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Central Line in Long-term Parenteral Nutrition in Children: A European Survey

*†Iva Hojsak, ‡Florence Lacaille, §Girish L. Gupte, and ||Jutta Köglmeier

ABSTRACT

Background and Aims: The guidelines for the insertion and maintenance of the central venous catheter (CVC) in children on long-term parenteral nutrition (PN) were published 12 years ago and studies evaluating the outcomes are limited. Therefore, the aim of the present study was to perform a survey about criteria for CVC insertion and maintenance in intestinal failure/rehabilitation centers treating children on home PN.

Methods: An online cross-sectional survey based on previous European Society of Paediatric Gastroenterology, Hepatology and Nutrition PN guidelines was distributed electronically to the members of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition networking group, Network for Intestinal Failure and Transplantation in Europe and tertiary pediatric gastroenterology centers in Europe.

Results: Overall, 55 responses from 49 centers in 18 European countries and Israel were collected. The majority of respondents were from the United Kingdom (10, 19%), followed by Germany (7, 13%) and France (6, 11%). Eleven centers (21%) cared for >30 patients, 8 (15%) centers between 20 and 30 patients, 18 (34%) centers between 10 and 20 patients, and 16 (30%) <10 patients on home PN. There was a high variability in the majority of answers to the cross-sectional survey.

Conclusions: CVC insertion and maintenance in children on home PN varies largely amongst centers in Europe. These differences could be at least partially explained by the lack of updated guidelines and limited evidence. There is an urgent need for collaborative research to make recommendations about the best possible practice.

Key Words: central line, children, home parenteral nutrition, intestinal failure

(*JPGN* 2018;67: 409–413)

What Is Known

- The guidelines for the insertion and maintenance of the central venous catheter in children on long-term parenteral nutrition were published 12 years ago and studies evaluating the outcomes are limited.

What Is New

- To the best of our knowledge, this is the first survey investigating current practices in relation to the insertion and maintenance of central venous catheter in children on long-term, home parenteral nutrition.
- This survey clearly demonstrates that practices relating to central venous catheter insertion and maintenance in children on home parenteral nutrition vary greatly amongst European centers.
- There is an urgent need to develop evidence-based guidelines to guarantee optimal catheter care for children.

Central venous catheter (CVC) is essential in the care of children with intestinal failure (IF) on long-term parenteral nutrition (PN). There are limited sites for placement of CVC in children and it is important to maintain the patency of the major vessels and to reduce the number of CVC-associated complications. Unfortunately, guidelines and recommendations on placement and maintaining CVC in children on long-term PN are scarce. The European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the European Society for Clinical Nutrition and Metabolism are from 2005 (1). New, updated guidelines are in preparation. No data about the implementation of previous guidelines and current practice in Europe are, however, available. Therefore, the aim of this study was to perform a survey about the techniques of insertion and maintenance of CVC in IF/rehabilitation centers treating children with prolonged or irreversible IF.

METHODS

This was a cross-sectional survey conducted from June 12th to September 4th, 2017. A questionnaire based on previous PN guidelines (1) was developed by the core group of researchers (I.H., J.K., G.G., F.L.) with the aim to assess practices in tertiary European centers treating children with IF on home PN. The concept for the survey was developed during the Network for Intestinal Failure and Transplantation in Europe (NITE) working group meeting at the ESPGHAN Annual Meeting in Prague (May 2017). After discussion with the working group members (representative from most of the IF centers in Europe) of NITE the authors decided to include all

Received December 7, 2017; accepted April 27, 2018.

From the *Children's Hospital Zagreb, University of Zagreb School of Medicine, Zagreb, the †School of Medicine, J.J. Strossmayer University, Osijek, Croatia, the ‡Service de Gastroentérologie-Hépatologie-Nutrition Pédiatriques, Necker-Enfants Maladies Hôpital, Paris, France, the §Liver Unit and Small Bowel Transplantation, Birmingham's Womens and Children's Hospital, Birmingham, and the ||Department of Paediatric Gastroenterology, Division of intestinal Failure and Rehabilitation, Great Ormond Street Hospital for Children NHS Foundation Trust, London, UK.

