Current Trends in Internal Medicine
Da Silva Braga MC, et al. Curr Trends Intern Med 6: 182.
www.doi.org/10.29011/2638-003X.100082
www.gavinpublishers.com

Review Article

SUPERFICIAL GREATER SAPHENOUS VENOUS: Safe Alternative for Venous Access in Small And/or Bedridden Children

Maria Cristina da Silva Braga[1], Viviane Ferreira Cesar[2], Esther dos Santos Ferreira[1], Debora Santana de Almeida[1], Larissa Santos Tanaka[1], Vanusa Ferreira de Queiroz Lima[1], Antonio Fernando Mota Resende[1], Shieley Elaine Alves Ferreira[1], Sara Ferreira dos Santos[1], Maria Lucia Barbosa Maia dos Santos[1*]

[1]Division of Nursing, Instituto da Criança, Hospital das Clínicas, University of São Paulo, São Paulo, Brazil. Avenida Doutor Enéas Carvalho de Aguiar nº647 - Cerqueira Cesar – São Paulo - Brazil. CEP: 05403-000

[2]Nursing Coordenation, Instituto do Coração, Hospital das Clínicas, University of São Paulo, São Paulo, Brazil. Avenida Doutor Enéas Carvalho de Aguiar nº44 - Cerqueira Cesar – São Paulo – Brazil. CEP: 05403-000

[*]**Corresponding author:** Maria Lucia Barbosa Maia dos Santos, Division of Nursing, Instituto da Criança, Hospital das Clínicas, University of São Paulo, São Paulo, Brazil. Avenida Doutor Enéas Carvalho de Aguiar nº647 - Cerqueira Cesar – São Paulo - Brazil. CEP: 05403-000

Citation: Da Silva Braga MC, Cesar VF, de Almeida DS, Tanaka LS, de Queiroz Lima VF, et al. (2022) SUPERFICIAL GREATER SAPHENOUS VENOUS: Safe Alternative for Venous Access in Small And/or Bedridden Children. Curr Trends Intern Med 6: 182. DOI: 10.29011/2638-003X.100082

Received Date: 11 December 2022; **Accepted Date:** 19 December 2022; **Published Date:** 22 December 2022

Abstract

Objective: Objective: This article describes a technique for inserting a peripherally inserted central catheter in the great saphenous vein through the ZIM zone, adapted as an alternative puncture site for venous access in children with difficult venous access during hospitalization in the Pediatric Intensive Care Unit.

Method: A case report series on the adaptation of the ZIM Zone technique in five patients who were unable to undergo venipuncture in the upper limbs.

Results: The median catheter permanence time was 18 (9-60) days. All insertions were successfully performed by trained and qualified intensive care unit nurses. Owing to the size of the children's vessels, single-lumen catheters of sizes 3 Fr and 4 Fr were inserted. The main complication of the procedure was bleeding at the insertion site, which was resolved with a compressive dressing, particularly in patients with abnormal coagulograms and thrombocytopenia.

Conclusion: None of the patients presented with complications related to catheter use the use of technology allied with the professional's expertise brings a combination of almost 100% assertiveness in performing the procedure in the first puncture attempt.

Keywords: Pediatric Nursing; Saphenous vein, Intravenous Infusion; Central venous Catheterization; Peripherally inserted central catheter

Introduction

Children admitted to intensive care units frequently require vascular access due to several therapeutic interventions, such as infusion of fluids and drugs, administration of blood products and parenteral nutrition [1].

Obtaining venous access in the pediatric population is challenging and difficult. In this context, peripherally inserted central catheters (PICC) are considered reliable alternatives to central venous access for drug therapy infusions in hospitalized children and adolescents [1].

