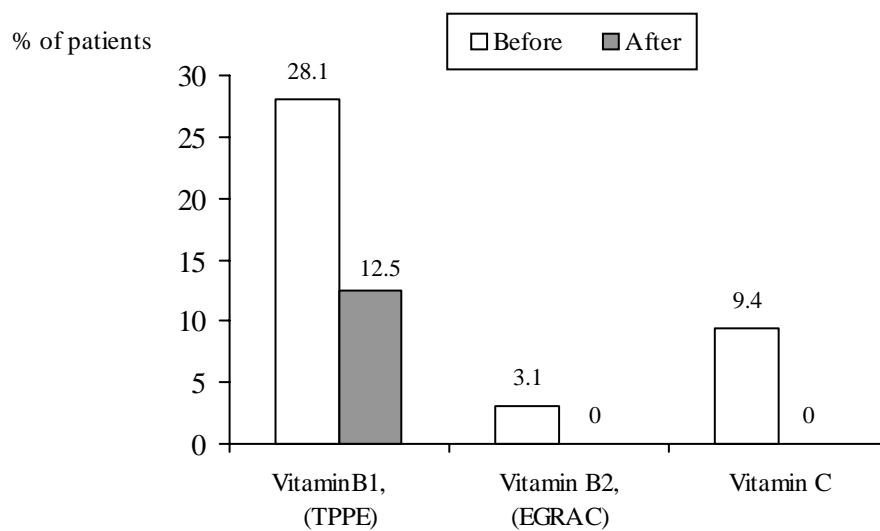


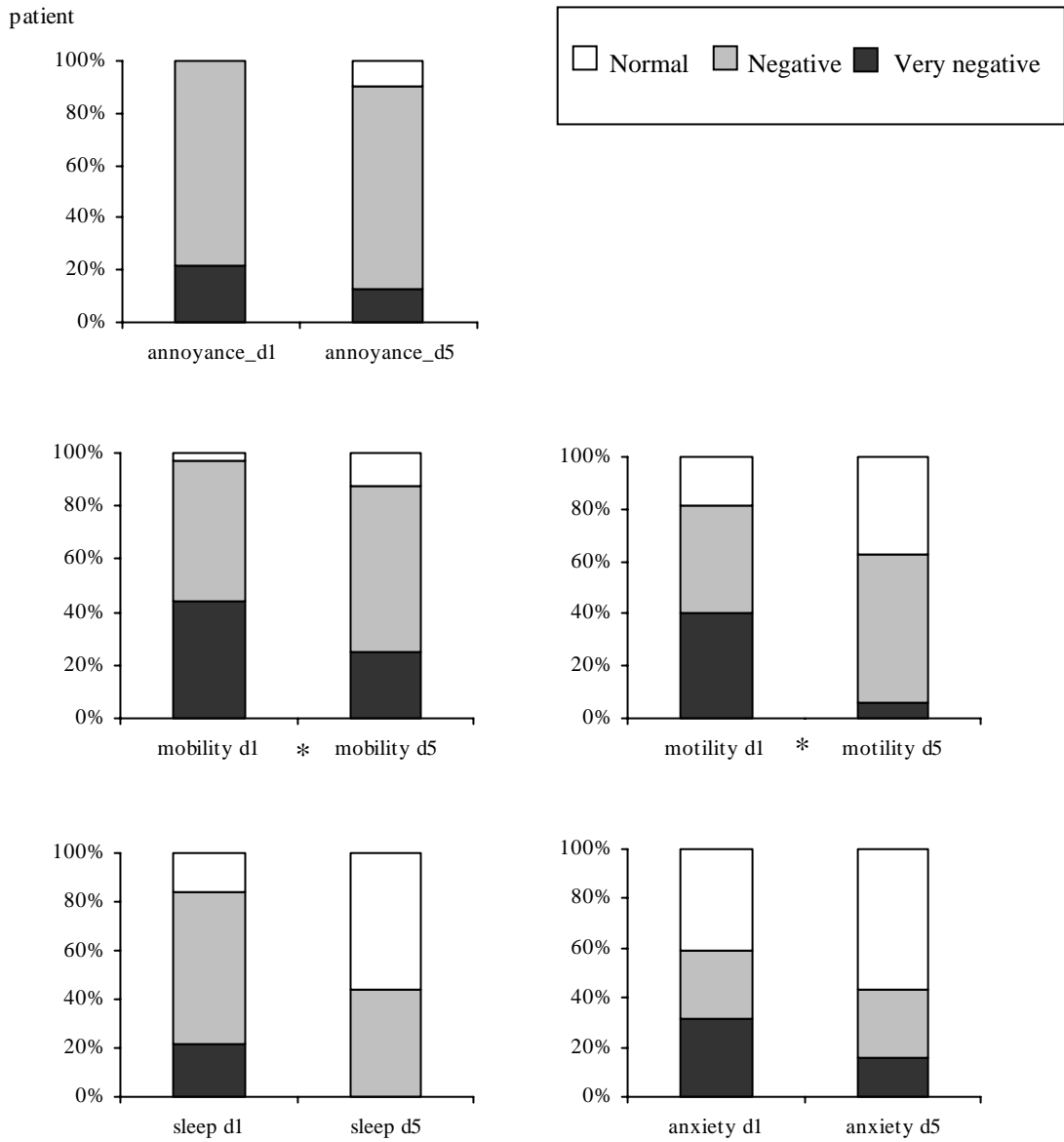
Figure 4-5 Prevalence (%) of vitamin deficiency before and after PPN administration.

4.3 Patients' psycho-somatic impact

Because of complaints about sleepless at night and motility during home total parenteral nutrition, the psychological status was investigated in our study. Both groups of patient were asked by the researcher at the first and the end of PPN administration. The questionnaire covered both anxiety, and motility of patients. The results of psycho-somatic impact of patients were shown in figure 4-6 and table 4-11. All patients in cyclic group were satisfied with the cyclic technique after 5 days of PPN administration. The reasons of satisfaction were shown in figure 4-7.

4.4 Nurses' opinion

Nurses' opinion was assessed in the cyclic group. Eighty-seven percent of nurses agreed with the benefit of cyclic technique on the convenience of patients. Moreover, 72.5% of nurses thought that cyclic technique also decreased nurse workload during the night (Figure 4-13).



*mobility: able to move around in the bed, motility: able to walk out of bed

Figure 4-6 The psycho-somatic impact in 32 patients

Table 4-11 Psycho-somatic impact on patients between different techniques*

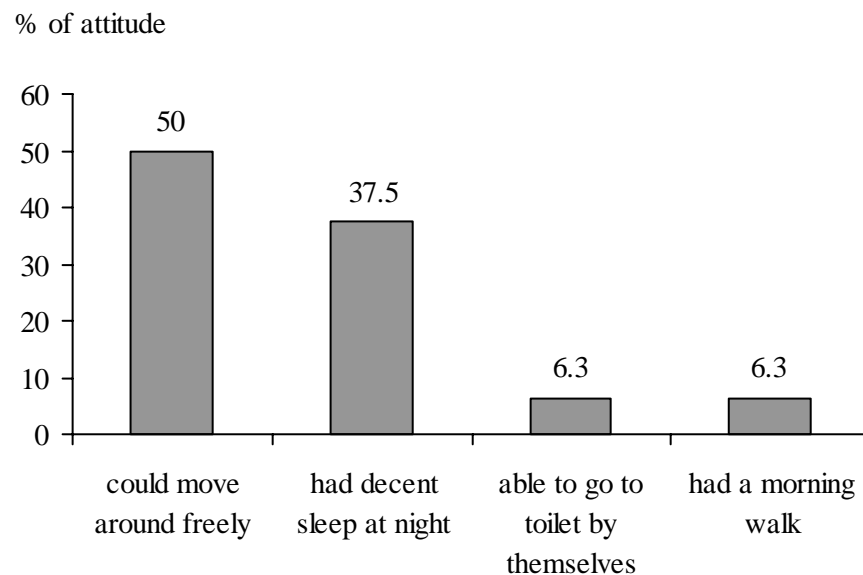
Variables	P-value	
	Continuous group	Cyclic group
Annoy	0.250	0.500
Mobility	0.500	0.500
Motility	0.141	0.004 ^a
Sleepness	0.016	0.004 ^a
Anxiety	1.000	0.031 ^b

*Exact Symmetry test for 3*3 contingency tables (Repeated measurement of categorical variables).

There was no significant difference between two techniques.

^a Significantly different from the first day of PPN administration; $p < 0.005$

^b Significantly different from the first day of PPN administration; $p < 0.05$

**Figure 4-7** Patients' psycho-somatic status in the cyclic group

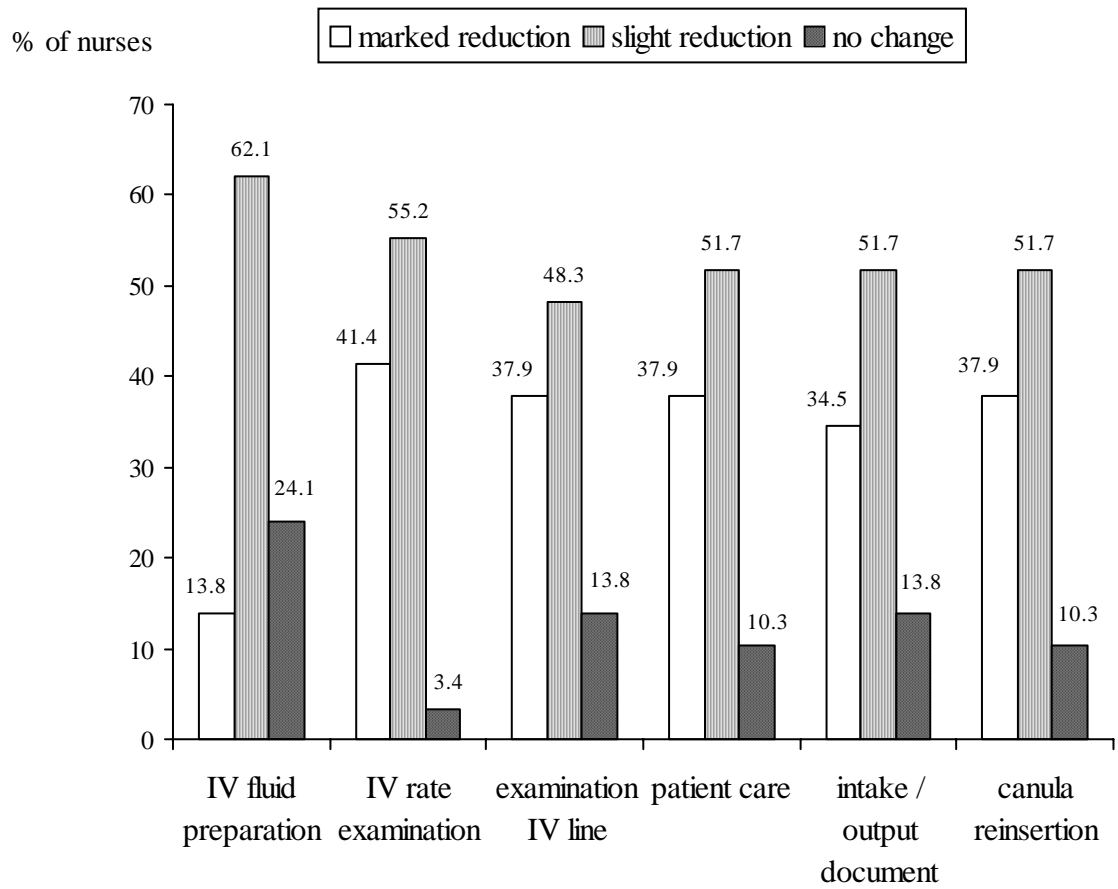


Figure 4-8 Nurses' workload in handling of the cyclic PPN as compared to continuous PPN (n=40).

