Original research article

JVA The Journal of Vascular Access

The selection of the suitable long peripheral catheter in DIVA patients: The significance of ultrasonography

The Journal of Vascular Access
1–5

DOI: 10.1177/11297298231187028
journals.sagepub.com/home/jva
Sage

Katerina Lisova, Katerina Pavelkova, Petra Šimkova, Dana Mokra, Sabina Palova and Jiri Charvat

Abstract

Background: There are several types of LPC (long peripheral catheters) that vary in length, size, insertion method, and cost. The aim of the study was to evaluate whether ultrasonography can be useful for the selection of the suitable LPC in DIVA (difficult intravenous access) patients.

Methods: Based on the ultrasonographic examination, a long peripheral catheter was selected. A 6.4 cm LPC into a vein at a depth of up to 0.5 cm, a 8.5 cm LPC into a vein at a depth up to 1.5 cm, and a 9.8 cm catheter at a depth up to 2 cm using the cannula over needle method. A 12 cm catheter was inserted into the deeper veins using the direct Seldinger method. The catheter diameter was no more than 33% vein diameter. Dwell time and the number of complications of four vascular devices were recorded and compared.

Results: One thousand one hundred fifty-six patients, average age 76 years (19–102), 501 men and 655 women, were included in the study. Average dwelling time was 10 days (1–30), there were 136 complications (11.7%). A catheter 6.4 cm long was inserted in 346 (29.8%), 8.5 cm in 140 (12.1%), 9.8 cm in 320 (27, 5%), and 12 cm in 356 (30.6%) patients. There were no significant differences in dwelling time, rate, and type of complications among the four catheters used.

Conclusion: Our results confirm that ultrasound examination can be useful for the selection of the suitable long peripheral catheter in DIVA patients.

Keywords

Long peripheral catheter, ultrasonography, complications, indwelling time, DIVA patient

Date received: 18 February 2023; accepted: 24 June 2023

Introduction

A long peripheral catheter is defined as vascular device 6–15 cm long.[1] It is indicated if the expected dwelling time of peripheral catheter is between 7 and 30 days and in DIVA patiens.[1–10] Catheter may be inserted under visual or palpation control like short peripheral catheter.[1] However in DIVA patients, ultrasonographic navigation during catheter insertion is indicated.[2,3,5,6] Currently, there are several types of long peripheral catheters available that differ in length, size, construction (e.g. incorporation of an extension tube to the catheter), and method of insertion. The price of individual long peripheral catheters is also different.[1]

Some long peripheral catheters are inserted by the cannula over needle method, others by the Seldinger method.[1] The optimal exit site of this catheter is located in the middle part of the forearm, where the vascular device can be properly fixed. If a suitable vein is not present in the forearm, an alternative is to insert a catheter into a vein in the arm.[1]

The frequency of complications depends on the selection of a suitable vein before insertion the vascular device. Ultrasonography provides sufficient information about vein diameter and depth especially in the DIVA patiens.[2,3,5,6]

Medical Department, 2nd Faculty of Charles University and Faculty Hospital Prague Motol, Czech Republic

Corresponding author:
Jiri Charvat, 2nd Faculty of Medicine, Charles University and Faculty Hospital Prague, V Úvalu 84, Prague 5, Praha 116 36, Czech Republic.
Email: JiriCharvat@fnmotol.cz

Table 1. Types of long peripheral catheters inserted in the study.

Type of catheter	Size	Catheter length (cm)	Maximum vein depth (cm)	Price (euro)
Introcan	22 or 20G	6.4	0.5	4
Bullpup 8.5 cm	22 or 20G	8.5	1.5	10
Bullpup 9.8 cm	18G	9.8	2	13
Vygon 12 cm	4F	12	No limits	30

At our vascular center, nurses trained in ultrasonography insert several types of long peripheral catheters that vary in length, size, method of insertion, and cost.

In our study, we attempted to answer the question of whether ultrasonographic examination prior to insertion of a long peripheral catheter may be useful for selecting the most suitable long peripheral catheter in a DIVA patient based on the assumption that the more peripherally placed the vein into which the catheter is inserted, the less the consequences of a possible complication are serious—for example, the extent of damage in the case of thrombosis.

