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Original article

Very long-term central venous access device for home parenteral nutrition in adults: A center-based cross-sectional survey

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SUMMARY

Background: Home parenteral nutrition (HPN) is life-saving treatment for chronic intestinal failure (CIF), a rare disease. Central venous access devices (CVADs) for HPN are vitals and are maintained in situ as long as possible. However, removal of very long-term CVADs may be difficult and associated with complications causing venous access loss. An international cross-sectional survey was carried out to evaluate clinicians' experiences in the management of very long-term CVADs (tunneled/Port catheters >10 years; Peripherally-Inserted Central Catheters-PICCs >2 years) and their opinions on elective replacement of these devices.

Methods: The HPN/CIF centers within the directory of the CIF database of the European Society for Clinical Nutrition and Metabolism were invited to answer to a structured questionnaire.

Results: Thirty-five centers participated. CVADs in place >10 years included 7.1 % of tunneled and 3.6 % of Port; 7.1 % of PICCs were in place >2 years. Complications when removing long-term CVADs were encountered by 44.1 % of centers for tunneled, 18.7 % for Port, 9.0 % for PICCs. Elective replacement of functioning long-term CVADs was recommended by 14.3 % of centers for tunneled, 5.9 % for Port, 30.3 % for PICCs. Around one-half of centers disagreed with elective replacement of functioning long-term tunneled and Port; one-third disagreed with elective PICC replacement.

Conclusions: Functioning very long-term CVADs occur rarely in a rare disease. A discrepancy was observed between the high percentage of centers that encountered complications when removing such CVADs compared with the low percentage of those that agreed with their elective replacement. These data can inform the development of protocols for the management of functioning long-term CVADs.

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1. Background

Chronic intestinal failure (CIF) is defined as “persistent reduction of gut function below the minimum necessary for the absorption of macronutrients and/or water and electrolytes, such that intravenous supplementation (IVS) is required to maintain health and/or growth, in a patient who is metabolically stable” [1]. CIF is a rare disease. In Europe, the prevalence of home parenteral nutrition (HPN) for CIF ranges from 5 to 80 cases per million of the population, with the highest prevalence observed in Denmark [2]. Intravenous supplementation is provided by home parenteral nutrition (HPN) programs [2] and is the primary life-saving therapy for CIF, such that preserving venous access for HPN infusion is of vital importance. Therefore, functioning central venous access devices (CVADs) are maintained in situ as longer as possible, to minimize the risk of loss of venous access due to venous damage and/or occlusion associated with repeated CVAD insertion. Tunneled CVADs (Hickman, Broviac) and implanted Port CVADs can stay in place for a long time, up to ten or more years. However, technical problems and complications may occur when removal of very long-term CVADs is attempted; for example, resistance to the removal of the catheter because of its adherence to the wall of a central vein (stuck catheter), scarring along the subcutaneous tunnel, and catheter breakage due to damage of the catheter wall resulting in rupture of the intravascular portion with the associated risk of cardiac and pulmonary embolism [3–6]. Particularly challenging is the so called “stuck catheter” a term that refers to a CVAD tightly embedded into the vessel vein. Its removal by standard techniques is very difficult or impossible and can be complicated by catheter fracture and fragmentation of a segment in the vessel lumen [7,8]. Further to the risk of venous access loss, the strong traction used in attempting to remove stuck catheters has been reported to be associated with complications such as retrosternal pain with neck radiation, tachycardia, ST depression on ECG, non-ST-segment elevation myocardial infarction and vasomotor collapse, central vein or atrial wall injury with fatal outcome and possibly CVC rupture [9,10]. All these events can lead to venous access loss [3–8]. Thus, scheduling the elective replacement of very long-term CVADs might be advisable in order to avoid such complications.

