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ORIGINAL ARTICLE

Follow-up of Patients Receiving Home Parenteral Nutrition With a Competent Home Infusion Nurse Decreases the Prevalence of Catheter Infections

A Pilot Study

Mert Eşme, MD; Cafer Balcı, MD; Gökşen Öz, MD; Fatma Tamer; Nilgün Doğancı; Kezban Akçay; Şermin Ataç; Burcu Kelleci; Seda Banu Akıncı, MD; Arzu Topeli, MD; Osman Abbasoğlu, MD; Meltem Halil, MD

High rates of infection are reported in patients receiving home parenteral nutrition (HPN). The aims of this study were to investigate the effect of the support of a competent home infusion nurse on catheter-related infection rates among patients receiving HPN as well as to investigate the effect of HPN on quality of life (QOL). Seventeen HPN patients older than 18 years were visited twice weekly by a competent home infusion nurse, and QOL tests were performed over a 2-year period. The patients were evaluated regularly for signs of catheter-related infections and other complications. The catheter infection rate was found to be 1.23 per 1000 catheter-days, and QOL scores remained stable. Involvement of an experienced nurse may help implement HPN with low catheter-related infection rates. **Key words:** *enteral*, *home*, *infection*, *infection rate*, *nurse*, *nutrition*, *parenteral*

Author Affiliations: *Geriatric Clinic, Mersin City Training and Research Hospital, Mersin, Turkey (Dr Eşme); Geriatric Clinic, Eskişehir City Hospital, Eskişehir, Turkey (Dr Balcı); Lösante Children and Adult Hospital, Ankara, Turkey (Dr Öz); Nutritional Support Team, Hacettepe University (Tamer, Doğancı, Akçay, Ataç, and Kelleci); and Division of Critical Care, Department of Anaesthesiology and Reanimation (Dr Akıncı), Divisions of Intensive Care Medicine (Dr Topeli) and Geriatrics (Dr Halil), Department of Internal Medicine, and Department of General Surgery (Dr Abbasoğlu), Hacettepe Universit Medicine Faculty, Ankara, Turkey.*

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Correspondence: *Mert Eşme, MD, Geriatric Clinic, Mersin City Training and Research Hospital, Mersin 33240, Turkey (mertesme87@hotmail.com).*

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DUDRICK ET AL[1] developed parenteral nutrition (PN) techniques more than 50 years ago. Home parenteral nutrition (HPN)

has been administered to patients who require intravenous (IV) nutrition beyond the hospital stay since the 1980s.[2] Although HPN has a high risk of complications, techniques (such as good hand hygiene as well as aseptic technique during catheter manipulation) have been adapted for home use, which have decreased the complication rate.[3] The development of home care services is critical to support patients and their caregivers to implement complex home infusion therapy. Patients may no longer be homebound due to PN therapy because PN solution has transitioned from glass bottles to "all in one" bags, along with portable infusion pumps and ambulatory backpacks. Commercial multichamber bags are increasingly used in the home setting. The care of patients receiving HPN should be patient-oriented, considering the quality of life (QOL) of the patient. Nutrition support teams (NSTs)[4] may consist of physicians, dietitians, pharmacists, nurses, and social workers. With a clear understanding of the pathophysiology of the underlying condition, the HPN team can oversee the provision of appropriate central venous access, safe PN prescription and solution compounding, metabolic management, and the treatment and prevention of infectious and noninfectious complications.

Although there are a growing number of patients receiving HPN, there is not always a structured system for the follow-up of these patients in every country.

The aim of this study was to examine the rate of catheter-related infections in patients receiving HPN under the supervision of a competent home infusion nurse and to examine the effect of HPN therapy on QOL.