Address correspondence and reprint requests to Iva Hojsak, MD, PhD, Referral Center for Pediatric Gastroenterology and Nutrition, Children's Hospital Zagreb, Klaiceva 16, 10000 Zagreb, Croatia (e-mail: ivahojsak@gmail.com).

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The authors report no conflicts of interest.

DOI: 10.1097/MPG.0000000000002064

questions addressed in the ESPGHAN/European Society for Clinical Nutrition and Metabolism PN guidelines to assess whether the recommendations from the guidelines were used. The survey was initially created by I.H. and then critically reviewed and edited through 2 rounds among the core group members (J.K., G.G., F.L.). The final version of the questionnaire was entered into the SurveyMonkey and sent electronically to the members of the ESPGHAN NITE working group and large pediatric gastroenterology centers in Europe. Reminders were sent on a monthly basis to ensure that the survey was completed and represented all the major IF/rehabilitation centers in Europe.

Twenty-two questions grouped into 3 categories relating to the insertion and maintenance of CVCs and the prevention of complications were included within the survey questionnaire. All of the questions except city and country of work were compulsory to answer to achieve successful completion of the survey.

The main focus was to determine current practices in relation to the insertion and maintenance of CVCs in centers across Europe.

RESULTS

A total of 55 responses from 49 centers from 18 European countries and Israel were collected of which 53 were completed. The mean time for completing the survey was 8 minutes. The majority of respondents were from the United Kingdom (10, 19%) and the distribution of other centers in Europe and Israel is presented in Figure 1. Eleven centers (21%) cared for >30 patients, 8 centers (15%) between 20 and 30, 18 centers (34%) cared for 10 to 20 patients, and 16 centers (30%) cared for <10 patients.

The majority (98%, n = 52) of respondents had a well-established protocol for the care of CVC in their center.

Insertion of Central Venous Catheter

Questions regarding the insertion practices are presented in Table 1. The jugular vein was the preferred insertion site for 60% of respondents and percutaneous insertion the preferred technique. The majority used fluoroscopic or ultrasound guidance during insertion. The position of the CVC tip was checked by 78% of respondents by x-ray. The remaining answers showed a wide variation amongst the respondents.

Maintenance of Central Venous Catheter

Questions regarding the maintenance of CVC are presented in Table 2. Most centers used transparent semipermeable polyurethane dressings to cover the CVC exit site and 75% of centers used 2% chlorhexidine solution in 70% isopropyl alcohol for skin care around the catheter. Furthermore, 89% of centers allowed children with a tunneled CVC to swim, 26% only in salty water.

Measures for Prevention of Complications

Questions regarding the prevention of CVC-related complications are presented in Table 3. Taurolidine line lock was used for the prevention of catheter-related blood stream infection (CRBSI) by 82% of respondents, but 43% prescribed it only in patients with recurrent CRBSI. Anticoagulant use for the prevention of catheter-related thrombosis was not routine practice in the majority of the centers.

DISCUSSION

Our survey highlights that there is a large variation in the CVC insertion techniques used and long-term catheter management applied amongst pediatric IF units in Europe. Many centers do not follow the ESPGHAN PN guidelines published in 2005 (1).

There is limited and conflicting evidence for the best CVC insertion site in children (2–5). Reassuringly there appears to be no difference in the number of complications according to site of insertion of the catheter. The 2005 guidelines do not state that a particular access site was superior, but recommend the subclavian vein due to ease of venepuncture (1). The majority of centers (60%), however, used the jugular vein as a first choice in children requiring long-term PN.