Methods

The study was carried out at Medical Department of the University Hospital Prague Motol, Czech Republic from January 1, 2021 to December 31, 2021. The protocol was approved by the Local Ethics Committee and respected the Helsinki Protocol. The patients signed the informed consent before the ultrasonography examination of the upper limbs.

Study design

DIVA patients with indications for peripheral vascular access participated in the study.[11] At the beginning, an ultrasonographic examination of the upper limbs was performed in order to find a suitable vein for the introduction of a long peripheral catheter.

The preferred site for catheter insertion was the middle part of the forearm not paging a joint that causes potential kinking. If no suitable forearm vein was found, an arm vein was selected based on ultrasonographic examination.

The depth of suitable veins was measured and the least deep vein was preferred. The type of long peripheral catheter was chosen so that the catheter did not occupy without tourniquet more than one-third of the lumen of the vein and that the vein was not placed deeper than indicated in Table 1.

The insertion of the long peripheral catheter was selected in the following order: Introcan 6.4 cm 22G or 20G (Bbraun, Germany), Bullpup 8.5 cm 22G or 20G (Bullpup, Israel) Bullpup 9.8 cm 18G (Bullpup, Israel), Vygon 12 cm 4F (Vygon, France).

Inclusion criteria

Age ⩾18 years.

Indication for the introduction of peripheral vascular access.

DIVA patient—failure of two consecutive insertion of short peripheral catheter or criteria for DIVA.[11]

Ultrasound detection of a suitable vein for a long peripheral catheter insertion.

Exclusion criteria

No suitable vein found by ultrasound scan.

Indication for central venous catheter.

Protocol for long peripheral catheter insertion

1. Hand washing of operator, operator in sterile gown, sterile gloves, surgical mask, and cap[12]
2. Disinfection of the insertion site with 2% chlorhexidine solution and large cover of puncture site
3. Insertion of the selected long peripheral catheter under ultrasonography navigation, Introcan 6.4 cm, Bullpup 8.5 cm, Bullpup 9.8 inserted via catheter-over-needle, Vygon 12 cm by direct Seldinger method
4. Catheter flushing and closing with sterile physiological solution
5. Catheter fixation with Stat-Lock, the application of glue on exit site and transparent dressing
6. Performance documentation and instruction for nursing staff

The patients were monitored by nurses in the ward. The insertion site was checked daily. When the catheter was used, the nurses washed their hands before touching the catheter and the surrounding area. The hub of the needleless connector was cleaned with 2% chlorhexidine gluconate for 15 s before use. The catheter was flushed with prefilled 0.9% NaCl syringes using the push-pause method. A new semipermeable transparent dressing was applied every 7 days or sooner in case of contamination or dressing loosening.

Catheter indwelling time and complication rates were recorded and evaluated for four different long peripheral catheters.

Table 2. Results—all 1156 patients.

Age (years)	76 (19–102)	
Gender (no. of men/%)	501 (43%)	
Dwell time (days)	10 (1–30)	
Complications (no./%)	136 (11.7%)	12/1000 days
Infection	3 (0.2%)	0.2/1000 days
Dislodgement	88 (7.6%)	7/1000 days
Deep venous thrombosis	15 (1.7%)	1.5/1000 days
Phlebitis	15 (1.7%)	1.5/1000 days
Mechanical	4 (0.3%)	0.2/1000 days

Catheter occlusion 11 (1.0%) 0.9/1000 days.

Statistical evaluation

Comparison of the number of complications of four types of long peripheral catheters and categorial variables were evaluated using Fischer-exact test. Mann-Whitney *U*-test was used to compared selected variables among four groups of patients. p Value <0.05 was considered to be statistical significant. The analysis was performed in statistical package R vision 3.6.3.

Results

A long peripheral catheter was inserted in 1156 patients. Baseline data and the frequency and type of complications in the entire group are summarized in Table 2.

Introcan 6.4 cm was introduced in 346 (29.8%), Bullpup 8.5 cm in 140 (12.1%), Bullpup 9.8 cm in 320 (27.5%), and Vygon 12 cm in 356 (30.6%) patients.

Total number of catheter-days was 11,428, in Introcan 6.4 cm 3216, Bullpup 8.5 cm 1385, Bullpup 9.8 cm 3215, and Vygon 12 cm 3612 days.