MATERIALS AND METHODS

HPN indications were determined according to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines for HPN.[5] Patients older than 18 years, patients who were not taking an oral diet, and those who had an indication for PN were included in the study. Another criterion for inclusion was residence in the province where our center is located so that patients could travel to our center quickly in case of a possible complication. Written informed consent was obtained from the patients before the study. Before the initiation of HPN therapy, patients and their caregivers were trained on catheter care, PN administration, and awareness of possible complications by an experienced, competent home infusion nurse from our NST with demonstrated knowledge and skills related to HPN administration per ASPEN standardized competencies.[6] Patients and caregivers were provided trainings for 3 days prior to hospital discharge. At the end of the training, patients' caregivers who were provided training were asked to complete all steps of catheter care and PN independently. It was concluded that the caregivers who fulfilled all steps completely were competent in providing PN support at home. After ensuring caregiver knowledge and competence, the patient was discharged from the hospital. The home infusion nurse conducted 2 home visits weekly to patients receiving HPN and performed catheter care and evaluation for catheter infection and other complications. Patient and caregiver education was also provided at the home to ensure competency. The Short-Form Health Survey-36 (SF-36)[7] and the Karnofsky QOL test[8] were performed on all patients. Patients' biochemical parameters, anthropometric measurements, and vital signs were evaluated by the nurse at home, and the results were evaluated weekly by the NST. Ethical approval for the study was obtained by Hacettepe University Ethical Committee (GO 16/180-03).

RESULTS

Seventeen (female: n = 9; male: n = 8) patients were included in the study. The median age of the patients was 61 years (range, 40-80 years). Fourteen patients received PN support due to malignancy, and 2 patients had short bowel syndrome (SBS). The median body

Table 1. Demographic Characteristics, Anthropometric Measurements, Laboratory Tests, and Daily Energy and Protein Intake of the Patients[a]

	Male (n = 8)	Female (n = 9)	Entire Group (N = 17)
Age, y	62 (51-80)	54 (40-77)	61 (40-80)
BMI, kg/m^2	18.28 ± 3.83	27.05 ± 4.17	20.7 (13-30)
Follow-up time, d	45 (0-107)	47 (0-155)	47 (0-155)
Handgrip, kg/m^2	17.7 (3-22.4)	12.8 (10.4-21.7)	17.25 (10.4-22.4)
Waist circumference	71.87 ± 11.7	80 ± 10.38	80 (59-88)
Calf circumference	26.5 (23-32)	30 (21-37)	29 (21-37)
Upper-arm circumference	21.5 (17-56)	24 (16-28)	20.5 (18-24)
Albumin, g/dL	2.82 ± 0.59	3.18 ± 1.62	3.87 ± 2.16
Prealbumin, mg/dL	11.8 ± 4.45	23.6 ± 7.69	17.5 ± 8.45
NRS-2002	4 (4-6)	5 (3-6)	4 (3-6)
C-reactive protein, mg/dL	10.5 ± 8.8	3.47 ± 4.35	4.62 ± 4.71
25-OH Vit D, μg/L	5.52 ± 2.2	6.71 ± 2.4	6.41 ± 2.12
Daily energy intake, kcal	1400 (910-1800)	1400 (900-1800)	1400 (900-1800)
Daily protein intake, g	51 (33-60)	51 (33-60)	51 (33-60)

Abbreviations: BMI, body mass index; NRS-2002, Nutritional Risk Screening-2002; Vit D, vitamin D.
[a]The values are median (range) or mean ± SD. Normal values of handgrip: male, >27 kg/m^2; female, >16 kg/m^2; calf circumference, >31. Normal reference range: albumin, 3.5-5.2 g/dL; C-reactive protein, 0-0.8 mg/dL; prealbumin, 18-38 mg/dL; 25-OH Vit D, >25 μg/L.

mass index (BMI) was 20.7 kg/m^2 (range, 13-30 kg/m^2), and the median Nutritional Risk Screening-2002 (NRS-2002)[9] score was 4 (range, 3-6), indicating nutrition risk. The demographic characteristics, anthropometric measurements, and laboratory values of the patients are shown in Table 1. Information on patients' current comorbidities, malignancy diagnosis, catheter types, and daily energy and protein intake is provided in Table 2.

The median follow-up period was 47 days (range, 0-155 days). Of the 17 study patients, 3 died shortly after being discharged from the hospital but received at least one home visit. At the end of the study, 15 patients had expired. PN support was discontinued in 2 patients who began oral feeding. One patient was hospitalized because of a catheter-related infection on day 63 of HPN. One patient had a port obstruction related to HPN support. Total HPN central venous catheter-days were 811. The rate of catheter infection was 1.23 per 1000 catheter-days. HPN complications including metabolic, infectious, and mechanical issues are described in Table 3.

Performance measurements of the patients were evaluated using the Karnofsky Performance Scale[10] during home visits, and QOL was evaluated using the SF-36 QOL scoring tool. According to these evaluations, QOL scores remained stable during HPN. Verbal statements of the patients also indicated that they were satisfied with HPN therapy in terms of both comfort and convenience.