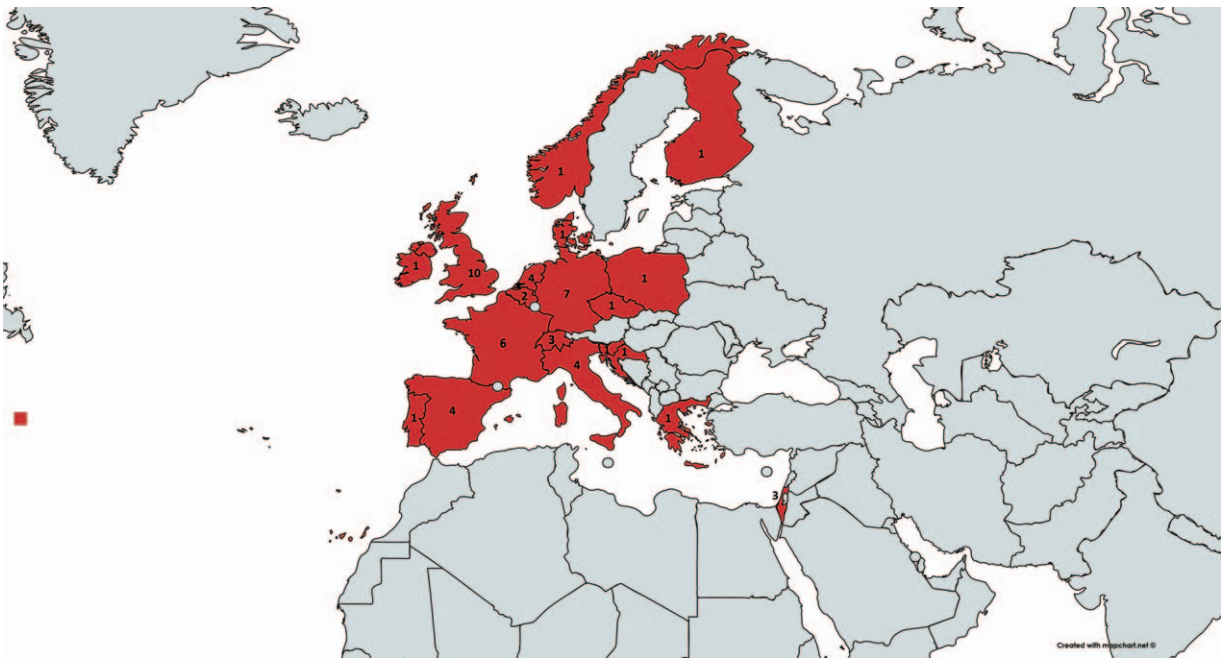

FIGURE 1. Countries and number of responders.

TABLE 1. Questions related to insertion of central venous catheter-related complications

Question	Response, n (%)
Preferred insertion site (n = 55)	
Subclavian	21 (38%)
Jugular	33 (60%)
Femoral	0
All sites are equally used	1 (2%)
Tunneled CVC is placed via (n = 55)	
Using percutaneous insertion	38 (69%)
Using surgical cut-down technique	17 (31%)
CVC is placed (n = 54)	
Fluoroscopy guided	27 (50%)
Ultrasound guided	22 (41%)
No imaging method is used	5 (9%)
CVC tip (n = 55)	
Should lie outside the pericardial sac	11 (20%)
Position at atriocaval junction is acceptable	15 (27%)
Position in the upper portion of the right atrium is acceptable	14 (26%)
All	3 (5%)
Should lie outside the pericardial sac and position at atriocaval junction is acceptable	5 (9%)
Position at atriocaval junction and position in the upper portion of the right atrium are acceptable	7 (13%)
Position of CVC tip is? (n = 55)	
Always checked by x-ray after insertion	43 (78%)
Checked only when ultrasound is not used during insertion	9 (16%)
Other	3 (5%)
Carina on the x-ray is used as a marker that CVC tip is outside the pericardial sac? (n = 55)	
Yes	26 (47%)
No	26 (47%)
Other	3 (5%)

CVC = central venous catheter.

TABLE 2. Questions related to maintenance of central venous catheter

Question	Response, n (%)
Following dressing is used to cover the catheter insertion site? (n = 52)	
Sterile gauze with tape	6 (12%)
Transparent semipermeable polyurethane dressing	36 (69%)
Nothing after the insertion site is well healed	1 (2%)
Other	1 (2%)
Sterile gauze with tape or transparent semipermeable polyurethane dressing	7 (14%)
Transparent semipermeable polyurethane dressing or nothing after the insertion site is well healed	1 (2%)
Children with well-healed tunneled catheters are allowed to swim? (n = 53)	
Yes	33 (62%)
Only in salty water (sea)	6 (11%)
No	14 (26%)
2% Chlorhexidine solution in 70% isopropyl alcohol is used for skin care around CVC insertion site? (n = 53)	
Yes, in all children	35 (66%)
Only in children older than 2 months	5 (9%)
No, because not available	4 (8%)
Not used	7 (13%)
Other	2 (4%)
Octenidin is used for skin care around CVC insertion site? (n = 53)	
Yes, in all children	10 (19%)
Only in children younger than 2 months	1 (2%)
No, because not available	12 (23%)
Not used	27 (51%)
Other	3 (6%)
In children on home PN blood sampling via CVC for routine monitoring is used? (n = 53)	
Yes	29 (54%)
No	25 (46%)

CVC = central venous catheter; PN = parenteral nutrition.