CHAPTER 5

DISCUSSION

Thrombophlebitis

The cyclic technique in this study was designed to reduce the thrombophlebitis, the most frequent complication in peripheral parenteral nutrition, in short-term gastrointestinal dysfunction patients (less than 14 days). Peripheral vein is an attractive choice to avoid the complication from central venous cannulation because of a low cost, simple to use and reduction in medical or nursing time (10,34). However, the limitation of this alternative is the development of thrombophlebitis. The incidence of thrombophlebitis varied widely (2.3-70%) (55) because of the differences in definition, study design, inclusion criteria of patients and follow-up time (37) as well as the needle gauge and infusate osmolality. According to the study of Pandero et al in 2002 (55), thrombophlebitis was more likely to occur within 48-h after catheter insertion. This is in accordance with other authors' findings (Gaukroger et al, 1988 and Campbell et al, 1998). In our study, the catheters in cyclic technique survived longer ($p < 0.0001$) and resulted in a lower incidence of thrombophlebitis within 48 hour (81 % in continuous VS 0 % in cyclic technique). The time of onset of 100 % of thrombophlebitis was delayed from 84-h in the continuous group to 120-h in the cyclic group. Not only delayed the onset of thrombophlebitis but the cyclic method reduced thrombophlebitis developing also. There was 100% of thrombophlebitis within 60-h after the first case in continuous group (24 to 84-h), whereas 72-h after the first thrombophlebitis case in cyclic group (48 to 120-h). These results suggested that mechanical trauma is an important factor in the aetiology of infusion phlebitis. This can be minimized by reducing the time for which the vein wall is exposed to nutrient infusion (31).

The first study about the effect of infusion time was Nordenstrom et al study, 1991 (45). They found 18% of thrombophlebitis when rotation with cyclic technique was used during 5 days of PPN administration. Nevertheless, no continuous

group in the same PPN regimen (as a control group) was compared in their study. In 1996, May et al (29) compared rotation with cyclic technique by reinsertion of catheter every 12-h and continuous PPN in 24-h. They found 0% thrombophlebitis in the rotation with cyclic technique group (within 7.5 days) VS 62% in continuous group (within 5 days) of 640 mOsm/l PPN administration. However, there were some disadvantages in both techniques such as the time consuming of nurses and doctors to reinsert a new catheter at another venous site and the suffers of patient from being repunctured (29). To resolve this problem, they employed the combination of rotation with cyclic technique by leaving the catheter *in situ*. The “left-in-situ” method in rotation with cyclic technique reduced the incidence of thrombophlebitis to 33%. Palmer et al in 1996 (30) reported the difference of thrombophlebitis incidence between two techniques (17% in continuous VS 0% in rotation with cyclic technique). No restriction of catheter insertion site, however, most catheters in cyclic group were placed in the dorsal veins of the forearm while either the cephalic or basilic vein in the antecubital fossa were used in the continuous group. As reported in 1991, Kerrin et al (44) found the reduction of thrombophlebitis incidence to be 23% by the rotation with cyclic technique. Interestingly, rotation technique resited in contralateral arm every 24-h alone also produced 23% reduction in the thrombophlebitis incidence.

Our results also found the thrombophlebitis incidence to be 37.5% reduction within 3.5 days in the rotate group. Apart from reducing the incidence of infusion thrombophlebitis our cyclic technique maintained a longer patency of catheter. The mean duration of becoming thrombophlebitis in our study were shorter than other studies, however, the disparity in osmolarity of PPN and the duration of infusion between various studies were the problems. From Table 4-3, most patients in the control group could not tolerate the concentration of PPN for a long time, so the distribution of thrombophlebitis occurrence was rather densed. Whereas, the distribution of thrombophlebitis occurrence in the cyclic group was scattered due to different patients’ characteristics including the large vein, male, and younger age in cyclic group more tolerated than the others as previously reported (13,34,37).

The Centers for Disease Control and Prevention (CDC) recommendations for preventing peripheral vein infusion thrombophlebitis are replacing catheters and rotating peripheral venous site every 48 to 72-hours (56).

However, this recommendation was still being questioned (37). The report by Weiss et al in 1975 (40) suggested that the standard recommendation to change infusion after 48-h is not stringent enough. Maki (1991) et al (57) suggested that the thrombophlebitis was constant after 2 days of catheterization. According to Brezenger et al, 1998 (58) they found that after 2 days of catheter insertion, the day-specific risk of peripheral vein thrombophlebitis was constant. Our data showed 50% thrombophlebitis incidence in the continuous group already occurred within 36-h. Consequently, The CDC recommendation should be reevaluated. Finally, thrombophlebitis in the cyclic technique in our study was happened 100% within 5 days because of no changed of the used vein. According to Payne-James et al, 1991 (59) showed the result of cannulas place in forearm veins with no infusion running in normal volunteers. They demonstrated that after 108-h almost 44% of veins with cannulas in place will develop phlebitis. Therefore, the incidence of thrombophlebitis can be reduced by both elective change of peripheral venous cannulas and a reduction in infusion period.

Nutritional status

Not only thrombophlebitis but nutritional status were also investigated in our study. Nutritional status classified by SGA showed severe malnutrition in 28.1% of the patients, 37.5% were moderately and mild malnourished and 34.4% were well nourished. In 1994, A study from McWhirter et al (60) found that out of 100 surgical patients, 27 were under nourished. Correia et al, 2004 (61) classified the nutritional status by SGA and found 53.8% of patients had malnutrition, 38.5% were moderately malnourished or suspected malnutrition and 7.7% were well nourished. Waitzberg et al in 2001 (62) reported in IBRANUTRI study, 48.1% of hospitalize patients in Brazil were malnourished with 12.6% severely malnourished. In Thailand, Tanpaichitr in 1980 (7) showed that more than 60% of hospitalized patients in Ramathibodi hospital were malnourished. Similarly, Komindr et al in 1995 (8) shown the prevalence of malnutrition was still highly prevalence(52.6%). Surprisingly, the prevalence of malnutrition were 65.6% when classified by SGA in our study. The malnutrition trend in developing country (Brazil and Thailand) were highly prevalence despite the fast development of Thai economy during the past year. The explanation

for a high rate of malnutrition were the chronicity of the disease, low socioeconomic status of patients, the most of underlying diseases presented were cancer, the high cost of nutrition support, and unawareness and underestimation of the complications of malnutrition by physicians (61,63).

The nutritional assessment tools in our study were subjective global assessment (SGA), laboratory data and anthropometric measurement. SGA is a simple and inexpensive technique, these characteristics make SGA an attractive tool for routine use in the nutritional assessment of surgical patients (64). In our study, there were 28.1 % of patients had severe malnutrition (grade C of SGA). After 5 days of PPN administration, the number of severely malnourished patients was the same before PPN administration. Whereas normal patients (grade A) were decreased from 34.4 to 28.1 %. The reason may come from the change of fluid balance during the 5 days of treatment. In our study, BMI of patients were significantly decreased, however, mid upper arm circumference and triceps skinfold were not significantly decreased after 5 days of PPN administration. Development of cachexia and marked weight loss were the important symptoms in cancer patients, especially for the upper gastrointestinal tract cancer.

Nutritional support often fails to improve serum albumin levels. For these reasons, hypoalbuminemia has been reported to be a predictor of risk in a broad sense malnutrition (47). Albumin and total protein are not sensitive enough to predict the improvement by nutritional support because of their long half-life. Our data showed the changes of albumin, total protein and prealbumin levels. Predominantly, prealbumin was only one protein that improved after 5 days of nutrition support. Prealbumin, a short-lived proteins (half-life, 48-h), is sensitive to protein and energy availability. Therefore, it is a good nutritional indicator (65). Prealbumin levels reflected the nutritional status of patients. If they come to well-nourished after nutrition support, prealbumin level will be in normal range (16-40 g/l). The mean of prealbumin levels were 13.25 ± 6.4 to 18.38 ± 7.1 g/l at baseline in our study. Robinson et al, 2003 (66) determined the effectiveness of prealbumin and albumin in identifying malnourished hospitalized patients. They found that prealbumin appeared to be better than albumin as a nutrition-screening/assessment tools to detect malnourished patient

(malnutrition was defined as a prealbumin levels < 20 g/l, whereas prealbumin levels ≥ 20 g/l was considered well-nourished).

Our results also according to Chuntrasakul et al, 1998 (67) the prealbumin levels (mg% \pm SE) in trauma patient after 4 days of PPN administration were improved from 17.19 ± 2.1 to 19.00 ± 3.3 mg%. Their 1300 kcal PPN regimen contained 50 g of protein, 150 g of glucose which was almost equivalent to our regimen. Nevertheless, the baseline of prealbumin levels in our study were lower than this study. The underlying disease of patients in our study were cancer (87.5%), but their study were accidental patients. The diet restriction from their disease caused a low protein diet. When they got nutrition support, however, prealbumin levels were significantly increased. Hence, the nutrients given in this regimen seemed to be rather adequate low energy PPN. According to some studies conducted with hypocaloric nutrition showed a lower complication rate (55). Interestingly, prealbumin levels after 5 days of PPN administration in pre-operation patients were less clear. Prealbumin levels were no significantly changed in pre-operation group in our study because of the statement of disease before operation. Whereas post-operation patients had a significantly improved of prealbumin levels after 5 days of PPN administration since the cause of catabolism has been removed. Butters et al in 1995 (50) found prealbumin level as well as anthropometric measurement in gastric and pancreatic cancer groups less than breast cancer group and control group.

Functional tests is one of nutritional assessment tools. Muscle activity is linked to cell energetics and it has been shown that skeletal muscle function can be rapidly altered by undernutrition (1). In 1993, Strokes et al (68) reported the effect of PPN on the physiologic function (handgrip strength) after 5 days of PPN administration. The handgrip strength increased from 33.3 ± 8.0 to 36.4 ± 9.2 kg ($p < 0.0001$). According to Strokes report, the skeletal physiologic function strength data in our study also improved from 17.29 ± 9.0 to 18.79 ± 10.6 kg ($p < 0.05$) after 5 days of PPN administration. Patients' characteristic were the most important factor responsible for the difference in handgrip strength between two study. Moreover, total calories in PPN regimens were also difference (1,620 VS 1,430 kcal/d).

Serum electrolyte and microelement levels before and at the first blood drawn on the day after starting PPN were shown in table 7. All serum electrolyte

(sodium, potassium, chloride and carbon dioxide) before PPN administration were abnormal. At the first blood drawn on the day after starting PPN, there were excess in potassium and carbon dioxide. These results suggested that monitoring of serum electrolyte in patients were necessary. Serum lipid and liver function before and after PPN administration were shown. There were significant decreases in cholesterol levels because PPN is free of cholesterol administration. While triglyceride levels were significantly increased, these results were caused by everyday lipid emulsion (LCT) used. In addition, the liver enzyme (GGT) was significantly difference after PPN administration in both groups. The reason may come from glucose in PPN increased the deposition of triglycerides in the liver. The mechanisms behind glucose-induced hepatic steatosis are not fully understood. If hepatic lipoprotein transport capacity is insufficient in relation to production of triglycerides from exogenous and recycled fatty acids, hepatic fat accumulation occurs (69).

Interestingly, the prevalence of deficiency were 28, 3 and 9.4% at the beginning of our study. After 5 days of vitamin added in PPN solution, no patients had vitamin B2 and C deficiency. It was surprising that thiamine deficiency was not totally eradicated even though they received 400 mg per day of vitamin B1. After 5 days of PPN administration, there were still 4 thiamine deficient patients (2 postoperative and 2 preoperative).

The postoperative patients were 71 and 72 years old. Before PPN administration, they had severe thiamine deficiency (TPPE 47.8 and 36.1%, respectively). After vitamin B1 400 mg was added in PPN solution, %TPPE were improved to 25.8 and 25 within 5 days. However, they were still deficient. The reason for thiamine deficiency in these two patients were their senility and the increased utilization during their recovery. Chuntrasakul et al,1998 (70) showed the improvement of elder patients after nutrition support were slowly. According to Sullivan et al in 1991 (71),1999 (72) suggested that the elderly may require more time to respond appropriately to a physiological stress (trauma, surgery), thereby influencing their nutritional status. On the other hand, 2 preoperative patients who had thiamine deficiency began with acceptable thiamine supplement in PPN solution, their thiamine status were decreased. These two patients had a critical illness before surgery, their problems were not removed and resulted in the deterioration of their

vitamin status. Moreover, they were mild to moderate malnourished. All of laboratory data were abnormal. After 5 days of PPN administration, they were continued with TPN. However, both of them died after 2 weeks and 1 month of surgery. In conclusion, it can be mentioned that the thiamine requirement of malnourished elderly patients and preoperative advance cancer patients are higher usually anticipated.