DISCUSSION

This study, which was funded by National Society of Parenteral and Enteral Nutrition (KEPAN), aimed to investigate the effect of the support of a home infusion nurse on the catheter-related infection rates of patients receiving HPN. In a similar study conducted at our center in 2017, oncology patients (n = 14) were followed up without a home nurse and a catheter-related infection developed in 3 patients who were on the 24th, 36th, and 65th days after catheter placement.[11] In this pilot study, HPN under the supervision of a competent home infusion nurse

Table 2. Comorbidities, Malignancy Diagnosis, and Catheter Types of the Patients

	Male (n = 8)	Female (n = 9)	Entire Group (N = 17)
Comorbidities			
Diabetes mellitus	2	1	3
Hypertension	2	...	2
Atrial fibrillation	1	1	2
Malignancy			
Gastrointestinal	7	5	12
Gynecologic	...	1	1
Other	1	1	2
Mesenteric vascular occlusion	...	2	2
Metastasis	8	7	15
Peritoneal carcinomatosis	5	6	11
Catheter type			
Venous port	4	4	8
Hickman	4	5	9

was planned to reduce the infection rate. The primary outcome of the study was to determine the rate of catheter infections during HPN therapy under the supervision of a competent home infusion nurse. The rate of catheter infections was found to be 1.23 per 1000 catheter-days. In a systematic review published in 2019,[12] the rate of catheter-associated infection observed in patients receiving HPN was between 0.05 and 3.08 per 1000 catheter-days. A national model of HPN therapy under the supervision of a home infusion nurse appears to demonstrate a reduction in our previous catheter infection rate and fall within the range of published catheter infection rates.

Table 3. Complications of HPN Therapy

	Entire Group (N = 17)
IV line obstruction	1
Catheter-related bloodstream infection	1
Hyperglycemia	2
Catheter infection rate	1.23 per 1000 catheter-days

Abbreviations: HPN, home parenteral nutrition; IV, intravenous.

A secondary aim of the study was to examine the effects of HPN on patients' QOL. Although there was no significant increase in QOL scales, it was observed that there were no comments that could be evaluated negatively about QOL in the verbal expressions of patients and their caretakers. Patients reported to be extremely satisfied with HPN in terms of both comfort and convenience. The study demonstrated that the model of HPN therapy under the supervision of a home infusion nurse was associated with maintenance of QOL.

HPN has been used to prevent and treat malnutrition in patients who do not have a functional gut and cannot tolerate or absorb adequate enteral and oral nutrition. Chronic intestinal failure (CIF), which is reduced gut function below the minimum needed for macronutrient and micronutrient absorption such that IV supplementation is necessary to maintain health,[13] can be caused by benign or malignant disease and can be reversible or irreversible. PN can be a lifesaving treatment in CIF due to benign disease, and it can be used as a treatment strategy in CIF due to malignant diseases, even in palliative care.[5,14]

Crohn disease, mesenteric ischemia, surgical complications, chronic bowel pseudo-obstruction, and radiation enteritis account

for about 75% of benign CIF cases.[15] SBS is the main cause of CIF, and the remaining 33% of cases are due to intestinal dysmotility, enterocutaneous fistulas, intestinal mechanical obstruction, and diffuse mucosal diseases.[15] If life expectancy due to malignancy is expected to be longer than 1 to 3 months in patients with advanced cancer with CIF, even those who do not receive active oncologic treatment can receive HPN therapy to prevent premature death from malnutrition.[5] In the current study, 14 patients received PN support due to malignancy and 2 patients had SBS. The patients in the current study were candidates for HPN with the indication of intestinal obstruction secondary to peritoneal carcinomatosis. Two patients who underwent surgery for mesenteric vascular occlusion and subsequently developed SBS also had an indication for PN.

CIF can be associated with life-threatening complications of HPN; HPN accounts for approximately 14% of total deaths (complications associated with venous access such as infections) in these patients.[5] To reduce the risk of catheter-related bloodstream infection (CRBSI), which is a serious PN complication, the choice of IV access route is as important as aseptic technique. Among the catheter types, tunneled catheters (Hickman, Broviac, Hohn types, for example) and implanted ports are the most preferred types due to the lower risk of infection than other types of catheter.[16] Different infection rates have been found according to catheter type in studies evaluating patients who receive HPN therapy.[17-20] In the current study, 9 patients had a Hickman tunneled catheter and 8 patients had an implanted port. Accordingly, the choice of catheters in patients may have contributed to our low infection rate.