Surprisingly, although a surgical cut down technique was discouraged in the 2005 guidelines (1) almost one third of responders named it as the preferred method for tunneled catheter insertion. Recent evidence confirms that percutaneous tunneled CVC implantation is safe, less invasive, and faster than the surgical approach (6).

Adult data and guidelines strongly support ultrasound guided puncture of the central vein during line insertion (7). Data for children are scarce, but there is some evidence that ultrasound guidance decreases the number of venepunctures and the time spent accessing the internal jugular vein (8). More than 90% of centers shared this view and used either ultrasound or fluoroscopy guidance.

There was no uniform opinion where the CVC tip should be positioned. Almost equal numbers of responders felt that the CVC tip should lie outside the pericardial sac, at the atriocaval junction, or in the upper portion of the right atrium. Given that there is little published evidence in children the difference in practice is hardly surprising. In growing children the position of a catheter preserved over a number of years may change over time further contributing to the different answers given and many centers may base their practice on guidelines published in adults which recommend all 3 sites as adequate (7). In children, there is, however, an increased risk of cardiac tamponade caused by the CVC eroding into the pericardial sac (9). Particularly preterm infants and neonates are considered to be at risk (10,11). Therefore, it is recommended that CVC placement in pediatric patients should be outside the pericardial sac (1). In adults the carina can be used to document positioning of the catheter outside the pericardial sac on chest x-ray. Unfortunately, in children, in whom growth has an impact on radiological landmarks, there is no agreement as is reflected in the results of our survey. Fifty percent of participants pointed that the carina is a good landmark, whereas the remainder did not.

After placement of the CVC, the 2005 PN guidelines recommended the application of sterile gauze with tape and various transparent polyurethane film dressings to cover the tunneled CVC exit site (1). Although no dressing is required in a well-established catheter with healed exit site, it is often used in children to prevent dislodgement. A recent Cochrane Systematic Review evaluated these 2 dressing methods and found a 4-fold increase in CRBSI with the use of polyurethane dressings (12), which outlines the need for revision of the guidelines.

The majority of units used 2% chlorhexidine solution in 70% isopropyl alcohol to clean the CVC exit site as recommended in the 2005 guidelines but 9% of the responding centers used it only in infants older than 2 months (1). There is good evidence in adults that this solution is the most effective in removing microorganisms from the skin surface (13–15). Some authors, however, report contact dermatitis in young infants (16). Octenidin in children younger than 2 months of age is recommended to prevent the development of contact dermatitis (17). Interestingly in 19% of our cohort Octenidin was the preferred agent for skin cleaning around the catheter, but only 2% used it in children younger than 2 months.

TABLE 3. Questions related to prevention of central venous catheter-related complications

Question	Response, n (%)
Before insertion of CVC, prophylactic antibiotics are routinely used? (n = 54)	
Yes	11 (20%)
No	43 (80%)
Ethanol line lock is used for preventing catheter related blood stream infection (CRBSI)? (n = 54)	
Yes, in every patient on long-term PN	0
Only in patient with recurrent CRBSI	11 (20%)
No	41 (76%)
No, because it is not available	0
Other	2 (4%)
Taurolidine line lock is sued for preventing CRBSI? (n = 54)	
Yes, in every patient on long-term PN	21 (39%)
Only in patient with recurrent CRBSI	23 (43%)
No	3 (6%)
No, because it is not available	5 (9%)
Other	2 (4%)
When catheter-related blood stream infection occurs, in conjunction with systemic antibiotics, antibiotic line locks are used? (n = 54)	
Yes	24 (44%)
No	9 (17%)
Only in selected patients	18 (33%)
Other	3 (6%)
When there is a need for CVC replacement due to severe sepsis...? (n = 54)	
CVC is exchanged via guide wire	2 (4%)
CVC is replaced	42 (78%)
Other	10 (19%)
For CVCs that are being accessed intermittently, flushing with 5–10 U/mL heparinized saline...? (n = 54)	
Is used once weekly	24 (44%)
Is used twice weekly	8 (15%)
It is not used	15 (28%)
Other	7 (13%)
Anticoagulants are used to reduce catheter-related thrombosis? (n = 54)	
Yes, vitamin K antagonists are routinely used	2 (4%)
Yes, low-molecular-weight heparin is routinely used	6 (11%)
Heparin during PN is routinely used	3 (6%)
No, not routinely	43 (80%)
To unblock a CVC following is used? (n = 54)	
Recombinant tissue plasminogen activator	16 (30%)
Urokinase	31 (57%)
Both	4 (7%)
None	2 (4%)
Other	1 (2%)