Nevertheless, the use of cyclic technique was not without problem. Hypoglycemia during the night was found in the 1 of 4 diabetic mellitus patients in cyclic group. She was a 60 year-old colon cancer patient. The hypoglycemia occurred because she received subcutaneous regular insulin 2 hours prior to PPN stopping. Her problems were sweating, shakiness, increased heart rate and numbness on the lips (DTX 60 mg%) which were ameliorated after 50% dextrose was given. Interestingly, there was no signs of fluid overloading problem in our cyclic group in the presence of rapid flow rate. It was showed that 156 ml/hr of PPN flow rate was safe to use in our cyclic PPN patients, although many of them were elderly. It was thought that the total amount of volume load during the 24-h period might be more important than the I.V. rate per se.

Patients' psycho-somatic impact

Our study was the first report to investigate the patients' psycho-somatic impact of stopping PPN in the night. All patients in two groups increased positive attitude at the end of study (Figure 4-6). This result may come from the tolerance of patients. Nevertheless, there was no significantly difference between 2 techniques. Interestingly, there were significant decreases in patients' anxiety, increases in motility and increases in the sleepness in the cyclic group after 5 days of PPN administration. 100% of patients in cyclic group satisfied this technique. 50% of their reasons were their ability to move around freely and 37.5% of patients could have decent sleep at night. According to the previous study, Palmer et al in 1996 (30) using the Hospital Anxiety and Depression Questionnaire (HAD) evaluated the patients mental impact between continuous and rotation with cyclic technique. There was no difference between continuous and rotation with cyclic techniques. There was no difference between groups in HAD score. This may reflect several co-existent factors such as the pain of cannulation, hospitalization, inadequate oral intake and the

underlying disease. However, fewer patients who had rotation with cyclic technique complained of mobility restriction. The researchers commented that the mobility of patients may be an important factor in patient well-being and tolerance of PPN.

Nurses' opinion

In our study, not only investigating in patients' psycho-somatic impact, but nurses' opinion were investigated as well. 72.5% of nurses thought the cyclic technique reduced their workload during the night in I.V. rate examination, patient care, cannula reinsertion, examination line, intake/output documentation and IV fluid preparation. 1 of 3 wards always used infusion pump in all of the cases, however, cyclic technique did not seem to decrease their workload on the I.V. rate examination and I.V. line examination. Importantly, most nurses (87.5%) thought cyclic technique gave patients the convenience. According to their answers about patient care, patients could go to toilet by themselves and had a morning exercise by themselves.

CHAPTER 6

CONCLUSION

Infusion duration is an important factor in the development of thrombophlebitis. The cyclic technique with intravenous cannula *in situ* significantly delays the onset of thrombophlebitis. In addition, cyclic PPN technique did not hinder the nutritional status. Partial parenteral nutrition (PPN) improves patients nutritional status, however, not only keeping the cannula patent, cyclic PPN technique with IV cannula *in situ* also improved the patients' mobility, psychosomatic status and reduced nurses' workload during the night.

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APPENDIX

Sample size calculation

Sample size of the control group (N_1) was the same as the study group (N_2)

$$N_0 = \frac{1}{(\Delta)^2} [Z_\alpha (2\overline{PQ})^{1/2}] + Z_\beta (P_1Q_1 + P_2Q_2)^{1/2}]^2$$

At confidence interval 95%, power of test 80%

Thrombophlebitis was minimized by rotation of venous access sites to 33%

$$N_0 = \frac{1}{(0.246)^2} [1.96 (2*0.335*0.665)^{1/2}] + 0.842 [(0.67)(0.33) + (1.000)(0)^{1/2}]^2$$

$$N_0 = 10$$

Number of catheters in this study including drop-out patients (20%) were 12 catheters per group.

เอกสารชี้แจงข้อมูล/คำแนะนำแก่ผู้เข้าร่วมการวิจัย (Patient/Participant Information Sheet)

ชื่อโครงการ ผลของการดัดแปลงวิธีการให้อาหารทางหลอดเลือดดำแบบไม่สมบูรณ์ต่อการลด
อัตราการอักเสบของหลอดเลือดดำส่วนปลายและการเปลี่ยนแปลงของภาวะโภชนาการ

ชื่อผู้วิจัย ศ.นพ. สุรัตน์ โคมินทร์
พญ. ครุณีวัลย์ วโรดมวิจิตร
ภญ. โนรี จงวิไลเกษม

สถานที่วิจัย โรงพยาบาลรามารชิบดี

บุคคลและวิธีการติดต่อเมื่อมีเหตุฉุกเฉินหรือความผิดปกติที่เกี่ยวข้องกับการวิจัย

ศ.นพ. สุรัตน์ โคมินทร์, พญ. ครุณีวัลย์ วโรดมวิจิตร, ภญ. โนรี จงวิไลเกษม

สถานที่ติดต่อ สำนักงานวิจัย ชั้น 6 โรงพยาบาลรามารชิบดี ถ.พระราม6 พญาไท กรุงเทพฯ

ผู้สนับสนุนการวิจัย บัณฑิตวิทยาลัย มหาวิทยาลัยมหิดล

ความเป็นมาของโครงการ

ในผู้ป่วยหลังผ่าตัดที่ไม่สามารถรับประทานอาหารได้ตามปกติ หรือได้รับสารอาหารที่ไม่เพียงพอกับความต้องการของร่างกายโดยการกินหรือให้ผ่านทางเดินอาหาร มีความจำเป็นจะต้องได้รับสารอาหารผ่านทางหลอดเลือดดำเพื่อให้ผู้ป่วยได้รับพลังงานและสารอาหารตามความต้องการร่างกาย เพื่อให้แผลหายได้ตามปกติ ดังนั้นการให้สารอาหารทางหลอดเลือดดำจึงมีความสำคัญในผู้ป่วยระยะนี้ ปัจจุบันมีการให้อาหารแก่ผู้ป่วยทางหลอดเลือดดำส่วนปลาย (Peripheral veins) เพื่อลด ภาวะแทรกซ้อนจากวิธีการให้ทางหลอดเลือดดำใหญ่ที่ต้องให้ทางบริเวณหัวไหล่หรือบริเวณคอ อีกทั้งการให้อาหารทางหลอดเลือดดำส่วนปลาย สามารถดูแลได้ง่ายกว่า และเหมาะสมในสถานพยาบาลที่มีอุปกรณ์และบุคลากรไม่เพียงพอ โดยที่ผู้ป่วยจะได้รับสารอาหารแบบครบถ้วน แต่ปัญหาการให้อาหารทางหลอดเลือดดำส่วนปลายที่พบได้เสมอ คือภาวะการอักเสบของหลอดเลือด ดังนั้นโครงการนี้จึงทำการศึกษาถึงวิธีการที่ให้อาหารทางหลอดเลือดดำเพื่อลดการเกิดภาวะหลอดเลือดดำส่วนปลายอักเสบ เพื่อเป็นแนวทางในการให้สารอาหารทางหลอดเลือดดำส่วนปลายอย่างปลอดภัยต่อไป

วัตถุประสงค์

1. เพื่อศึกษาถึงความสามารถในการลดการอักเสบของหลอดเลือดดำส่วนปลายหลังจากดัดแปลงวิธีการให้สารอาหารทางหลอดเลือดดำ
2. เพื่อประเมินภาวะทางโภชนาการของผู้ป่วยที่ได้รับสารอาหารทางหลอดเลือดดำ

3. เพื่อศึกษาถึงการเปลี่ยนแปลงทางจิตใจและอารมณ์ รวมทั้งระยะเวลาการอยู่โรงพยาบาล หลังจากการได้รับอาหารทางหลอดเลือดดำ

รายละเอียดที่จะปฏิบัติต่อผู้เข้าร่วมการวิจัย

ผู้ป่วยที่เข้าร่วมในโครงการนี้เป็นผู้ป่วยที่จำเป็นต้องได้รับสารอาหารทางหลอดเลือดดำส่วนปลาย ผู้ป่วยจะได้รับการสุ่มเพื่อแบ่งเป็น 3 กลุ่ม ในทุกกลุ่มจะได้รับอาหารแบบครบถ้วนทางหลอดเลือดดำส่วนปลายโดยใช้สูตรอาหารทางหลอดเลือดดำที่ผลิตโดยโรงพยาบาลรามาธิบดี และมีวิธีการได้รับสารอาหารทางหลอดเลือดดำโดยการหยดเข้าเส้นเลือดอย่างต่อเนื่องในกลุ่มที่1 หรือแบบเปลี่ยนตำแหน่งในกลุ่มที่2 และแบบหยุดพักควบคู่กับการเปลี่ยนตำแหน่งในกลุ่มสุดท้าย ผู้ป่วยจะได้รับการติดตามการเกิดภาวะหลอดเลือดดำอักเสบอย่างใกล้ชิด และ มีการประเมินภาวะโภชนาการทางคลินิกและการวัดไขมันใต้ผิวหนังของร่างกาย ตลอดจนการเจาะเลือดเพื่อตรวจวัดระดับของสารอาหารแต่ละชนิด ตลอดระยะเวลา 5 วันของการได้รับสารอาหารทางหลอดเลือดดำโดยคณะวิจัย

ประโยชน์และผลข้างเคียงที่จะเกิดแก่ผู้เข้าร่วมการวิจัย

ประโยชน์

นอกจากการได้รับการติดตามการเกิดหลอดเลือดดำส่วนปลายอักเสบอย่างใกล้ชิดแล้ว ผู้ป่วยจะได้รับการปรับเปลี่ยนระดับสารอาหารเพื่อให้เหมาะสมกับความต้องการโดยประเมินจากผลเลือดทางห้องปฏิบัติการ นอกจากนี้ผู้ป่วยจะได้รับสารอาหารทางหลอดเลือดดำ, การตรวจเลือด, และการประเมินผลทางด้านโภชนาการ โดยไม่เสียค่าใช้จ่ายใดๆ

ผลข้างเคียง

ผลข้างเคียงที่อาจเกิดกับผู้ป่วยที่เข้าร่วมโครงการ คือ

1. การที่ผู้ป่วยจะถูกรบกวนในระหว่างการพักผ่อนเพื่อทำการตรวจประเมินภาวะทางโภชนาการ (Anthropometrics) และการตอบแบบสอบถามเกี่ยวกับอาการป่วยจากแบบประเมิน SGA ซึ่งอาจก่อให้เกิดความรำคาญแก่ผู้ป่วยได้

แนวทางแก้ไข คณะผู้วิจัยจะทำตรวจประเมินผู้ป่วยทั้งภาวะทางร่างกายและการตอบแบบสอบถามในช่วงเวลากลางวัน และจะไม่รบกวนผู้ป่วยในเวลาอนหลับ

2. ผู้ป่วยอาจเกิดอาการปวดในตำแหน่งที่เกิดภาวะหลอดเลือดดำอักเสบ

แนวทางแก้ไข คณะแพทย์และพยาบาลจะติดตามการเกิดภาวะหลอดเลือดดำอักเสบอย่างใกล้ชิด และถ้าพบปัญหาดังกล่าวจะหยุดการให้อาหารทางหลอดเลือดที่เส้นเลือดนั้นทันที และจะพิจารณาการให้อาหารในตำแหน่งอื่นๆตามความจำเป็นต่อไป อีกทั้งแพทย์และพยาบาลจะติดตามรักษาการเกิดอาการอักเสบของหลอดเลือดดำส่วนปลายอย่างใกล้ชิด กระทั่งหายเป็นปกติ โดยผู้ป่วยไม่ต้องเสียค่าใช้จ่ายที่เกิดจากผลของการเกิดภาวะหลอดเลือดดำอักเสบในการศึกษาครั้งนี้