The number of lumens in the catheter is also one of the parameters affecting infection rates. The use of catheters with as few lumens as possible is recommended by ASPEN.[16] In the current study, 4 patients had a double-lumen catheter and the remainder had a single-lumen catheter. Careful selection of catheter type and HPN formulation is required for each patient to best meet their needs and minimize HPN-related complications. Strict observance of aseptic technique and HPN administration procedures is essential to decrease complications due to patients and caregivers. The competent home infusion nurse, along with evidence-based instructions for the patient and caregivers, is the most effective treatment strategy to prevent CRBSIs.[2]

ESPEN has prepared a list of criteria for the safe inclusion of patients in HPN programs.[21] The most important of these is the requirement for the patient or his or her legal representative to provide informed consent for HPN therapy. The patient should be metabolically stable, able to be monitored at home, and at a safe home environment. The caregiver and the patient should be deemed competent to provide HPN safely and aware of potential complications and should be able to bring the patient to the hospital or PN clinic when necessary. In accordance with the guidelines,[21,22] each patient and caregiver in our study received training on HPN therapy for 3 to 5 days prior to hospital discharge. Care was taken that the patients included in the study resided at a location from where they could reach the hospital quickly when necessary. Under the supervision of competent nurses who made home visits, patients were reevaluated for possible complications.

ESPEN guidelines[21] recommend to use 0.5% to 2% alcoholic chlorhexidine solution during dressing changes for skin antisepsis. If there is a contraindication to chlorhexidine, iodine tincture, iodophor, or 70% alcohol may be used as an alternative.[21] ESPEN guidelines for aseptic technique were followed throughout the study and were used in patient and caregiver education.

An interdisciplinary NST can improve clinical outcomes of HPN patients, including reduced mortality and morbidity.[23-25] A benefit regarding QOL was demonstrated in 6 prospective studies in patients receiving HPN therapy for more than 1 month.[26-30] Two

randomized controlled trials[31,32] assessed the impact of HPN on patient outcomes reporting an improvement in energy balance, increased long-term survival, increased body fat, and a greater maximum exercise capacity. Obling et al[33] compared the effects of 6-month HPN in cachectic patients with gastrointestinal cancer and reported that HPN preserved or increased lean mass and improved QOL.[33] Dreesen et al[34] emphasized that the QOL of patients with cancer is one of the most important outcome indicators of HPN. Sowerbutts and colleagues[35] observed that the QOL of patients receiving HPN was determined more by the underlying disease and patients with SBS, in particular, scored lower on QOL scales than patients who received parenteral support due to dysmotility problems. From another point of view, it was reported that the symptoms of patients with dysmotility such as abdominal pain and bloating affected QOL much more than the type of treatment given.[36]

Metabolic complications (hypoglycemia, hyperglycemia, various electrolyte deficiencies) and mechanical complications (IV line obstructions, catheter dislocation) may also be observed during HPN. Leiberman et al[37] conducted a large randomized study, and patients receiving HPN were followed for 173 151 catheter-days. Complication rates were not associated with age, sex, underlying disease, and catheter type. However, when the effect of the duration of HPN therapy on the complication rate was examined, patients receiving HPN for less than 2 years had a higher complication rate than those who received HPN for longer than 2 years. Among all complications, 61% were infections, cuff extrusion and catheter damage were similar at 14% each, and the rate of thrombosis was 6%.[37] In the current study group of 17 patients, catheter infection rate was calculated as 1.23 per 1000 catheter-days. Hyperglycemia was observed in 2 patients, and IV obstruction developed in one patient. In comparison, our low rate may be attributed to the presence of experienced home infusion nurses providing care.

The most important limitation of the study is the small sample size. However, we tried to include all appropriate patients within the scope of this project, which continued for 2 years. This pilot study is important in establishing baseline HPN data, as there is no national system for HPN in Turkey. The study demonstrates lower rates of complications among HPN patients with the support of a competent home infusion nurse.

CONCLUSION

HPN is an important therapy that can increase or maintain the QOL of patients with an appropriate PN indication. The prevalence of complications, especially the risk of catheter-related infections, may be reduced when patients on HPN are followed by a competent home infusion nurse. Larger studies are needed to evaluate the impact of the role of a home infusion nurse on HPN clinical outcomes and complications.

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