Patients with CIF rated improvement in the management of their central lines second in their top ten research priority list [11]. No studies have been carried out to investigate after how long after placement, a CVAD should be removed to minimize the risk of complications potentially leading to venous access loss. Therefore, there are no objective data supporting the decision to keep a functioning CVAD in place as long as possible or to schedule elective removal after a defined period of time. Despite many HPN-dependent patients surviving into older age, there are, to date, no recommendations on the management of long-term CVADs, with the decision relying primarily on the individual clinician's expertise and attitude. Therefore, an international questionnaire-based survey was carried out aimed at evaluating current experience, practice and opinion of CIF centers regarding scheduled very long-term (e.g. >10 years for tunneled/Port, >2 years for PICCs) functioning CVAD removal and replacement, to gain information for a consensus to support the clinical decision in routine practice.

2. Methods

2.1. Study design

This was a descriptive cross-sectional questionnaire-based observational study investigating the experience and current practice of HPN/CIF centers regarding very long-term functioning CVADs in patients with CIF due to benign disease, as well as center opinion on elective removal and replacement of such CVADs.

2.2. Questionnaire

A structured questionnaire was devised by the Home Artificial Nutrition & Chronic Intestinal Failure special interest group of the European Society for Clinical Nutrition and Metabolism (ESPEN) and was embedded in the REDCap electronic data capture tool. The questionnaire consisted of 3 sections: a) responder's affiliation and profession; b) HPN/CIF center experience on long-term HPN for CIF due to non-malignant (benign) disease; c) center experience, current practice and opinion on elective long-term CVAD removal. Questions of section c) investigated three types of CVAD: tunneled (ie: Hickman or Broviac), implanted Port, and peripherally inserted central catheters (PICCs).

Questions of sections b): year of starting HPN for CIF (first patient) and total (since starting activity) and current CIF population (n. of patients); types and percentages of CVADs in place in the current population, categorized as: tunnelled, Port, PICC or other (specify).

Questions of section c) asked for each type of CVAD, tunnelled, Port and PICC: longest duration of CVAD in the current population (years); experience of any complication when removing long-term CVAD (yes/no); if yes, type of complication: stuck into vessel wall, breakage within the vein, embolization into heart/lung, other (specify); current practice recommendation of replacing functioning CVAD after a certain time period (yes/no)? If yes, how many years since placement; opinion about routine removal of long-term CVAD: agree, disagree, no opinion, case-by-case consideration (specify).

2.3. Center recruitment

Criterion for Center invitation to participate was to be in the directory of the ESPEN's CIF database [12] or, if not in the CIF database directory, to be member of the Chronic or Acute Intestinal Failure special interest groups of ESPEN. The invitation to participate in the survey was sent by email to the principal investigators of the centers. The invitation letter contained the link to the REDCap embedded questionnaire.

Centers that filled in the questionnaire were included in the study. Centers were required to complete the questionnaire by the principal investigator only, to avoid more than one questionnaire from individual centers. The survey was carried out between June 27th and July 25th, 2024.

2.4. Statistical analysis

The data collected through the REDcap embedded questionnaire are reported as absolute number, mean, standard deviation (SD), median, interquartile range (IQR), absolute range and percentage.

Center patient cohorts were categorized as “total population”, including all the patients on HPN for CIF due to benign disease cared for since the year of center commencement, and “current population”, including ongoing patients at the time of questionnaire completion.

Very long-term CVADs were defined as tunneled or Port CVADs in place for >10 years and PICCs in place for >2years.

The statistical analysis was performed by co-authors LP and MZ using the Statgraphics 5 Plus statistical package (Manugistic, Inc., Rockeville, Maryland, USA).

The strengthening reporting of observational studies in epidemiology (STROBE) Statement—Checklist of the study is available in Supplementary Fig. 1.

3. Results

3.1. Participating centers

Thirty-five centers from 20 countries completed the questionnaire (21.9 % of invited centers). Center nationality: Italy 7, Spain 7, Belgium 2, France 2, UK 2 centers. Austria, China, Croatia, Denmark, Estonia, Hungary, Israel, Malaysia, Mexico, Netherlands, Norway, Poland, Serbia, Slovakia, Turkey, 1 center. Country by continents: Europe 17 (77.2 %), others 5 (22.8 %).