One hundred thirty-two catheters (11.5%) were inserted into veins on the forearm. On the arm 318 catheters (27.5%) into the cephalic vein, 297 catheters (26%) into basilic vein, and 409 catheters (35%) into brachial vein were inserted.

Comparison of age, gender, dwell time, and complications among different type of long peripheral catheters are presented in Table 3. Thrombotic complication was diagnosed according to symptoms and confirmed by ultrasonography.

Comparison of different types of complications among different type of long peripheral catheters are presented in Table 4.

Discussion

Ultrasonography is essential for insertion of long peripheral catheters in DIVA patiens.[1–9] The aim of our study was to assess whether pre-insertion ultrasonography is important in selection of the optimal catheter in terms of the selection of the most suitable long peripheral catheter.

Insertion of the catheter into the forearm or into less deeply located veins of the arm can prevent the complication in the deeper veins of the arm, which are suitable for the introduction of other vascular devices, for example, PICC.

Different types of long peripheral catheters were inserted in our study. The catheter was selected based on ultrasonographic examination. Its diameter was not to be greater than 33% of the diameter of the vein, and at least two-thirds of the length of the catheter had to be placed in the vein after insertion to limit the risk of dislodgement.

Evaluating whole group of patients, our results in terms of the dwell time and frequency of complications are comparable to previous studies.[13,14] The low frequency of infectious and thrombotic complications confirms that a long peripheral catheter is a suitable vascular device for hospitalized patients.

The first choice was the introduction of a catheter on the forearm, where a 6.4 cm long catheter was used preferentially in a vein that was a maximum of 0.5 cm deep. The frequency of complications including dislodgement was comparable to other tested long peripheral catheters. The depth of 0.5 cm was chosen because there was a high frequency of dislodgement of 6.4 cm long catheter when inserting into deeper veins in our previous study.[15] These patients were in the minority, as our group consisted of DIVA patients. However based on our results, in nonDIVA patients with a good superficial venous system in the forearm, where the catheter could be reliably inserted under visual control, this type of long peripheral catheter would be sufficient and advantageous considering its cost.

In the case where a suitable forearm vein was not found, the cephalic vein was ultrasonographically assessed on the arm, as it is usually located relatively superficially in the mid-arm. Depending on the depth of the vein, either Introcan 6.4 cm long or Bullpup 8.5 cm or 9.8 cm long was applied to it. The size of the catheter was chosen according to the diameter of the vein.

If a suitable cephalic vein was not detected, a catheter was inserted into the mid-arm into either the basilic vein or the brachial vein. In this case, depending on the depth of the vein and its diameter, either Bullpup 8.5 cm or 9.8 cm or Vygon 4F was inserted.

In our group, if the specified insertion criteria were followed, we did not find a significant difference in the dwell time, in the number of total complications and their characteristics among the evaluated long peripheral catheters.

On the basis of our results, it can be concluded that ultrasonographic examination before the introduction of a long peripheral catheter is necessary for the selection of the most suitable long peripheral catheter.

Table 3. Comparison of age, gender, dwell time, and complications among long peripheral catheters.

	Introcan (6.4 cm) ($n = 346$)	Bullpup (8.5 cm) ($n = 140$)	Bullpup (9.8 cm) ($n = 320$)	Vygon (12 cm) ($n = 356$)	p
Age (years)	77 (20–102)	75 (19–95)	76 (20–99)	76 (20–100)	N.S.
Gender (no./% of men)	146 (42%)	61 (44%)	148 (46%)	146 (41%)	N.S.
Dwell time	9 (1–30)	10 (1–30)	9 (1–30)	10 (2–30)	N.S.
Complications (no./%)	37 (10.7%)	19 (12.8%)	40 (12.5%)	40 (11.2%)	N.S.
Complications (per 1000 catheter days)	11	13	12	11	N.S.

Table 4. Comparison of different types of complications among long peripheral catheters.