3. ผู้ป่วยอาจมี ปัญหาการบวมและเหนื่อยจากการให้โภชนบำบัด

แนวทางแก้ไข คณะแพทย์และพยาบาลในโครงการวิจัยจะแก้ไขปัญหาดังกล่าวตามความเหมาะสมและติดตามดูแลกระทั่งผู้ป่วยหายเป็นปกติ โดยที่ผู้ป่วยไม่ต้องเสียค่าใช้จ่ายที่เกิดจากการตรวจที่ไม่เกี่ยวกับการรักษาโดยตรง

สิทธิของผู้ป่วยที่เข้าร่วมโครงการ

การที่ผู้ป่วยเข้าร่วมโครงการนี้เป็นความสมัครใจของผู้ป่วยเอง และผู้ป่วยไม่จำเป็นต้องเข้าร่วมโครงการหากไม่ประสงค์ และการตัดสินใจไม่เข้าร่วมโครงการของผู้ป่วยจะไม่มีผลต่อทัศนคติของแพทย์ที่มีต่อผู้ป่วยและต่อการรักษาที่ผู้ป่วยจะได้รับ หากผู้ป่วยสมัครใจในการเข้าร่วมโครงการ ผู้ป่วยต้องลงนามเพื่อยืนยันการยินยอมเข้าร่วมโครงการ และผู้ป่วยสามารถถอนตัวออกจากโครงการเมื่อใดก็ได้ภายหลังเข้าร่วมโครงการ แต่ขอให้แจ้งแพทย์หรือผู้ร่วมวิจัยให้ทราบถึงความประสงค์ของผู้ป่วยก่อน

การเก็บข้อมูลเป็นความลับ

ข้อมูลส่วนตัวของผู้ป่วยที่ได้ระหว่างโครงการนี้จะถูกเก็บไว้เป็นความลับ โดยผลของการวิจัยจะอ้างอิงเฉพาะหมายเลขผู้เข้าร่วมโครงการและอักษรย่อของชื่อและนามสกุลเท่านั้น

ผู้ป่วยจะได้รับสำเนาแบบแสดงความยินยอม หากผู้ป่วยมีปัญหาหรือมีข้อสงสัยประการใด กรุณาติดต่อ ศาสตราจารย์นายแพทย์สุรรัตน์ โคมินทร์ หรือ แพทย์หญิงครุณีวัลย์ วโรดมวิจิตร ภาควิชาอายุรศาสตร์ คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี หรือ เกสัชกรหญิงโนรี จงวิไลเกษม สำนักงานวิจัย ชั้น 6 โรงพยาบาลรามาธิบดี ซึ่งยินดีให้คำตอบแก่ผู้ป่วยทุกเมื่อ

ถ้าท่านมีปัญหาข้อสงสัยหรือรู้สึกกังวลใจกับการเข้าร่วมโครงการวิจัยนี้ ท่านสามารถติดต่อกับประธานกรรมการจริยธรรมการวิจัยในคน คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี โทร 0-2201-1541 ในเวลาราชการ

หนังสือยินยอมโดยได้รับการบอกกล่าวและเต็มใจ (Informed Consent Form)

ชื่อโครงการ: ผลของการดัดแปลงวิธีการให้อาหารทางหลอดเลือดดำแบบไม่สมบูรณ์ต่อการลดอัตราการ
อักเสบของหลอดเลือดดำส่วนปลายและการเปลี่ยนแปลงของภาวะโภชนาการ

ชื่อผู้วิจัย : ศ.นพ. สุรัตน์ โคมินทร์
พญ. ดรุณีวัลย์ วโรคมวิจิตร
กญ. โนรี จงวิไลเกษม
สำนักงานวิจัย โรงพยาบาลรามาราชบิต

*ชื่อผู้เข้าร่วมวิจัย.....

อายุ.....เลขที่วาระเบียน.....

คำยินยอมของผู้เข้าร่วมการวิจัย

ข้าพเจ้า นาย/นาง/นางสาว.....ได้ทราบรายละเอียดของโครงการวิจัย
ตลอดจนประโยชน์ และข้อเสี่ยงที่จะเกิดขึ้นต่อข้าพเจ้าจากผู้วิจัยแล้วอย่างชัดเจน ไม่มีสิ่งใดปิดบังซ่อนเร้นและ
ยินยอมให้ทำการวิจัยในโครงการที่มีชื่อข้างต้นและข้าพเจ้ารู้ว่าถ้ามีปัญหาหรือข้อสงสัยเกิดขึ้นข้าพเจ้าสามารถ
สอบถามผู้วิจัยได้ และข้าพเจ้าสามารถไม่เข้าร่วมโครงการวิจัยนี้เมื่อใดก็ได้ โดยไม่มีผลกระทบต่อการรักษาที่
ข้าพเจ้าพึงได้รับ นอกจากนี้ผู้วิจัยจะเก็บข้อมูลเฉพาะเกี่ยวกับตัวข้าพเจ้าเป็นความลับและจะเปิดเผยได้เฉพาะในรูป
ที่เป็นสรุปผลการวิจัย การเปิดเผยข้อมูลเกี่ยวกับตัวข้าพเจ้าต่อหน่วยงานต่างๆที่เกี่ยวข้อง กระทำได้เฉพาะกรณี
จำเป็นด้วยเหตุผลทางวิชาการเท่านั้น

ลงชื่อ.....(ผู้เข้าร่วมการวิจัย)
.....(พยาน)
.....(พยาน)
วันที่.....

คำอธิบายของแพทย์หรือผู้วิจัย

ข้าพเจ้าได้อธิบายรายละเอียดของโครงการ ตลอดจนประโยชน์ของการวิจัย รวมทั้งข้อเสี่ยงที่อาจจะ
เกิดขึ้นแก่ผู้เข้าร่วมการวิจัยทราบแล้วอย่างชัดเจน โดยไม่มีสิ่งใดปิดบังซ่อนเร้น

ลงชื่อ.....(แพทย์หรือผู้วิจัย)
วันที่.....

หมายเหตุ : กรณีผู้เข้าร่วมวิจัยไม่สามารถอ่านหนังสือได้ ให้ผู้วิจัยอ่านข้อความในใบยินยอมฯนี้ให้แก่ผู้เข้าร่วมการ
วิจัยฟังจนเข้าใจดีแล้ว และให้ผู้เข้าร่วมการวิจัยลงนามหรือพิมพ์ลายนิ้วหัวแม่มือรับทราบในการให้ความยินยอม
ดังกล่าวข้างต้นไว้ด้วย

ผู้เข้าร่วมการวิจัย หมายถึง ผู้ยินยอมคนให้ทำวิจัย

แบบบันทึกข้อมูลทั่วไปของผู้ป่วยที่ได้รับอาหารทางหลอดเลือดดำส่วนปลาย (PPN)

วันที่บันทึก หอผู้ป่วย.....เตียง..... Code.
 ชื่อผู้ป่วย.....นามสกุล.....อายุ.....ปี เพศ.....HN.....
 วันที่เข้าโรงพยาบาล..... วันที่เริ่มให้PPN.....
 Diagnosis..... ส่วนสูง..... น้ำหนักวันที่เข้าโรงพยาบาล.....kg
 โรคประจำตัว.....
 ชนิดสารอาหารทางหลอดเลือดดำที่ได้รับ

Control group

Continuous method

Study group

Cyclic method

พฤติกรรมการสูบบุหรี่

สูบบุหรี่ วันละ..... มวน/ วัน สูบมานาน.....ปี
 เคยสูบ แต่เลิกสูบแล้ว.....ปี ไม่สูบบุหรี่

ยาที่ผู้ป่วยได้รับในแต่ละวัน

วันที่	รายการและขนาดยาที่ได้รับ
ก่อนให้PPN	
D1	
D2	
D3	
D4	
D5	

วันที่ผู้ป่วยออกจากโรงพยาบาล.....

APACHE II Score Form

PHYSIOLOGIC VARIABLE	HIGH ABNORMAL RANGE					LOW ABNORMAL RANGE				
	+4	+3	+2	+1	0	+1	+2	+3	+4	
1 Temperature (°C)	>=41	39-40.9		38.5-38.9	36.0-38.4	34-35.9	32-33.9	30-31.9	<=29.9	
2 Mean arterial pressure = (SBP -DBP) / 3 +DBP)	>=160	130-159	110-129		70-109		50-69		<=49	
3 Heart rate (ventricular response)	>=180	140-179	110-139		70-109		55-69	40-54	<=39	
4 Respiratory rate (non-ventilated or ventilated)	>=50	35-49		25-34	12-24	10-11	6-9		<5	
5 Oxygenation A-a gradient A-a = 7(FiO2) - (Pa O2 +PCO2)	>=500	350-499	200-349		<200					
6 Arterial pH If no ABGs record Serum HCO3 below	>=7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15	
7 Serum Sodium (Na+)	>=180	160-179	155-159	150-154	130-139		120-129	111-119	<=110	
8 Serum Potassium (K +)	>=7	6-6.9		5.6-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5	
9 Serum Creatinine: Cr (mg/dl)	>=3.5	2-3.4	1.5-1.9	46-49.9	30-45.9		20-29.9		<20	
10 Hematocrit (%)	>=60		50-59.9	15-19.9	3-14.9		1-2.9		<1	
11 White Blood Count	>=40		20-39.9							
12 Glasgow Coma Scale (Score = 15 - actual GCS)	15-GCS=									
A Total Acute Physiology Score (APS)										
Sum of the 12 individual variable points =										
* Serum HCO3(venous-mMol/L) Not preferred, use if no ABGs	<52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15	
Glasgow Coma Scale (Circle appropriate response)	B Age Points		C Chronic Healths Points		Apache-II Score (sum of A+B+C)					
Eyes open 1 - no response 2 - to painful stimuli 3 - to verbal 4 - spontaneously	Age points = Age <44 0 45-54 2 55-64 3 65-74 5 >75 6		If the patient has a history of severe organ system insufficiency or is immunocompromised, assign points as follows: a. for nonoperative or emergency postoperative patients 5 points or b. for elective postoperative patients 2 points		A APS points + B Age points + C Chronic Health Points = Total Apache-II					
Motor response 1 - no response 2 - incomprehensible sounds 3 - inappropriate words 4 - disoriented and talks 5 - oriented and contraversed verbal - <u>nonintubated</u> verbal - <u>intubated</u>	Points 0 2 3 5 6		Liver Cardiovascular Pulmonary Kidney Immune		If any of the 5 CHE categories is answered with yes give +5 points for non-operative or emergency postoperative patients - Cirrhosis with PHT or encephalopathy - class IV angina or at rest or with minimal self care activities - chronic hypoxemia or hypercapnia or polycythaemia of PHT > 40mmHg - chronic peritoneal or hemodialysis - immune compromised host Chronic Health Points =					
6 - to verbal command 5 - localizes to pain 4 - withdraws to pain 3 - decorticate 2 - decerebrate 1 - no response										

Knaus, W.A., et al. (1995). APACHE II: A Severity of Disease Classification System. *Critical Care Medicine*, 13 (10), 818-829.

ชื่อ-สกุล HN
 ตารางบันทึกผลการเปลี่ยนแปลงของภาวะหลอดเลือดดำส่วนปลายอีกเสมอ (บันทึกเวลาในช่อง)
 เพียงที่

จำนวนวัน (ตั้งแต่วันที่ให้ PPN) วันที่ 1 (เริ่มแทงเข็มPPN)	วัน / เดือน / ปี	ไม่พบสิ่งผิดปกติ	เวลาที่พบสิ่งผิดปกติ				เส้นเลือดอีกเสมอ ต้น
			ปวด	แดง	คลำได้เส้นเลือด	คลำได้เส้นเลือดแข็งเป็นถ้ำ	
วันที่ 2							
วันที่ 3							
วันที่ 4							
วันที่ 5							

ตารางบันทึกผลการประเมินภาวะทางโภชนาการ

ชื่อผู้ป่วย.....นามสกุล.....อายุ.....ปี เพศ.....HN.....