In Brazil, the use of CCIP began in the 1990s and was regulated by the Federal Council of Nursing in 2001. Since then, their use has become increasingly frequent. The indications, insertions, maintenance, and removal of CCIP in Brazilian health institutions are the exclusive responsibilities of nurses with theoretical and practical training [2]. PICC have numerous advantages for patients, staff and institutions. Advantages include preservation of the venous network, a lower risk of infection, less restriction of mobility, reduced pain and discomfort, safe insertion, and bedside performance. In addition, it reduces the time and stress of the team, patient and family by avoiding repeated punctures, and has greater cost-effectiveness and longer stay [3].

CCIP is traditionally inserted into the veins of the upper limbs, such as the basilic, cephalic, brachial and axillary veins [1]. However, in many cases, the lack of adequate venous access sites in the upper body can result in delayed treatment or other more invasive procedures, such as venodissection of the vein, leading to an inability to access the vessel afterwards [1]. The use of the saphenous vein as an alternative access site for CCIP offers a simple and safe solution for patients with upper-body venous access exhaustion [3].

The use of ultrasound to guide the puncture for PICC insertion, minimizes risks and makes the procedure safer because it avoids inadvertent puncture of arteries or nerves and multiple punctures, maximizes the assertiveness of the punctures and increases the reliability of the patient and family in the professional, making the procedure more effective and with better results [4].

Literature shows that PICC insertion in the saphenous vein is technically uncomplicated, even in patients with difficult venous access and has a good safety profile compared to PICC insertion in the upper limb. However, there is a need to consider aspects related to the insertion site, such as the diaper area, due to the risk of infection, areas of folds and flexion, to avoid trauma to the intima of the vessel, due to excessive manipulation [1].

Positioning of the catheter tip in the superficial greater saphenous vein

An important point related to the use of the PICC in the saphenous vein is the positioning of the catheter tip owing to the large number of tributary veins of the inferior vena cava with a greater potential for catheter tip migration.

The ideal position of the catheter tip in the inferior vena cava (IVC), is distal to the level of the diaphragm and/or located in the inferior vena cava near the junction with the right atrium (CAJ) (0.5-1 cm outside the cardiac chambers in premature babies and 1-2 cm outside the chambers in infants) [5]. That is, one can leave the tip located between T9 and T11 according to the recommendations of the Infusion Nurse Society [6].

Potential complications include catheter migration to the azygos vein, pulmonary artery, ascending lumbar vein, and/or lumbar venous plexus resulting in paraplegia. In a case report on malposition of a catheter inserted through the saphenous vein in which the tip was visualized in the IVC on an abdominal radiograph at the L4-L5 level, it was considered central and released for the administration of Parenteral Nutrition (PN) after clinical worsening of the child was reevaluated on an abdominal radiograph in the lateral view, indicating that the central line had deviated posteriorly at the intervertebral level of L5, resulting in paraplegia [7].

The professional responsible for nursing care to patients using PICC in the great saphenous vein should pay attention to the early signs that may indicate migration of the catheter tip, which may indicate migration of the catheter tip, according to the literature [8]: absence of venous return aspirations; subtle lateral deviation of the catheter at the level of L4 and L5 on frontal abdominal radiographs, and the catheter path directly over the spine rather than to the right of the midline for an inferior vena cava catheter. These points should be carefully investigated in children using lower limb vein catheters.

This study aimed to describe puncture of the Superficial Saphenous Vein using the ZIM Method adapted for choosing the ideal site for needle insertion in the thigh and ultrasound-guided/guided and modified Seldinger techniques in young and bedridden children with venous access failure.

Materials and Methods

Study Type

This is a case report series based on the adapted ZIM method, describing a specific technique for superficial great saphenous vein (GSV) puncture in bedridden infants and young children who used PICC during their stay in the Pediatric ICU.

Scenario

The study was conducted in the Intensive Care Unit of a Quaternary University Hospital, which has 20 ICU beds, with an average annual admission of 500 children aged one month to 18 years from various regions of the country for postoperative liver, kidney, and bone marrow transplants, among others, from June 2021 to May 2022. This study included five children.

Inclusion Criteria

Indications included infants and bedridden children with venous access failure in the upper limbs and neck, history of venodissection and the need to receive intravenous infusion therapy for a period of seven days or longer.