The profession of the responders for each center was: physician n. 32, nurses n. 2, dietitian n. 1.

The range of starting HPN activity at the centers was 1970–2023 (median 1995); 21 centers (60 %) between 1970 and 1999, 14 centers (40 %) between 2000 and 2023. The "total population" cared for by the centers was: mean (SD) 493 (642), median [IQR] 240 [651], range 1–2500. The "current population" was: mean (SD) 91 (125), median [IQR] 48 [157], range 1–560.

Types of CVAD in place in the current population (Table 1).

The CVADs in place were tunneled in one-half of patients, PICCs in one-fourth and Port catheters in 15 % of patients. Long-term CVADs in place were 7.5 % of tunneled, 4.4 % of Port and 7.0 % of PICCs. The longest duration of CVAD in place was 26 years for tunneled, 15 years for Port and 5.2 years for PICC.

3.2. Centers that encountered complications when removing long-term CVADs (Table 2)

Complications when removing long-term CVADs were encountered by 44.1 % of centers for tunneled CVADs, by 18.7 % for Port and by 9.0 % for PICCs. The most frequent complications included CVAD being stuck within the vein wall and breakage of the CVAD with the vein on attempted removal.

Table 1
Types of central venous access device (CVAD) in place and CVAD duration in the "current population" of patients of home parenteral nutrition/chronic intestinal failure centers participating in the survey.

Question	Centers answering	% of total CVADs		
	n.	Mean (SD)	Median [IQR]	Range
CVAD types in place				
• Tunneled	33	54.8 (29.4)	60.0 [51.0]	0–100
• Port	33	15.6 (19.8)	7.0 [19.5]	0–80
• PICC	33	27.3 (25.0)	20.0 [32.5]	0–90
• Other types	33	3.6 [11.3]	0 [1.2]	0–50
Duration of CVADs in place (years)				
Tunneled				
<5	30	71.1 (26.9)	75.5 [42]	20–100
5-10	29	22.4 (20.8)	15.0 [26.5]	0–75
10.1–15	29	4.9 (7.3)	2.0 [5]	0–30
15.1–20	29	2.1 (4.2)	0 [3.5]	0–20
>20	27	0.5 (1.3)	0 [0]	0–5
Port				
<5	22	70.5 (36.1)	89.0 [50]	0–100
5-10	22	25.5 (35.0)	10.0 [25]	0–100
10.1–15	22	2.8 (4.3)	0 [5]	0–15
15.1–20	22	1.0 (2.5)	0 [0]	0–10
>20	22	0.3 (1.1)	0 [0]	0–5
PICC				
<0.5	25	47.0 (33.2)	50 [62]	0–100
0.5–1	25	33.4 (28.1)	25 [37.7]	0–100
1.1–2	25	12.5 (14.8)	8 [25]	0–50
2.1–3	25	2.5 (8.1)	0 [2.2]	0–40
3.1–4	25	1.3 (3.4)	0 [0.5]	0–14
>4	25	3.2 (11.0)	0 [0]	0–50

PICC, peripherally inserted central catheter.

3.3. Center current practice recommendations and opinions regarding elective replacement of functioning long-term CVADs (Table 3)

In the centers' current practice, elective replacement of a functioning long-term CVAD was recommended by 14.3 % of centers for tunneled CVAD, by 5.9 % for Port and by 30.3 % for PICC. Centers that recommended such replacement did so after a median duration of 10 years for tunneled CVAD and 1 year for PICC. Elective replacement of Port catheters was recommended by one center after 2 years and by another center after 10 years.