รายการ	วันที่เริ่มให้ PPN	2	3	4	5
Weight (kg)					
อาการข้างเคียงที่น่าจะเกิดจาก PPN					
Vital sign					
Temperature (C)					
Pulse (ครั้ง/ นาที)					
Blood pressure (mmHg)					
Anthropometric measurement					
<input type="checkbox"/> แขนขวา <input type="checkbox"/> แขนซ้าย					
Midarm circumference(cm)					
Handgrip strength (kg)					
Triceps skinfold (mm)					

ตารางบันทึกผลทางห้องปฏิบัติการ

ชื่อผู้ป่วย.....นามสกุล.....อายุ.....ปี เพศ.....HN.....

LAB		D1	D2	D3	D4	D5
		วันที่.....	วันที่.....	วันที่.....	วันที่.....	วันที่.....
P1 screening						
Glucose	, mg/dl					
BUN	, mg/dl					
Cr	, mg/dl					
Uric acid	, mg/dl					
Na	mmol/l					
K	mmol/l					
Cl	mmol/l					
CO2	mmol/l					
Ca	mg/l					
In. P	mg/l					
T. bilirubin	mg/l					
D. bilirubin	mg/l					
Cholesterol	mg/l					
AST	u/l					
ALT	u/l					
ALP	u/l					
GGT	u/l					
Total protein	g/l					
Albumin	g/l					
TG	mg/dl					
Other						
Prealbumin	g/l					
B1	ETKA, IU					
	TPPE, %					
B2	EGRA, IU					
	AC, %					
C	mg/dl					
Treatment record (Electrolyte add to)						
P	mg/l					
Na	mmol/l					
K	mmol/l					
Ca	mg/l					
Cl	mg/l					
Zn	mg/l					
Mg	mg/l					
Other.....	mg/l					

ตารางบันทึกผลทางห้องปฏิบัติการ

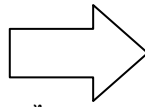
ชื่อผู้ป่วย.....นามสกุล.....อายุ.....ปี เพศ.....HN.....

LAB	D1	D2	D3	D4	D5
	วันที่.....	วันที่.....	วันที่.....	วันที่.....	วันที่.....
WBC					
RBC					
Hb					
Hct					
MCV					
MCH					
MCHC					
RDW					
Plt					
Neut					
Lymph					
Mono					
Eos					

การประเมินภาวะโภชนาการ PG-SGA
(Patient-Generated Subjective Global Assessment)

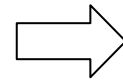
สถิติเกอร์ ชื่อ-นามสกุล ผู้ป่วย

- น้ำหนัก
ขณะนี้คุณสูง..... ซม. น้ำหนัก..... กก.
1 เดือนก่อน คุณหนัก กก.
6 เดือนก่อน คุณหนัก กก.
ในช่วง 2 สัปดาห์ก่อน น้ำหนักของคุณมีการเปลี่ยนแปลงอย่างไร
 ลดลง (1) ไม่เปลี่ยนแปลง (0) เพิ่มขึ้น (0)
- การกินอาหาร โดยเทียบกับช่วงเวลาปกติ คุณคิดว่าในช่วง 1 เดือนที่ผ่านมา
ลักษณะอาหารที่รับประทานตรงกับข้อใด
 มากกว่าปกติ (0) เหมือนช่วงปกติ (0)
 น้อยกว่าปกติ ระบุปัจจุบันคุณรับประทานอาหารอย่างไร
 อาหารปกติ แต่ปริมาณลดลง (1)
 อาหารปกติ ปริมาณน้อยมาก (2)
 รับประทานอาหารเฉพาะอาหารเหลว (3)
 รับประทานอาหารเฉพาะอาหารเสริม (3)
 รับประทานอาหารได้น้อยมากๆ / แทบจะรับประทานอาหารไม่ได้เลย (4)
 รับประทานอาหารทางสายยางหรือได้รับอาหารทางเส้นเลือด (0)



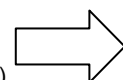
ใช้ นน. ที่ 1 เดือน มาเป็นตัวให้คะแนน ถ้าไม่มี
ข้อมูล ใช้ นน. ที่ 6 เดือนมาคิดการ
เปลี่ยนแปลงของ นน. นำคะแนนที่ได้บวกอีก 1
ถ้านน.ลดลงใน 2 สัปดาห์
นน. 1 เดือน – นน. ปัจจุบัน
----- x 100 = -----
%

นน. 1 เดือน		
นน. 1 เดือน	คะแนน	นน. 6 เดือน
≥10%	4	≥20%
5-9.9%	3	10-19.9%
3-3-4.9%	2	6-9.9%
2-2.9%	1	2-5.9%
0-1.9%	0	0-1.9%



คะแนนรวม

- ในช่วง 2 สัปดาห์ที่ผ่านมา คุณรับประทานอาหารได้ลดลง เนื่องจากอาการเหล่านี้หรือไม่
โดยมีอาการต่อเนื่องตลอด 2 สัปดาห์(เลือกได้มากกว่า 1 ข้อ)
 ไม่มีปัญหาเรื่องการรับประทานอาหาร (0) เจ็บปาก / แผลในปาก (2)
 คลื่นไส้ (1) มีปัญหาเรื่องการกลืน (2)
 อิ่มเร็ว (1) อาเจียน (3)
 รู้สึกอาหารมีกลิ่นไม่น่ารับประทาน(1) เบื่ออาหาร / ไม่อยากกินอาหาร (3)
 รสชาติอาหารแปลกไปหรือกินไม่รู้รสชาติ (1) ท้องเสีย (3)
 ท้องผูก (1) มีอาการปวดอื่นๆ
 ปากแห้ง (3) ระบุตำแหน่ง (3).....
 อื่นๆ (1)
- เช่น ปัญหาทางการเงิน ซึมเศร้า / สุขภาพจิต ปัญหาเรื่องฟัน เป็นต้น



คะแนนรวม

- การทำกิจกรรมต่างๆ ในช่วง 1 เดือนที่ผ่านมา คุณคิดว่า ความสามารถในการทำงาน / กิจกรรมต่างๆ
ของคุณตรงกับข้อใดต่อไปนี้
 ทำงานได้ตามปกติ (0)
 ทำงานได้ลดลงบ้าง แต่ยังช่วยเหลือตัวเองในการทำกิจวัตรประจำวันได้ค่อนข้างปกติ (1)
 ทำงานและกิจวัตรประจำวันได้ประมาณครึ่งเดียว แต่ยังพอเดินไปมาในบ้านได้ (2)
 ทำงานไม่ไหวแต่พอช่วยเหลือตัวเองได้บ้าง บางครั้งต้องมีคนดูแล ส่วนใหญ่ นั่งในเก้าอี้ / อยู่บนเตียง (3)
 ทำงานไม่ไหวต้องมีคนดูแลตลอดเวลา อยู่บนเตียงเกือบทั้งวัน (4)



คะแนนรวม

คะแนนรวมข้อ 1-4

คะแนนรวม (ข้อ1-7)

- 0-1 ไม่ต้องการการดูแลทางโภชนาการ ประเมินซ้ำ
- 2-3 ให้คำแนะนำแก่ผู้ป่วยและญาติ โดยดูจากอาการในข้อ 3 ส่งตรวจทางห้องปฏิบัติการตามความเหมาะสม
- 4-8 ต้องการการดูแลทางโภชนาการโดยนักโภชนาการ ร่วมกับแพทย์และพยาบาล
- ≥ 9 จำเป็นต้องได้รับโภชนาบำบัด (nutrition support)

ผู้ประเมิน..... ตำแหน่ง..... วันที่

การประเมินภาวะโภชนาการโดยรวม (Subjective Global Assessment, SGA)

	A	B	C
น้ำหนัก	น้ำหนักไม่ลด หรือ เพิ่มขึ้น หรือ เคยลดแต่เพิ่มขึ้นแล้ว	น้ำหนักลดไม่เกิน 5% ใน1เดือน หรือ ไม่เกิน10%ใน6เดือน	น้ำหนักลดมากกว่า 5% ใน1เดือน หรือ มากกว่า10%ใน6เดือนหรือลดลงเรื่อยๆ
การกินอาหาร	ปกติ	การกินอาหารลดลงชัดเจน	กินอาหารได้น้อยมาก
อาการ	ไม่มีอาการที่มีผลต่อการกิน หรืออาการเหล่านั้นดีขึ้น	มีอาการที่มีผลต่อการกิน เช่น ปวดท้อง อาเจียน ท้องเสีย เบื่ออาหาร	มีอาการที่มีผลต่อการกิน ตามข้อ Bแต่นานกว่า 2 wk /เรื้อรัง
ความสามารถในการทำงาน	ปกติ	ทำงานได้ลดลง	ทำงานได้ลดลงมาก ทำงานไม่ไหว
การตรวจร่างกาย	ปกติ	มีลักษณะของการขาดอาหาร เช่น ขมับบวม แก้มตอบ ผอมลง	มีลักษณะของการขาดอาหารชัดเจน เช่น ผอมมาก บวมน้ำ

การแปลผลการประเมินโภชนาการโดยรวม (Subjective Global Assessment)

- A : โภชนาการปกติ
- B : ทุกโภชนาการปานกลาง หรือสงสัยจะมีทุกโภชนาการ
- C : ทุกโภชนาการรุนแรง

แบบประเมินผลกระทบจากการให้อาหารทางหลอดเลือดดำส่วนปลายต่อสภาวะร่างกายและจิตใจของผู้ป่วย

ชื่อ-สกุล.....HN.....กลุ่ม.....

วันที่รับเข้าโรงพยาบาล.....วันที่เริ่มให้PPN.....

ใส่เครื่องหมาย / ในช่องสี่เหลี่ยมตามอาการที่เกิดขึ้นในวันนี้

ความกังวลและความเครียด

D 1 2 3

- ฉันกังวลกับอาการป่วยครั้งนี้มาก
- ฉันกังวลกับอาการป่วยครั้งนี้เพียงเล็กน้อย
- ฉันไม่กังวลกับอาการป่วยครั้งนี้

ความสามารถในการเคลื่อนที่

- ฉันไม่มีแรงพอที่จะเดินออกจากเตียงคนเดียวได้
- ฉันรู้สึกเหนื่อยเวลาเดินจากเตียงคนเดียว
- ฉันมีแรงพอที่จะเดินออกจากเตียงคนเดียวได้โดยไม่เหนื่อย

ความคล่องตัวในการเคลื่อนไหว

- ฉันรู้สึกไม่สะดวกมากในการเคลื่อนไหวเนื่องจากมีสายน้ำเกลือ
- ฉันรู้สึกไม่สะดวกเล็กน้อยในการเคลื่อนไหวเนื่องจากมีสายน้ำเกลือ
- ฉันขยับตัวได้ตามปกติแม้มีสายน้ำเกลือ

ปัญหาในการนอนไม่หลับ

- ฉันนอนไม่หลับเลยเนื่องจากมีสายน้ำเกลืออยู่
- ฉันนอนหลับๆตลุดๆตลอดคืนเนื่องจาก.....
- ฉันหลับได้ตามปกติ

การรบกวนร่างกายและจิตใจ

- ฉันรำคาญที่มีเข็มอยู่ที่แขนจนทนไม่ได้
- ฉันรำคาญที่มีเข็มอยู่ที่แขนบ้าง แต่พอทนได้
- ฉันเคลื่อนไหวได้ตามปกติ แม้มีเข็มคาอยู่ที่แขน

การรบกวนร่างกายและจิตใจ

- ฉันรู้สึกดีเวลาที่ไม่มีสายน้ำเกลืออยู่
- ฉันรู้สึกเฉยๆกับสายน้ำเกลือที่เสียบอยู่

แบบสอบถามคนไข้ที่ได้รับอาหารทางหลอดเลือดดำแบบหยุดพัก

1. ท่านพอใจวิธีให้น้ำเกลือแบบหยุดพักในช่วงกลางคืนหรือไม่ เมื่อเปรียบเทียบกับที่ได้รับน้ำเกลือตลอดเวลา

พอใจ

เพราะ

เฉยๆ

ไม่พอใจ

เพราะ

2. หากให้ท่านเลือกวิธีที่จะได้รับน้ำเกลือทั้ง 2 แบบ ท่านจะเลือกวิธีใด

..... ให้น้ำตลอดเวลา

..... ให้แบบหยุดพัก

แบบสอบถามทัศนคติของพยาบาลเมื่อผู้ป่วยได้รับอาหารทางหลอดเลือดดำส่วนปลายแบบหยุดพัก (Cyclic PPN) เทียบกับการให้แบบมาตรฐาน (Continuous PPN)