Data Collection

The data were collected between June 2021 and May 2022. All children who met the inclusion criteria were asked to give informed consent to their legal guardian to participate in the study. Pediatric Logistic Organ Dysfunction (*PELOD-2*) was collected to assess the presence of organ dysfunction, clinical and sociodemographic information of the patients was collected. The *PELOD-2* score used at admission was divided into four subsections scored according to the cardiovascular, neurological, respiratory, hematological, and renal organ systems. Based on the score of each system, a dysfunction score and a predicted mortality [9], rate were attributed. All saphenous vein punctures were performed by intensivists with theoretical and practical training in PICC insertion. All nurses had received previous training to adapt to the technique.

Data analysis

The data were organized and stored in an Excel spreadsheet, and the same program was used to check the means and standard deviations and for the median, maximum, and minimum values.

Ethical Aspects

The study was approved by the Ethics and Research Committee on May 13, 2021, under Opinion number4.709.743, which complies with the ethical and legal precepts contained in Resolution 466/12 of the National Health Council. Data collection began after ethical approval was obtained. The Informed Consent Form was signed by the parents or legal guardians of the children.

Results

The median age of the patients was 15 months (6-83), the median weight was 9.5 kg (6-28), and four (80%) were female. All patients were Caucasian and had chronic underlying diseases and were hospitalized.

All five patients were scored in at least two organ systems. The renal system was scored in all patients, and 3 patients (60%) were malnourished, as shown in Table 1.

Age months	Gender	Weight (Kg)	Diagnosis	Nutritional status	Score PELOD-2	Predicted mortality	Laboratory tests					Vein diameter occupancy	Catheter permanence time (days)
							Platelet **(k/µL)**	PT sec	PTT sec	PT activity (%)	INR		
24	Female	7.6	Brochiolitis obliterans PO of GTM	malnourished	**score 5** Renal, Respiratory	1.4%	305	14.9	25.6	79	1.25	31	9
6	Male	6	Syndrome Mitochondrial depletion type III	eutrophic	**score 2** Renal	0.3%	197	21	42	24	2.6	32	18
7	Female	8.5	PO of TX liver	malnourished	**score 2** Renal	0.3%	338	14.2	27.2	72	1.20	33	14
15	Female	9.5	PO of TX liver	malnourished	**score 6** Renal, Hematological Cardiovascular	2.2%	29	20.6	32.2	41	1.47	33	24
83	Female	28	Neonatal Encephalopathy Neonatal Anoxia	overlap	**score 7** Renal, Respiratory Cardiovascular	3.5%	201	13.8	27.8	91	1.06	32	60
PO-postoperative, GTM: gastrostomy, Sd: syndrome, TX: transplant, *PELOD-2* - Pediatric logistic organ dysfunction; PTT: Activated Partial Thromboplastin Time, Plasma, PT: Prothrombin Time, Plasma, INR: International Normalized Ratio. SEC: Seconds													

Table 1. Characterization and description of the saphenous vein's five cases of puncture technique (adapted ZIM Zone). Sao Paulo, SP Brazil – 2022.

The median catheter stay was 18 days (9 - 60) and all patients underwent catheter removal without infectious or mechanical complications.

The occupation of the vessel diameter followed the guidelines of the literature, which recommend occupation of up to 45% of the lumen. To measure the vessel, we used a GE ultrasound device model Logic-e [9]. Owing to the size of the children's vessels, single-lumen catheters (3 Fr) and double-lumen catheters (4 Fr) were inserted.

The main complication of the procedure was bleeding at the insertion site, which was resolved with a compressive dressing, particularly in patients with altered coagulograms and thrombocytopenia. The first dressing was performed using sterile gauze and a transparent semipermeable film, which was changed 24h after insertion.