A few more centers agreed about the usefulness of elective replacement of functioning long-term CVADs. Disagreement about elective replacement was expressed by one-half of centers for tunneled and Port CVADs, and by one-third for PICCs. Around 20 %–40 % of centers were keen to replace functioning long-term CVADs on a case-by-case decision, particularly in the context of CVAD malfunction or damage, damaged cutaneous access site or venous thrombosis.

3.4. Question responses according to the experience of the centers (Table 4)

The experience of the center was categorized on the basis of the year of starting HPN activity.

In the group of 21 centers that started their HPN activity between 1970 and 1999 (longer experience), the percentages of centers that had long-term tunneled CVADs in place, that encountered complications on long-term tunneled or Port removal and that recommended and/or had a positive opinion about elective long-term tunneled CVAD replacement were numerically higher than those observed in the 14 centers that started the HPN activity after 2000 (shorter experience). No other numerical differences were observed between the longer and shorter experience groups.

4. Discussion

This study provides novel data that may inform the development of dedicated protocols for the management of long-term functioning CVADs in clinical practice. It is particularly notable that, despite a consistent percentage of centers encountering complications at the time long-term tunneled or Port CVAD removal, few centers agreed that these catheters should be electively replaced after a certain period of time. Functioning very long-term CVADs accounted for 7.1 % of tunneled and 3.6 % of Port (>10 years) and 7.1 %. of PICC (>2 years) in place. Therefore, this issue is clearly a rare occurrence in a rare disease, perhaps reflecting the low response rate (21.9 %) from invited centers. Nonetheless, complications when removing long-term CVADs were encountered by 44.1 % of the responding centers for tunneled CVADs and 18.7 % for Port CVADs, but elective removal of long-term CVADs was currently recommended by only 14.3 % of centers for tunneled and 5.9 % for Port. When centers were asked for their opinion, slightly higher percentages agreed for elective removal of long-term tunneled and Port CVADs (17.7 % and 12.1 %, respectively), but around one-half disagreed (44.1 % for tunneled and 45.4 % for Port). The complications described by the participating centers represent a clear risk factor for losing central venous access for HPN infusion, highlighting the dilemma faced by clinicians and patients when managing functioning very long-term tunneled and Port CVADs. Indeed, most centers were in

Table 2
Home parenteral nutrition/chronic intestinal failure centers that encountered complications when removing long-term central venous access device (CVAD).

	Tunneled CVAD	Port CVAD	PICC
Center answering, n.	34	32	33
Centers that encountered complications at removal, n. (%) of centers	15 (44.1)	6 (18.7)	3 (9.0)
Type of complications, n. (%) of centers			
Stuck into vein wall	9 (47.4)	2 (28.6)	2 (66.7)
Breakage (fracture) within the vein	6 (31.6)	2 (28.6)	0
Embolization into heart/lung	1 (5.3)	1 (14.3)	0
Other type of breakage	3 (15.8)	0	0
Hematoma	0	2 (28.6)	0
Obstruction	0	0	1 (33.3)

PICC, peripherally inserted central catheter.

Table 3
Home parenteral nutrition/chronic intestinal failure center current practice recommendations and opinions about elective replacement of long-term functioning central venous access device (CVAD).

	Tunneled	Port	PICC
Current practice recommendation of elective replacement			
Centers answering, n.	35	34	33
• Yes, n. (%)	5 (14.3)	2 (5.9)	10 (30.3)
• If yes, years after placement, median [IQR], range	10 [9], 2-15	2–10	1 [1.5], 0.5–4
Center opinion about elective replacement			
Centers answering, n.	34	33	32
• Agree, n. (%)	6 (17.7)	4 (12.1)	12 (37.5)
• Disagree, n. (%)	15 (44.1)	15 (45.4)	11 (34.4)
• No opinion, n. (%)	0	5 (15.2)	2 (6.2)
• Case-by-case decision, n. (%)	13 (38.2)	9 (27.3)	7 (21.9)

PICC, peripherally inserted central catheter.