1. ท่านเป็นพยาบาลในward.....
2. ท่านได้ดูแลผู้ป่วยที่ให้PPN แบบหยุดพักหรือไม่
ใช่ไม่ใช่
3. ท่านรู้สึกว่าการะงานของท่านในเวรดีลดลงเมื่อให้PPNแบบหยุดพักใช่หรือไม่
ใช่ไม่ใช่
4. ท่านรู้สึกว่าผู้ป่วยสุขสบายขึ้นเมื่อได้หยุดพักการให้PPNตอนกลางคืน
ใช่ไม่ใช่

ใส่เครื่องหมายในช่องที่ท่านเห็นด้วยมากที่สุดเมื่อเปรียบเทียบภาระงานของการให้PPN แบบหยุดพัก กับการให้แบบมาตรฐาน ในช่วงเวรดี

ภาระงาน	น้อยลงมาก	น้อยลง	เหมือนเดิม	เพิ่มขึ้น	เพิ่มขึ้นมาก
การเตรียมน้ำเกลือ					
การround rateน้ำเกลือ					
การตรวจตราสายน้ำเกลือ (leak, ข้อต่อ)					
การช่วยเหลือผู้ป่วยในการเคลื่อนที่ (เช่น เข้าห้องน้ำ, ลุกนั่ง)					
การลดการคิดintakeในเวรดี					
การแทงเส้นเมื่อมีการรั่วของสายน้ำเกลือ					

ข้อเสนอแนะ

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Thrombophlebitis

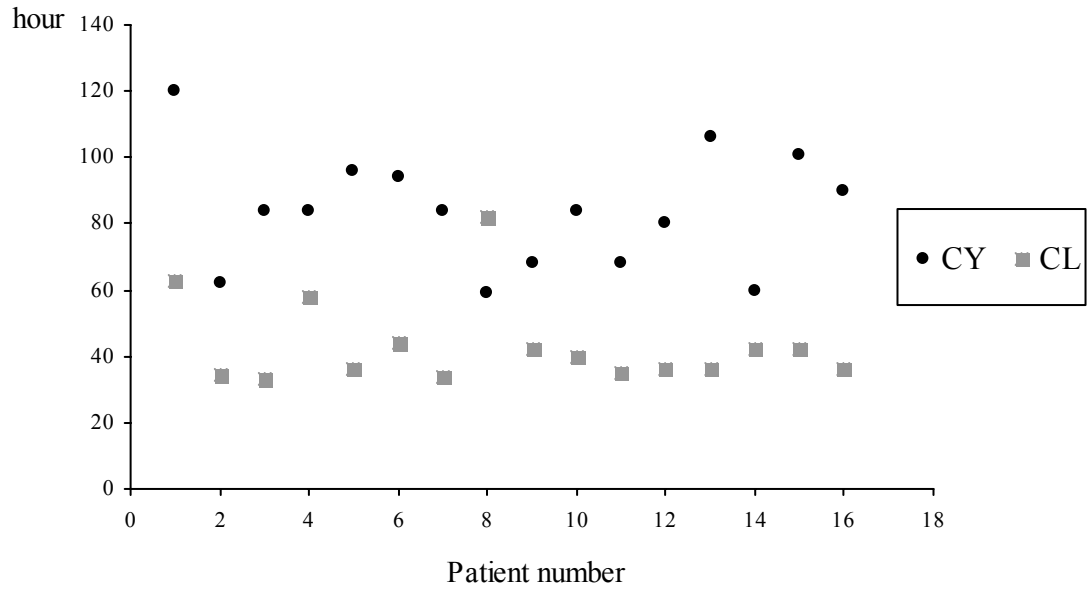


Figure C1 Scatter-plot of onset of thrombophlebitis

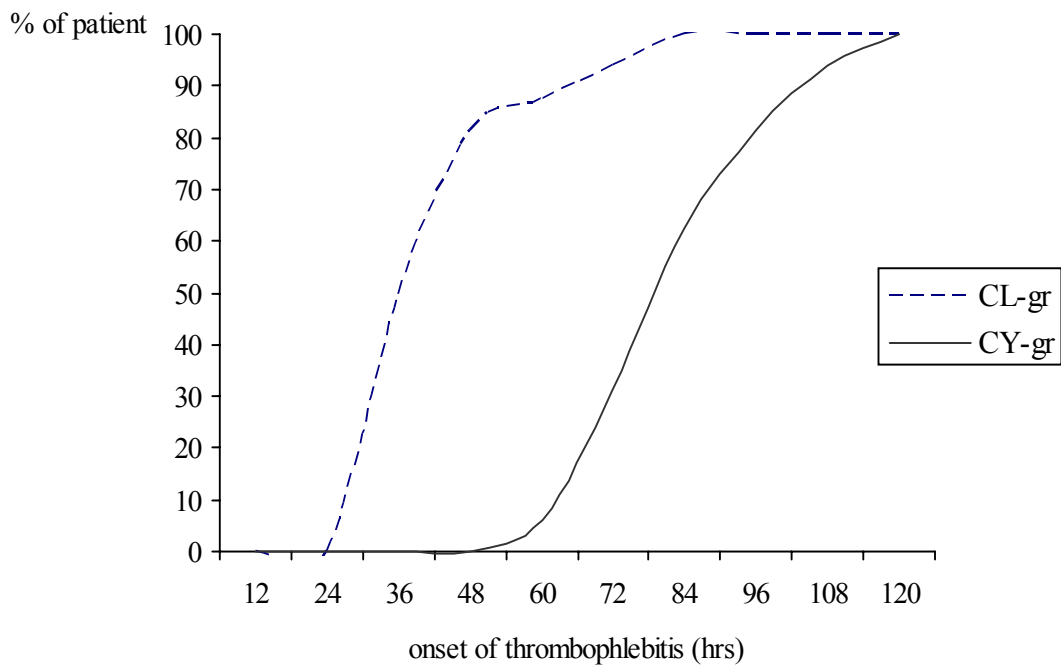


Figure C2 Cumulative incidence (%) of onset of thrombophlebitis in both techniques

Table C1 Raw data of patients

ID	HN	AGE	GENDER	GROUP	Wt_b	Wt_a	Phlebitis
1	3473133	62	1	1	71	70	63
2	3749309	69	2	1	51	50	34.2
3	3758516	71	1	1	42	40	33
4	3769182	69	2	1	45	45	58
5	3288230	43	1	1	48.5	48	36
6	3755078	69	2	1	42	44	44
7	3573638	55	1	1	42	40	34
8	3400843	37	1	1	62.2	58.8	82
9	3329882	58	2	1	57	55	42
10	3772712	69	2	1	39	38	40
11	3782302	74	2	1	49.5	47	35
12	3783217	61	2	1	52	50	36
13	3750007	55	1	1	45	41	36
14	2510625	52	2	1	48.5	46	42
15	3445135	37	1	1	81.8	81.2	42
16	3786112	67	2	1	50	47	36
21	3750007	55	1	2	58.5	55	120
22	3733706	60	2	2	55.9	55	62
23	2808939	72	1	2	42	40	84
24	3746324	35	2	2	74.5	74	84
25	3692276	57	1	2	57.5	54	96
26	3747523	49	1	2	58	55	94
27	3764992	69	1	2	67	66	84
28	3767369	47	2	2	52.3	50.5	59
29	3759693	64	2	2	51	49	68
30	3721248	50	1	2	68	67	84
31	3781948	61	1	2	47.1	45	68
32	3786157	66	2	2	45	45.5	80
33	3773748	59	1	2	41.5	45	106
34	3767752	62	2	2	40	39.3	60
35	3039873	41	1	2	64	62.5	101
36	3782385	71	1	2	66	64	90

Table C1 (Cont.) Raw data of patients

ID	Prealbumin_b	Prealbumin_a	etkaB1_b	etkaB1_a	TPPE B1_b	TPPE B1_a	AC B2_b
1	7.07	15.8	168.73	213.14	0	0	0.97
2	10.6	22.6	86.78	283.91	10	1.37	0.93
3	17.5	23.7	157.85	198.14	36.11	25	1.19
4	5.95	4.7	88.2	285.14	6.67	19	0.98
5	20.6	25.6	274.02	144.58	0	27.58	0.92
6	14.9	15.3	213.24	261.49	30.23	0	0.89
7	37	22.2	323.16	182.15	11	0	0.91
8	18.9	28.8	134.22	179.73	6.67	0	1.02
9	19.7	29.1	458.76	598.95	15	0	0.93
10	17.1	10.4	157.65	223.41	0	0	0.99
11	9.93	12.7	286.35	330.72	0	0	0.98
12	7.52	4.95	202.08	358.14	0	0	0.91
13	10.4	16.8	392.64	649.78	0	0	0.93
14	16.4	29.5	215.51	305.31	59.17	0	1.12
15	11.2	28	258.95	293.77	0	0	1.15
16	7.88	15.42	178.79	325.34	42	0	1.14
21	22.2	11.6	283.91	352.27	1.37	0	1.08
22	11.6	15.8	85.73	177.92	0	0	0.93
23	7.9	18.4	112.03	154.21	47.83	25.81	0.9
24	14.6	16.1	258.74	292.81	34.34	0	1.08
25	16	21.8	159.81	201.07	8.11	0	0.92
26	5.24	25.2	238.9	326.83	16	0	0.92
27	14.2	25.7	177.09	317.12	6.1	0	1
28	10.2	12.3	413.89	302.52	54.95	0	1.24
29	13.4	16.3	355.98	377.33	0	0	0.91
30	12	9.91	182.3	333.94	0	0	1.02
31	15.6	26.9	264.65	349.28	0	0	0.83
32	4.77	9.04	260.94	281.8	0	0	0.87
33	14	20.2	123.4	226.58	0	0	0.93
34	6.87	14.1	303.19	359.79	2.41	0	1.17
35	14.6	25.7	183.5	283.79	10.91	0	1.03
36	8.06	13.6	227.78	370.44	14.75	0	1.05

Table C1 (Cont.) Raw data of patients

ID	AC B2_ a	EGRA B2_b	EGRA B2_a	Vit C_b	Vit C_a	SGA_b	SGA_a
1	1	2404.55	2759.77	0.28	1.7	2	1
2	0.97	2997.75	2669.63	0.42	2.33	2	2
3	1.04	2042.75	2557.45	0.76	2.18	2	2
4	0.94	3384.33	4371.92	0.43	1.31	3	3
5	0.86	3442.88	4326.99	0.8	2.81	2	2
6	1.1	5736.49	3962.05	0.55	1.1	2	2
7	0.78	4645.16	2723.03	1.1	4.19	3	3
8	1.08	2903.23	3053.28	0.34	1.53	2	2
9	1.02	4645.16	4858.73	0.54	1.95	2	2
10	0.95	4154.84	5312.57	0.2	1.2	2	2
11	0.74	4587.81	5125.69	0.66	3.01	2	2
12	0.95	3008.79	2787.09	0.32	1.8	3	3
13	0.99	2802.24	6503.22	0.48	2.82	3	3
14	0.95	4696.77	6219.35	0.5	1.68	2	2
15	1.02	2374.19	3174.19	0.85	2.41	1	1
16	0.77	2038.71	2450.19	0.65	2.6	2	2
21	1.09	1809.17	3468.39	0.69	1.55	2	2
22	0.97	2997.75	2669.63	0.42	2.33	2	2
23	1.07	4806.45	2075.5	0.17	2.26	2	2
24	0.96	4180.65	3630.7	0.6	1.25	1	1
25	0.83	2477.42	4992.21	0.18	2.07	2	2
26	0.93	3848.85	2076.25	0.5	1.91	2	2
27	0.95	3509.68	5011.88	0.18	2.54	3	3
28	1.02	4216.38	4903.23	1.01	2.01	2	2
29	0.66	4351.5	4190.74	0.86	1.76	2	2
30	0.95	3014.41	4228.28	0.77	1.3	1	1
31	0.87	2246.01	6860.96	0.45	1.87	2	2
32	0.93	2876.83	2141.93	0.26	1.35	3	3
33	0.97	2472.42	2398.32	1.17	2.18	2	2
34	0.98	1363.25	2568.5	0.35	2.38	2	2
35	1.04	2269.79	2269.77	0.92	2.2	1	1
36	1.04	1625.8	3035.19	0.43	1.47	2	2