Description of the puncture technique used in the five cases

Anatomically, the great saphenous vein originates in the medial marginal vein of the dorsum of the foot and ends in the femoral vein, approximately three centimeters below the inguinal ligament. It ascends in front of the tibial malleolus and along the medial aspect of the leg in relation to the saphenous nerve, runs upward behind the medial condyles of the tibia and femur along the medial side of the thigh, passes through the fossa ovalis, and ends at the femoral vein figure 1.

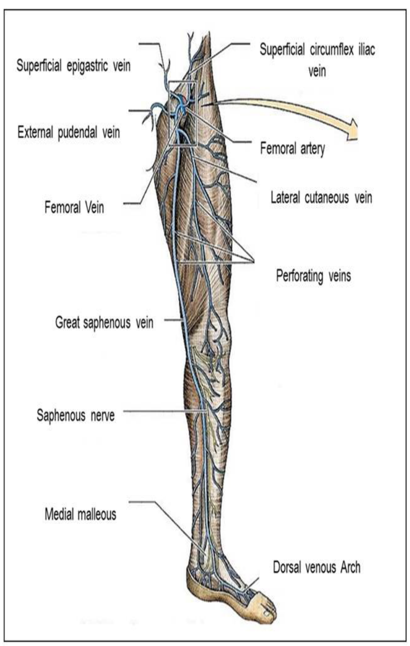

Figure 1. Superficial great saphenous vein. Sao Paulo, SP. Brazil, 2022

Source: MOORE, K.L. Clinically Oriented Anatomy. 5th edition. Rio de Janeiro: Guanabara Koogan, 2007.

GSV puncture was performed using the modified Seldinger technique and was guided by ultrasound with a linear transducer. The veins were located in the transverse plane five cm above the knee joint on the inner side of the thigh. GSV puncture was performed after applying the adapted ZIM Method, ultrasound-guided puncture, and modified Seldinger Technique for PICC insertion, as shown in figure 2.

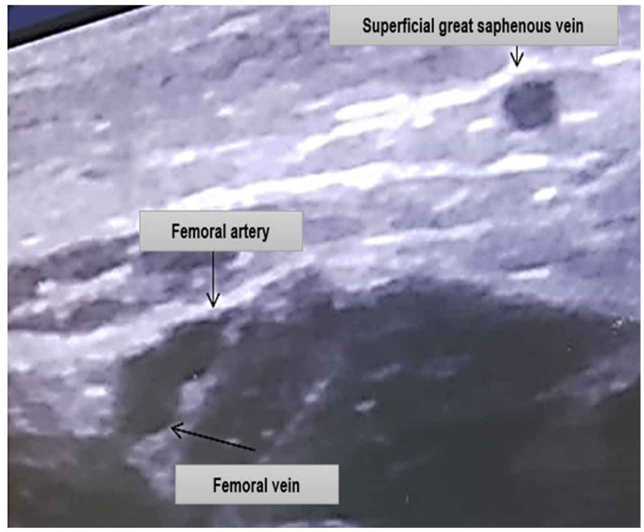

Figure 2. Ultrasound image of the saphenous vein of the thigh of a 5-month-old infant. Sao Paulo, Sp. Brazil, June 2022.

Source: Image by author

The ZIM Method, which describes the ideal position for PICC insertion into the upper limbs, was used to determine the puncture site. The method recommends measuring the selected arm as follows.

- Zero point at the medial epicondyle to the axillary line.

Divide this final measure into three equal parts.

1. **Red zone** (more distal portion) avoids puncturing this area, which is close to the cubital fossa, smaller vessel caliber, difficult catheter stabilization, and passive limb movement.

2. **Green zone:** (middle portion): ideal place for catheter insertion, far from the cubital fossa, adequate vessel caliber, easy catheter stabilization as it has a larger area without flexion.

3. **Yellow zone** (most proximal portion): avoid puncture in this region, close to the axillary region, more colonized, risk of inadvertent artery puncture, difficult catheter stabilization, limb movement area, and adaptation of the zoning technique proposed by Dawson, which delimits the ideal zone for catheter insertion Figure 3.