CRBSI = catheter-related bloodstream infection; CVC = central venous catheter; PN = parenteral nutrition.

CRBSIs are a potentially life-threatening complication of long-term PN, and all effort should be made to reduce their incidence. In recent years taurolidine has been used increasingly to lock the CVC, which was not even mentioned in the 2005 guidelines (1). There is increasing evidence demonstrating reduction of CVC-related sepsis in adults and children with taurolidine line locks (18–20). It is, however, still not clear whether to use taurolidine in every child on long-term PN or reserve it only for those who already experienced CRBSI. The results of our survey reflect this uncertainty as almost 40% of respondents used taurolidine in every patient and around 43% only in children with recurrent CRBSI. In contrast, the majority of centers (approximately 76%) did not use ethanol line locks, although it is cheaper and there is evidence showing its effectiveness in reducing CRBSI (21). We can only speculate that underuse of ethanol in our survey may be due to reports of the association with catheter damage and increased risk of CVC-related thrombosis (22).

Long-term catheter survival is crucial in the management of children with prolonged or irreversible IF. Efforts to preserve the CVC by means of intraluminal sterilization have hence been made. There is evidence that the combination of systemic antibiotics and culture-guided lock therapy is superior to systemic antibiotics alone in selected patients (23). In our study, antibiotic locks were used in conjunction with systemic antibiotics for the treatment of CRBSI in 44% of our respondents routinely and in 33% only in selected patients.

Another serious complication of long-term CVC is thromboembolism, particularly in pediatric patients (24). There is limited evidence in the literature regarding prevention of thromboembolic phenomena in children. A systematic review from 2013 (25) showed that systemic treatment (low-molecular-weight heparin, antithrombin supplementation, or low-dose warfarin) has no significant benefit compared to no treatment in cancer patients with a tunneled CVC in situ. The only trial investigating the role of prophylactic anticoagulation in children receiving home PN (26), however, showed that low-molecular-weight heparin and 2 vitamin K antagonists decreased the incidence of thrombotic events. Our survey showed that the majority of centers did not use routine prophylaxis for thromboembolism. Amongst the respondents who prescribed prophylactic anticoagulants low-molecular-weight heparin was, however, the preferred agent. In case of CVC occlusion 57% of respondents used urokinase, followed by recombinant tissue plasminogen activator in approximately 30%.

We believe that our study provides useful insights into current practice amongst European centers, but we are aware of several limitations. Representation from all major IF/rehabilitation centers from across Europe was achieved, but our data set is not complete as not all centers treating children on long-term PN were included. Furthermore, it was not designed to establish which of these practices are more effective because there were no outcome measures such as infection rate, catheter longevity, and so on. Nevertheless, to the best of our knowledge, this is the first survey investigating current practices in relation to the insertion and maintenance of CVC in children on long-term, home PN and should provoke further collaborative research and sharing of good practices amongst pediatric IF/rehabilitation centers in Europe.

This survey clearly demonstrates that practices relating to CVC insertion and maintenance in children on home PN vary greatly amongst European countries. There is an urgent need to develop evidence-based guidelines to guarantee optimal catheter care for children. Furthermore, future studies are needed to assess best practices and to assure high-quality evidence.

Acknowledgment: The authors thank all respondents to the survey for their contribution and help.

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