Table C1 (Cont.) Raw data of patients

ID	APACHE_a	Glucose_b	BUN_b	BUN_a	Cr_b	Cr_a	Na_b
1	5	97	4.7	5	0.7	0.5	139
2	9	112	15	12	1	0.4	135
3	5	115	14	18	1.3	0.9	142
4	7	175	16	13	0.5	0.4	132
5	4	90	19	17	1.7	1.3	130
6	9	99	11	13	0.6	0.5	131
7	8	88	16	24	0.6	0.6	135
8	1	85	6	7	0.8	0.6	141
9	5	142	7	6	0.6	0.4	142
10	5	115	12	6	1	1	139
11	5	114	6	11	1.1	1.1	141
12	6	146	4	16	1	1.1	139
13	3	133	3	8	0.6	0.7	139
14	2	114	10	8	0.8	1	140
15	0	133	8	7	1.1	1	142
16	9	553	11	7	1	0.6	131
21	6	350	8	10	1.5	0.9	143
22	3	153	6	13	0.8	0.8	139
23	5	96	16	10	1	1.1	143
24	0	103	10	12	0.8	0.8	142
25	3	110	8	14	0.9	0.8	132
26	2	133	20	23	0.9	0.7	134
27	5	133	10.83	13	1.2	1.1	143
28	4	92	15	14	0.7	0.5	144
29	3	146	9	13	0.8	0.7	135
30	2	106	24		1.6		143
31	5	76	13	16	0.7	0.9	133
32	5	117	9	7	0.8	0.7	134
33	4	168	24	10	0.9	0.8	135
34	5	106	11	10	1	0.8	133
35	0	83	16	10	0.9	0.9	142
36	7	146	8	8	0.7	0.5	140

Table C1 (Cont.) Raw data of patients

ID	Na_a	Na_first	K_b	K_a	K_first	Cl_b	Cl_a
1	145	136	3.28	3.54	3.04	103	107
2	140	140	3.83	3.64	3.64	100	104
3	134	134	3.51	4.26	4.26	104	96
4	131	131	4.06	4.9	4.9	100	92
5	140	140	3.23	3.97	3.97	87	100
6	128	128	3.76	3.87	3.87	94	88
7	126	126	3.9	6.1	6.1	104	93
8	138	138	3.95	5.74	5.74	102	100
9	139	139	3.47	4.24	4.24	105	100
10	138	138	3.32	4.27	4.27	103	108
11	139	139	3.77	4.51	4.51	106	100
12	130	130	3.79	3.71	3.71	103	94
13	136	136	4.43	4.88	4.88	101	96
14	140	140	4.27	4.97	4.97	104	106
15	142	145	3.97	5.04	4.01	103	104
16	136	138	4.67	8.05	4.46	97	99
21	140	141	4.45	4.49	4.86	105	103
22	136	136	4.8	5.36	5.36	99	100
23	133	139	4.02	5.15	4.3	107	102
24	139	139	3.93	3.9	3.9	100	100
25	137	137	3.19	5.16	4.45	106	101
26	134	134	4.52	4.49	4.06	95	93
27	133	133	3.63	7.87	7.87	109	95
28	137	134	4.35	5.32	3.66	110	98
29	139	134	3.51	4.17	3.07	97	100
30			4.24			108	
31	135	133	4.28	3.98	4.11	107	96
32	145	137	3.49	3.8	3.46	100	107
33	141	141	4.33	5.63	5.63	100	108
34	143	143	3.52	4.16	4.16	95	98
35	143	143	3.66	4.07	4.07	103	103
36	142	143	3.31	3.45	3.4	102	101

Table C1 (Cont.) Raw data of patients

ID	Cl_first	CO2_b	CO2_a	CO2_first	Ca_b	Ca_a	InP_b
1	101	28.5	25	26.6	8.11	8.5	3.7
2	104	24	21.3	21.3	8.5	8.7	3.1
3	96	21	27.3	27.3	9.3	8.9	5.8
4	92	27.2	29.4	29.4	8.01	8.7	4.4
5	100	34.7	26.1	26.1	9.4	9	4
6	88	26.6	23.6	23.6	9.4	9.2	2.9
7	93	25.9	16.2	16.2	8.9	8.2	3.6
8	100	27.2	20.9	20.9	9.8	8.9	1.31
9	100	25.9	23.6	23.6	9.5	9.2	3.3
10	108	10.4	12.8	12.8	9	8.7	3.4
11	100	21.1	24.7	24.7	9.4	9.5	4
12	94	25.4	24.5	24.5	8.3	9.4	3.9
13	96	30.6	33.2	33.2	9	9	4
14	106	24.6	21.3	21.3	9.2	8.7	3.2
15	109	23.1	23.7	26.1	9.1	9.5	4.2
16	109	25.5	28.8	18.3	8.5	9.1	4
21	104	26.1	32.7	30.6	8.8	8.4	4.1
22	100	28.5	22.1	22.1	10.13	9.6	1.46
23	105	26.4	24.6	21	7.8	8.8	2.4
24	100	27.7	23.7	23.7	9.3	9.8	3.3
25	100	22.3	27.6	27.8	8.2	9.7	3.6
26	93	32.3	21.1	26.4	10.6	9.7	3.6
27	95	21.3	20.5	20.5	8.2	9.3	4.4
28	99	27.2	23.4	24.9	8.6	9	4.5
29	98	29.5	23.5	27.8	9.2	9.4	1.2
30		23.8			9.8		3.3
31	98	25.9	27.8	30	8.2	8.3	4
32	104	23.8	18.7	19.9	7.9	9.1	2.3
33	108	26.3	21.3	21.3	8.7	8.5	3.9
34	98	37.9	32.4	32.4	9	9	4.7
35	103	20.2	25.7	25.7	9.1	9.4	4.3
36	107	23.7	27.6	26.2	8.4	8.2	2.7

Table C1 (Cont.) Raw data of patients

ID	InP_a	tbil_b	tbil_a	dbil_b	dbil_a	Cholesterol_b	Cholesterol_a
1	3.6	0.3	0.2	0.2	0.1	211	83
2	2.4	0.5	0.3	0.1	0.1	208	144
3	2.7	4.2	0.2	2	0.1	251	98
4	4.2	0.8	0.7	0.2	0.4	142	118
5	4.4	1.7	1.6	0.4	0.7	101	117
6	3.4	0.9	0.3	0.2	0.2	192	147
7	4.1	2.2	7.5	1.9	6.7	92	99
8	4.1	0.3	0.2	0.1	0.1	171	146
9	3.4	0.4	0.5	0.1	0.2	207	144
10	4.8	0.3	0.3	0.2	0.1	219	204
11	3.3	0.2	0.3	0.1	0.2	204	153
12	2.4	0.8	0.9	0.3	0.4	181	128
13	4.7	0.4	0.2	0.2	0.1	154	136
14	1.1	0.3	0.5	0.3	0.2	163	156
15	4.7	0.2	0.2	0.1	0.2	145	134
16	4.7	0.4	0.2	0.2	0.1	108	120
21	2.6	0.4	0.2	0.1	0.2	152	114
22	3	0.4	0.4	0.2	0.2	231	224
23	1	0.4	0.1	0.1	0.1	188	142
24	3.6	0.4	0.3	0.1	0.2	221	161
25	5.4	0.6	0.5	0.2	0.2	120	152
26	4.2	1	1	0.2	0.4	194	120
27	3.4	0.3	0.3	0.1	0.2	140	146
28	4.3	0.4	0.5	0.1	0.2	173	173
29	4.3	0.5	0.3	0.2	0.1	197	191
30		0.3		0.1		198	
31	3.5	0.4	0.2	0.2	0.1	166	121
32	3.1	0.6	0.4	0.2	0.2	181	158
33	4.2	0.3	0.4	0.1	0.2	177	198
34	3.4	1.1	0.2	0.4	0.2	153	111
35	3.5	0.6	0.3	0.2	0.2	240	194
36	1.8	28.3	11.5	25.3	9.4	143	151

Table C1 (Cont.) Raw data of patients

ID	AST_b	AST_a	ALT_b	ALT_a	ALP_b	ALP_a	GGT_b
1	17	20	33	18	91	53	46
2	18	16	24	16	67	38	28
3	17	14	24	17	55	49	17
4	48	44	28	21	119	191	68
5	24	37	39	32	66	56	26
6	34	15	46	23	95	77	84
7	361	1771	158	363	832	494	380
8	11	67	24	55	73	72	33
9	23	90	41	61	60	99	33
10	190	107	60	59	24.4	136	169
11	24	17	24	19	115	92	49
12	22	28	27	30	74	353	33
13	35	16	49	25	383	222	480
14	32	15	32	15	85	45	30
15	14	40	25	59	63	100	27
16	35	19	26	19	74	84	57
21	12	18	59	32	73	72	47
22	55	54	31	20	148	112	139
23	23	32	23	29	64	92	50
24	21	47	37	84	67	197	48
25	17	24	26	29	17	7	13
26	13	31	47	45	138	135	168
27	23	26	40	32	84	99	78
28	18	17	27	15	76	68	22
29	16	36	25	28	66	62	25
30	13		26		132		39
31	23	23	27	19	82	41	23
32	26	39	34	41	51	92	39
33	37	39	39	41	54	50	14
34	20	40	23	14	184	145	53
35	21	42	39	66	95	97	37
36	412	91	205	79	159	154	93

Table C1 (Cont.) Raw data of patients

ID	GGT_a	TP_b	TP_a	Alb_b	Alb_a	TG_b	TG_a
1	81	69.8	58.1	38.1	28.3	115	92
2	19	64.8	59.3	36.2	30.1	117	83
3	35	67	64.2	43	31.9	81	94
4	116	53.7	59.1	20.1	21.6	81	126
5	18	78.3	69	46.8	37.9	96	114
6	48	76.4	75.1	32.9	32.3	75	86
7	438	60.9	43.2	28.3	16.9	56	71
8	102	70.5	69.9	42.8	39.2	258	232
9	125	74.5	68.7	47.1	38.7	138	335
10	148	65.5	58.3	32.3	26.3	200	155
11	36	87.9	81.8	43.4	37	171	149
12	106	62.6	58.5	31.8	26.5	134	368
13	297	59.3	63.8	29.1	33.2	97	235
14	37	69.5	59.2	41.1	30.4	100	94
15	153	80.6	79.2	42.2	39	99	219
16	41	67.9	73	26.2	24.9	166	167
21	63	60.6	50.5	37.3	26.5	119	254
22	151	78.9	74.9	40.8	33.7	116	98
23	184	76.1	60.7	28.7	30.3	67	183
24	60.1	82.7	82.3	46.9	40.8	65	87
25	26	56.3	63.4	37.5	36.1	114	102
26	296	77.7	68.7	43.9	32.8	96	268
27	238	69.3	73.5	34.4	33	90	123
28	18	69.5	74.6	36.3	32.7	71	86
29	44	71.9	73	39.9	36.7	66	162
30		84.1		45.1		170	
31	28	54.3	52.4	30.5	26	57	110
32	69	54.4	66.5	26.7	28.7	146	123
33	19	53.7	55.2	33	35.3	91	120
34	80	70.5	65	30.4	25.5	119	135
35	127	79.7	77.8	45	41.3	171	125
36	114	52.3	58.1	28.1	26.1	332	712