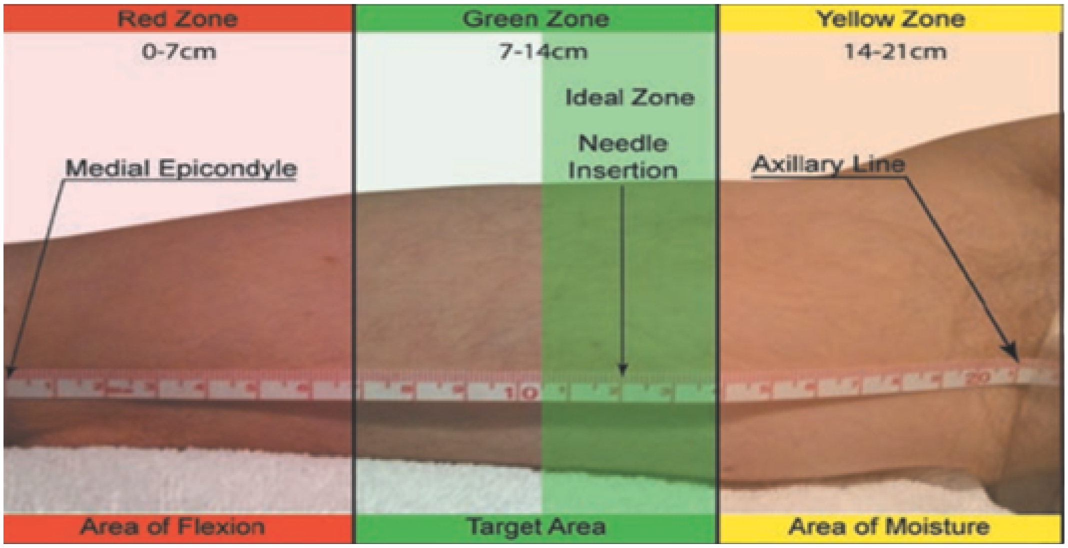

Figure 3. ZIM method. Sao Paulo - SP. Brazil, January 2022

Source: Robert B. Dawson (2011) PICC Zone Insertion Method (ZIM)

The adaptation of Dawson's technique consisted of measuring the length of the thigh (knee to inguinal region), considering the knee joint as the red area, the green area five cm above the knee joint, and the inguinal region as the yellow area (Figure 4 and 5).

1. Red Zone (the most distal portion) avoids puncture in this area, which is close to flexion and bending, and vessel caliber makes it less difficult to stabilize the catheter.

2. Green zone: (middle portion): ideal place for insertion of the catheter, far from the area of flexion and bending, adequate vessel caliber, and easy catheter stabilization as it has a larger area without flexion.

3. Yellow zone (most proximal portion): avoid puncture in this region – close to the groin region, more colonized, higher risk of infection and inadvertent artery puncture, difficult catheter stabilization, and limb movement area.