Table 4
Complications encountered when removing long-term central venous access device (CVAD), current practice recommendations and opinions regarding elective replacement of long-term functioning CVAD in home parenteral nutrition/chronic intestinal failure (HPN/CIF) centers grouped according to the center experience, categorized by duration of activity.

	Year of starting the activity of the center for HPN/CIF					
	1970–1999, n. 21			2000–2023, n. 14		
	Tunneled	Port	PICC	Tunneled	Port	PICC
Long-term CVADs in place[a]						
Center answering, n.	19	16	15	11	7	9
Yes, n. (%)	14 (73.6)	7 (43.7)	6 (40.0)	3 (27.2)	3 (42.8)	4 (44.4)
Centers that encountered complications at removing, n. (%)						
Center answering, n.	20	19	19	14	13	14
Yes, n. (%)	11 (55.0)	4 (21.0)	1 (5.2)	4 (28.5)	2 (15.3)	2 (14.2)
Current practice recommendation of elective replacement						
Centers answering, n.	21	20	20	14	14	13
Yes, n. (%)	4 (19.0)	1 (5.0)	6 (30.0)	1 (7.1)	1 (7.1)	4 (30.7)
Center opinion about elective replacement						
Centers answering, n.	20	19	20	14	14	12
Agree, n. (%)	4 (20.0)	2 (10.5)	7 (35.0)	2 (14.2)	2 (14.2)	5 (41.6)
Disagree, n. (%)	7 (35.0)	8 (42.1)	7 (35.0)	8 (57.1)	7 (50.0)	4 (33.3)
No opinion, n. (%)	0	2 (10.5)	1 (5.0)	0	3 (21.4.3)	1 (8)
Case-by-case decision, n. (%)	9 (45.0)	7 (36.8)	5 (25.0)	4 (28.5)	2 (14.2)	2 (16.6)

PICC, peripherally inserted central catheter.
[a] Long-term CVADs: tunneled or Port CVAD >10 yr; PICC >2yr.

favor of leaving functioning CVADs in situ as long as possible. The reasons were not investigated by our questionnaire. Supposed explanations could be lack of evidences supporting replacement scheduling, variability of clinician experience and concerns about unnecessary procedures, since replacing a CVAD in the absence of complications also poses a risk of venous damage. However, it could equally be argued that the timely elective replacement of a very long-term functioning CVAD may be associated with a lower risk of venous damage and venous access loss than removing a CVAD that may be tightly adherent to the vessel wall as a result of its longevity. Indeed, one third of centers would proceed to elective removal on a case-by-case basis (38.2 % for tunneled, 27.3 % for Port), described as catheter damage, cutaneous access site damage and vein thrombosis, that might be risk factors for venous access loss.

Respondents recorded a different approach for PICC management. Even though PICCs are not generally recommended for long-term HPN [1,2], one-third of patients with PICCs had it in place for >2 years. However, complications on long-term PICC removal were encountered less frequently and the percentage of centers that agreed with the elective replacement and/or routinely replaced PICCs in their current practice was higher than those observed for

long-term tunneled and Port CVADs. It could be argued that the higher risk of vein thrombosis associated with PICC [1,2] and the simpler procedure required to replace a PICC compared to tunneled and Port CVADs accounted for these differences. The discrepancy between current guidelines and real-world experience highlights the need for additional long-term safety data related to the use of PICC lines for extended periods of time.

Centers with longer experience appeared to favor elective replacement of long-term functioning tunneled CVADs, probably because of their experience of a higher proportion of long-term CVADs and associated complications on removal compared to centers with shorter CIF experience. However, it is notable that a consistent percentage of centers with longer CIF experience that encountered complications did not necessarily agree with elective removal of long-term functioning CVADs. This may suggest that the latter centers feel that the risk of complications associated with long-term CVAD removal do not necessarily favor elective removal of a functioning catheter, possibly because respondents from these centers had not experienced such complications and/or because they felt such complications are very rare.