Table C1 (Cont.) Raw data of patients

ID	surgery status	Disease group	Handgrip_b	Handgrip_a	Reason CY	Like CY	BMI_b
1	2	3	20	25	.	.	25.46
2	2	1	10	10	.	.	21.79
3	2	6	18	20	.	.	17.48
4	1	6	7	9	.	.	16.73
5	1	3	29	35.5	.	.	18.25
6	3	7	16	18	.	.	17.71
7	3	4	7.5	5.5	.	.	15.24
8	2	6	31	40	.	.	24.3
9	2	1	15	17	.	.	25
10	1	4	8	6	.	.	16.03
11	2	1	8	9	.	.	23.54
12	1	5	8.5	7	.	.	21.64
13	2	2	18	18.5	.	.	17.58
14	2	6	15	17	.	.	22.14
15	2	1	44	50	.	.	25.82
16	2	1	8	10	.	.	22.22
21	2	2	25	25	1	1	21.49
22	2	1	13	17	3	1	23.57
23	2	1	20	19	1	1	17.04
24	2	4	25	19	1	1	31.41
25	2	5	27	34	1	1	20.13
26	3	7	18	18	3	1	17.9
27	2	1	10	16	1	1	24.61
28	2	6	18	20	2	1	25.58
29	2	4	16	19	4	1	22.67
30	1	3	22.5	23	1	1	24.09
31	2	1	17	18	3	1	17.09
32	2	1	6	7	3	1	19.74
33	1	2	19	24	3	1	15.43
34	2	5	2	2	1	1	17.78
35	2	5	30	30	1	1	24.69
36	2	4	22	13	3	1	26.11

Table C1 (Cont.) Raw data of patients

ID	BMI_a	IBW	Tricep_b	Tricep_a	MAC_b	MAC_a
1	25.1	60.7	13	13	31	30.5
2	21.36	47.3	19	19	26	26
3	16.65	50	4.5	4.5	22	21
4	16.73	57.7	11	10.5	24.5	24.5
5	18.07	57.7	5	4.8	24.5	24.5
6	18.55	47.8	6.8	6.8	23.3	23.3
7	14.52	56.5	4.8	4.8	17	17
8	22.97	56.4	16.4	16.4	26.5	26.5
9	24.12	49.3	26	26.5	30	30
10	15.61	48.9	5.5	5.3	22	22
11	22.35	43.2	18.5	18.5	26.5	26.5
12	20.81	51.4	31	31	26	26
13	16.02	52.7	5.3	5.6	27	27
14	21	44.6	33	33	27.3	27
15	25.63	69	34.2	34	31.6	31.6
16	20.89	48.6	38	38	23.5	23.5
21	20.2	55.9	8.4	8.1	28.5	28
22	23.19	51	13.8	13.8	27	27
23	16.23	51.4	8	8	20	20
24	31.2	51	33	33	37	37
25	18.91	62.3	5.4	5.4	27.5	27
26	16.98	70.9	6	6	23.7	24
27	24.24	59.5	30	31.8	32	32
28	24.7	43.2	14	13.8	27	27
29	21.78	45.5	13	13.2	25.7	26
30	23.74	61.4	8.8	8.8	28.5	28.5
31	16.33	60.1	5.2	5.2	25	25
32	19.96	46.2	7.2	7.4	23	23
33	16.73	55	5.5	5.2	21.7	21.5
34	17.47	45.5	6.8	6.6	21.7	21.6
35	24.11	56.8	13.8	13.5	28.3	28.3
36	25.32	56	12.4	12.6	27.6	27.8

Table C1 (Cont.) Raw data of patients

ID	APACHE_b	APACHE_a	WBC	RBC	Hb	Hcy
1	3	2	20.7	4.08	9.2	28
2	3	3	4.77	3.78	8.6	26.2
3	2	2	6.82	4.27	10.1	31
4	3	3	11.9	3.57	10.7	30
5	1	2	4.33	3.84	10.8	31.8
6	3	3	20.4	4.46	10.4	30.3
7	2	3	8.64	0.46	10	30.4
8	1	1	9.87	4.86	12.4	38.9
9	1	2	5.02	4.94	13.6	42.8
10	3	2	6.62	4.09	11.7	34.9
11	3	2	6.39	3.52	9.1	27.6
12	1	3	5.38	4.82	12.1	36.3
13	2	1	3.08	3.6	9.5	28.4
14	1	1	7.61	4.8	11.5	34.9
15	1	1	8.74	3.99	7.7	21.7
16	2	3	12.6	5.07	11.1	35.2
21	1	3	6.15	4.56	13.4	39.1
22	1	1	7.64	3.99	9.8	30.9
23	2	2	7.04	3.58	9.3	27.8
24	1	1	13.8	4.47	12.2	37.1
25	2	1	3.84	4.24	13	37.8
26	1	1	5.81	4.19	11.3	34.8
27	2	2	4.9	4.02	10	30
28	2	2	6.41	3.15	6.3	20.4
29	3	1	6.87	3.93	9.2	29.7
30	2	1	13.4	4.5	11.6	34.5
31	2	2	6.97	3.66	9	27.4
32	3	2	8.12	3.86	7.3	22.3
33	1	2	5.48	3.77	11	32.8
34	3	2	32.64	3.18	6	18.6
35	1	1	6.68	5.46	15.3	46.2
36	3	3	12.2	3.92	9.9	29

Table C1 (Cont.) Raw data of patients

ID	MCV	MCH	MCHC	RDW	Plt
1	68.7	22.6	32.9	17	416
2	69.2	22.6	32.7	17.1	269
3	72.7	23.7	32.7	22.7	303
4	84.2	29.9	35.5	14.2	357
5	82.7	28.1	34	22.4	163
6	68	23.4	34.4	21	467
7	87.8	28.9	32.9	19.2	268
8	80	25.5	31.9	15.5	270
9	86.6	27.6	31.9	15.7	284
10	85.4	28.7	33.6	13.2	321
11	78.3	26	33.1	26.2	239
12	72.3	25.2	34.8	15.8	148
13	78.9	26.5	33.6	19.7	615
14	72.7	23.9	32.9	15.2	282
15	62	19.2	30.9	35.7	602
16	69.3	21.9	31.6	24	585
21	85.6	29.3	34.3	13.7	291
22	77.4	24.5	31.6	15.9	283
23	77.6	26	33.5	16.9	309
24	83	27.2	32.8	15.6	232
25	89.1	30.6	34.3	17	207
26	83	26.9	32.4	21	283
27	74.2	24.9	33.6	16.8	232
28	64.8	19.9	30.7	29.5	38
29	75.6	23.5	31.1	30.3	251
30	76.5	25.8	33.8	17.1	574
31	74.9	24.6	32.9	18.9	370
32	57.9	18.8	32.5	24.1	663
33	87	29.2	33.6	14.4	298
34	58.7	19	32.3	26.1	1053
35	84.6	28	33.1	15.6	277
36	73.9	25.2	34.2	16	249

Table C2 Raw data of psycho-somatic impact

ID	Anx1	Anx2	Anx3	Motility1	Motility2	Motility3	Mobility1	Mobility2	Mobility3
1	0	0	0	0	1	0	2	1	1
2	2	1	0	2	2	1	1	1	1
3	1	1	1	1	1	1	2	2	1
4	1	1	1	0	1	2	2	2	2
5	0	0	0	0	0	0	2	0	0
6	0	0	0	1	1	1	1	1	1
7	0	0	0	1	2	1	1	1	1
8	0	0	0	1	0	0	1	1	1
9	1	0	0	1	0	0	1	1	1
10	2	2	2	1	2	2	2	2	2
11	0	0	0	1	1	0	1	1	1
12	1	1	1	1	1	1	1	1	1
13	2	2	2	1	1	1	1	1	1
14	2	1	1	2	1	1	1	1	1
15	0	0	1	1	1	0	1	1	1
16	2	2	2	2	1	1	2	2	2
21	0	0	0	0	1	1	2	1	0
22	1	0	0	1	1	1	2	1	1
23	1	0	0	2	2	1	2	1	1
24	0	0	0	0	0	0	1	1	1
25	0	0	0	1	0	0	1	1	1
26	1	1	1	2	1	1	2	2	2
27	2	2	1	2	1	1	2	2	2
28	0	0	0	2	0	0	1	1	1
29	1	0	0	2	1	0	1	1	1
30	2	2	2	0	1	1	1	1	1
31	0	0	0	2	2	1	2	2	2
32	2	2	2	2	2	1	2	2	2
33	2	2	1	2	0	0	1	1	1
34	2	1	1	2	2	1	2	2	2
35	0	0	0	1	1	0	0	0	0
36	1	1	0	2	2	1	1	1	0

Table C2 (Cont.) Raw data of psycho-somatic impact

ID	Sleep1	Sleep2	Sleep3	Annoy1	Annoy2	Annoy3	Feeling1	Feeling2	Feeling3
1	1	1	1	1	1	1	2	2	2
2	1	1	0	1	1	1	2	2	2
3	1	2	1	2	1	1	2	2	2
4	2	2	1	2	2	2	2	2	2
5	0	0	0	1	0	0	2	2	2
6	1	1	0	2	2	2	2	2	2
7	2	1	1	1	1	1	2	2	2
8	0	0	0	1	1	1	2	2	2
9	0	0	0	2	2	2	2	2	2
10	1	1	1	1	1	1	2	2	2
11	1	1	0	1	1	1	2	2	2
12	1	1	0	2	2	1	2	2	2
13	2	1	1	2	1	1	2	2	2
14	1	1	1	1	1	1	2	2	2
15	1	1	0	1	1	1	2	2	2
16	1	1	1	1	1	1	2	2	2
21	1	0	1	1	1	0	2	2	2
22	1	0	0	1	1	1	2	2	2
23	0	0	0	1	1	1	2	2	2
24	2	1	1	2	2	2	2	2	2
25	1	1	1	1	1	1	2	2	2
26	2	2	1	1	1	1	2	2	2
27	1	1	0	1	1	1	2	2	2
28	1	1	0	1	1	1	2	2	2
29	1	0	0	1	1	1	2	2	2
30	1	1	0	1	1	1	2	2	2
31	0	0	0	1	1	1	2	2	2
32	2	2	1	1	1	1	2	2	2
33	2	0	0	1	1	1	2	2	2
34	1	1	1	1	1	1	2	2	2
35	1	0	0	1	1	1	2	2	2
36	1	1	0	1	1	0	2	2	2

Table C3 Raw data of nurse

ID	Ward	decwork	ptlike	prepare	round	detect	pt_care	intake	leak
1	1	1	1	3	2	1	1	1	2
2	1	1	1	3	2	1	1	1	2
3	2	2	2	3	3	3	3	3	2
4	2	2	1	2	2	3	3	3	3
5	2	2	2	3	2	3	2	3	3
6	2	1	1	3	2	3	3	3	3
7	3	1	1	2	3	3	2	2	2
8	3	1	1	2	2	2	2	2	2
9	3	1	1	2	2	2	2	2	1
10	3	2	2	3	3	3	3	3	3
11	3	1	1	2	1	2	3	3	2
12	3	1	1	2	2	2	1	1	1
13	3	1	1	2	2	2	2	2	1
14	3	2	1	3	3	3	3	3	3
15	3	2	1	3	3	3	3	3	3
16	3	2	1	3	3	3	3	3	3
17	3	1	1	2	2	2	2	2	2
18	1	1	1	2	1	2	2	1	2
19	1	1	1	2	2	2	2	2	2
20	1	1	1	3	1	1	1	1	1
21	1	1	1	3	2	2	2	3	2
22	1	1	1	3	2	2	2	2	2
23	2	2	1	2	3	3	3	3	3
24	2	1	1	2	2	2	1	3	3
25	2	1	1	1	1	1	1	1	1
26	2	1	1	2	2	3	2	2	2
27	1	1	1	3	2	2	2	2	2
28	1	1	1	2	2	2	3	2	2
29	1	1	1	1	1	3	2	1	1
30	1	2	2	3	2	3	2	3	3
31	3	1	1	1	1	1	1	1	1
32	3	1	1	2	2	2	2	2	3
33	2	2	2	3	1	2	2	3	2
34	2	2	1	2	3	3	3	2	3
35	2	1	1	2	1	1	1	1	2
36	2	1	1	2	1	1	1	1	1
37	2	1	1	1	1	1	1	2	2
38	2	1	1	2	1	1	1	2	1
39	1	1	1	2	1	1	2	2	1
40	1	1	1	2	1	1	2	2	1

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