Type of complication	Introcan (6.4 cm) ($n = 346$)	Bullpup (8.5 cm) ($n = 140$)	Bullpup (9.8 cm) ($n = 320$)	Vygon (12 cm) ($n = 356$)	p
Catheter infection (no./%)	1 (3%)	0 (0%)	1 (2.5%)	1 (2.5%)	N.S.
Dislodgment (no./%)	24 (65%)	13 (70%)	25 (62%)	26 (65%)	N.S.
Deep vein thrombosis (no./%)	4 (10%)	2 (10%)	4 (10%)	5 (12.5%)	N.S.
Catheter occlusion (no./%)	3 (8%)	1 (5%)	4 (10%)	3 (7.5%)	N.S.
Phlebitis (no./%)	3 (8%)	3 (15%)	5 (12.5%)	4 (10%)	N.S.
Mechanical (no./%)	2 (6%)	0 (0%)	1 (2.5%)	1 (2.5%)	N.S.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The study was supported by Ministry of Health, Czech Republic—conceptual development of research organization, University Hospital Motol, Prague, Czech Republic 00064203.

Ethical approval

The protocol was approved by the Local Ethics Committee Faculty hospital Motol, Prague, Czech Republic.

ORCID iD

Jiri Charvat https://orcid.org/0000-0001-9734-6638

References

1. Qin KR, Nataraja RM and Pacilli M. Long peripheral catheters: is it time to address the confusion? *J Vasc Access* 2019; 20(5): 457–460.
2. Scoppettuolo G, Pittiruti M, Pitoni S, et al. Ultrasound-guided "short" midline catheters for difficult venous access in the emergency department: a retrospective analysis. *Int J Emerg Med* 2016; 9(1): 3.
3. Fabiani A, Dreas L and Sanson G. Ultrasound-guided deep-arm veins insertion of long peripheral catheters in patients with difficult venous access after cardiac surgery. *Heart Lung* 2017; 46(1): 46–53.
4. Bundgaard Madsen E, Sloth E, Skov Illum B, et al. The clinical performance of midline catheters-an observational study. *Acta Anaesthesiol Scand* 2020; 64(3): 394–399.
5. Paladini A, Chiaretti A, Sellasie KW, et al. Ultrasound-guided placement of long peripheral cannulas in children over the age of 10 years admitted to the emergency department: a pilot study. *BMJ Paediatr Open* 2018; 2(1): e000244.
6. Gilardi E, Grandi T, Giannuzzi R, et al. Long peripheral cannula in COVID-19 patients: 769 catheter days experience from a semi-intensive respiratory COVID unit. *J Vasc Access*. Epub ahead of print 5 September 2022. DOI: 10.1177/11297298221115002.
7. Privitera D, Mazzone A, Pierotti F, et al. Ultrasound-guided peripheral intravenous catheters insertion in patient with difficult vascular access: short axis/out-of-plane versus long axis/in-plane, a randomized controlled trial. *J Vasc Access* 2022; 23(4): 589–597.
8. Qin KR, Ensor N, Barnes R, et al. Long peripheral catheters for intravenous access in adults and children: a systematic review of the literature. *J Vasc Access* 2021; 22(5): 767–777.
9. Qin KR, Pittiruti M, Nataraja RM, et al. Long peripheral catheters and midline catheters: insights from a survey of vascular access specialists. *J Vasc Access* 2021; 22(6): 905–910.
10. Swaminathan L, Flanders S, Horowitz J, et al. Safety and outcomes of midline catheters vs peripherally inserted central catheters for patients with short-term indications: a multicenter study. *JAMA Intern Med* 2022; 182(1): 50–58.
11. van Loon FH, Puijn LA, Houterman S, et al. Development of the A-DIVA scale: a clinical predictive scale to identify difficult intravenous access in adult patients based on clinical observations. *Medicine (Baltimore)* 2016; 95(16): e3428.

12. Pittiruti M, Van Boxtel T, Scoppettuolo G, et al. European recommendations on the proper indication and use of peripheral venous access devices (the ERPIUP consensus): a WoCoVA project. *J Vasc Access* 2023; 24(1): 165–182.
13. Patel SA, Araujo T, Rodriguez LP, et al. Long peripheral catheters: a retrospective review of major complications. *J Hosp Med* 2019; 14(12): 758–760.
14. Tripathi S, Kumar S and Kaushik S. The practice and complications of midline catheters: a systematic review. *Crit Care Med* 2021; 49(2): e140–e150.
15. Pavelkova K, Lisova K, Blahova P, et al. Comparison of 12-cm versus 6-cm long peripheral catheters in patients with difficult intravenous access (DIVA). *J Vasc Access* 2022; 23(1): 94–97.