To the best of our knowledge, only previous data from an abstract submitted by a single Polish CIF center to an ESPEN congress are available in the literature on this subject [5]. In that study, 8 of 23 tunneled CVADs that were in place for >10 years were removed because of occlusion, mechanical rupture or subcutaneous tunnel infection. Complications at removal, causing venous access damage, were reported in two cases [5]. The largest data relating to catheters being stuck within the vein on removal attempt have been published by hemodialysis centers, because such complication has been reported as high as 20 % in catheters in situ for over 2 years [13–15] and, of course, because of the much higher prevalence of patients on hemodialysis (~900/10^6 inhabitants) [16] compared to those on HPN for CIF (5–80/10^6 inhabitants) [2]. In hemodialysis patients the risk for a catheter becoming stuck has been reported to be associated with factors such as cumulative catheter dwell time, laterality of site of insertion (left jugular and brachiocephalic veins), frequency of catheterization, recurrent catheter infection, catheter damage, diameter and intimal injury of the vein, calcification inside the fibrin sleeve, and female gender [4,14]. The latter association highlight the potential role of the narrow calibre of the blood vessels in the development of catheter retention, a factor also occurring in children and adolescent patients on HPN, where such complication has also been reported [7].

Interpretation of our results has to take into account the limitations due to the type of study and the low rate of participation in the survey. This was a questionnaire-based survey on CIF center experience and opinion. The study design did not investigate risk factors related to catheter longevity, such as patient demographics, CIF characteristics, patients' perspectives, CVAD materials and insertion techniques. The potential reasons for the small percentage of responders might be related to the rarity of very long-term functioning CVADs. Many centers may have never experienced this problem and/or may not have formal protocols in place to handle it. Additionally, some centers did not answer all the questions. The reason was not clarified, but it could be assumed that they were not using all types of CVADs and/or did not have long-term CVADs at time of filled out the questionnaire. The low responder rate would represent a bias of the study because the results could represent the opinion of centers that experienced long-term CVADs and, therefore, these centers may be more sensitized to the problem. Due to the observational design of the study, the observed differences between center experience categories should not be generalized. Nevertheless, they provide a good background for future studies including larger number of centers. None of the existing guidelines provide recommendations (pro or against) elective replacement of very long-term CVADs. The 2024 update of the "Infusion Therapy Standards of Practice" by the Infusion Nurses Society recognizes the need for further research on clinical indications for CVAD removal [17].

Prospective and adequately sized surveys comparing complications occurring when removing CVADs with different indwelling times and considering the CVAD types [6,18] and any confounding variables when performing statistical analysis, will, of course, give a more objective insight of the problem.

In conclusion, functioning very long-term CVADs occur rarely in patients with CIF, a rare disease. A discrepancy was observed between the high percentage of centers that encountered complications when removing such CVADs compared with the relatively low percentage of those that agreed with their elective replacement. Improvements in care of CIF have increased patients' survival expectancy and could increase the frequency of very long-term CVADs. These novel data can inform centers on this rare but vital event and support them to develop dedicated protocols for the management of very long-term functioning CVADs in clinical practice. However, prospective surveys on the risk of mechanical complications when removing very long-term indwelling CVADs and surveys aimed at understanding the opinions of patient on their elective removal are required to provide data to develop recommendations on this topic.

Author contribution

LP devised the study protocol, analyzed the results and drafted the manuscript.

FJ, CC, PBJ, GL, MSM, KS, AVG, TV, GW, SL, discussed and approved the protocol study, discussed the results and reviewed the manuscript before submission.

MZ collected the data, cured the data, performed the statistical analysis, cured the data presentation and reviewed the manuscript.

Declaration of Generative AI and AI-assisted technologies in the writing process

Generative AI and AI-assisted technologies were not used in the writing process of this manuscript.

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None to be declared by all the Authors, in relation to the content of the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2025.06.052.

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