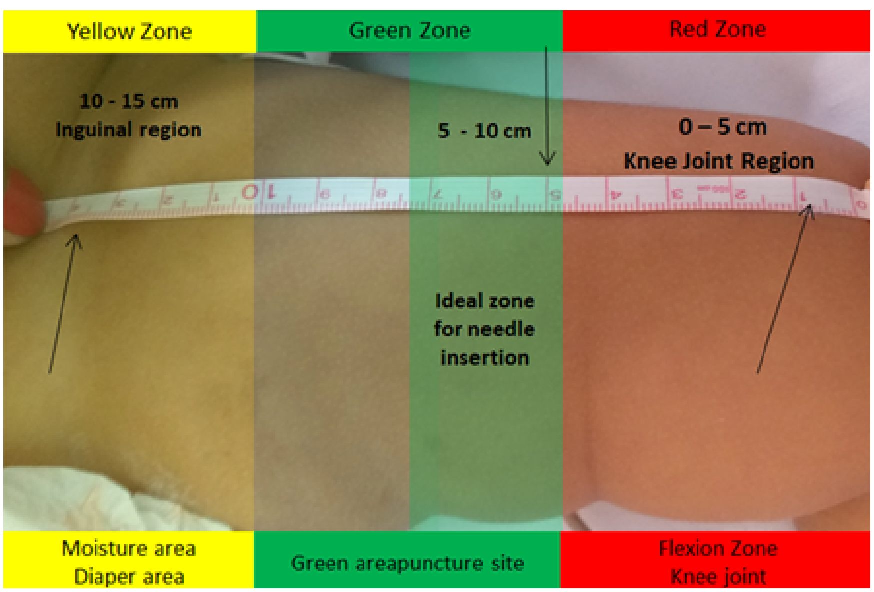

Figure 4. Thigh: Zone ZIM technique adapted for the ideal position for PICC insertion in the thigh. Sao Paulo - SP. Brazil, June 2022

Source: Image by author

Figure 5. Thigh: Zone ZIM technique adapted for the ideal position for PICC insertion in the thigh. Sao Paulo-SP. Brazil, June 2022

Source: Image by author

The ultrasound-guided micropuncture technique (USG):

The USG allows analysis of the anatomy before insertion to identify vascular changes, such as occlusion or thrombosis, assess the diameter of the vein, position the probe of the device vertically in the vein, insert the needle, keep the needle visualized until the inside of the vessel, and use a transparent cover and gel for the sterile probe.

Modified Seldinger Technique.

- Vessel puncture with a long, smaller-gauge needle.
- Insert the flexible guidewire into the needle.
- The needle was withdrawn and the guidewire was retained.
- Insert the dilator.
- The guidewire was removed.
- Insert the catheter into the dilator
- When the catheter reaches the ideal position.
- Removing the dilator using the peel-away technique.

Using the techniques cited allowed the catheter to be inserted away from the diaper area, which contributed to maintenance care and reduced infection risk, as well as being a safe distance from the flexing and bending areas. It also helps to reduce repetitive movements that can damage the endothelium and lead to an inflammatory response with thrombosis formation and/or phlebitis.

The children were placed in a horizontal dorsal decubitus position and all punctures were performed at the bedside. Before starting the procedure, ketamine was administered at a dose of 0.5 mg/kg and/or propofol at 1 mg/kg and a local anesthetic button with 2% lidocaine hydrochloride without vasoconstrictor, as prescribed by the doctor.

All catheters were fixed to the skin with a catheter stabilizer without sutures, occluded with sterile gauze and a transparent semipermeable film.

Discussion

The great saphenous vein, which is a part of the superficial venous system, is clinically significant and easily accessible. Because of its more superficial position in relation to the skin and because it is farther from the artery and nerve, puncture of the superficial greater saphenous vein can be performed with support/assisted/guided ultrasound without the risk of major complications, an alternative to venous access in bedridden infants and/or older children with access failures and/or inability to access the upper limbs. Compared to femoral vein puncture, the risk of inadvertent puncture of the artery is eliminated [10,11].

The use of the superficial Greater Saphenous Vein (GSV) as vascular access has been widely discussed in previous publications in the neonatal population, with the puncture being performed at the level of the malleolus by a radiologist or intensive care nurse [12]. We found a publication on the puncture of the GSV with a description of the puncture in the middle of the thigh and using ultrasound to perform the puncture, and we did not find any publication with adaptation of the ZIM zone for puncture of the superficial great saphenous vein. The puncture of the GSV through the ZIM zone adapted to 5 cm from the height of the knee joint is important because one of the flaws associated with the traditional technique at the malleolus height is the difficulty of advancing the catheter at the knee height due to the natural course and funneling of the great saphenous vein in this anatomical region.

The choice of the puncture site at five cm above the knee joint allowed the puncture to be successful, as well as a greater caliber of the vessel than the area below the knee and contributed to the reduction in mechanical complications due to repetitive movements, such as phlebitis. The fact that it is far from the diaper area reduces the risk of infection compared to femoral vein puncture, as reported in another study [3].

Although venous access is preferred in the upper limbs, pediatric patients with access failures and venous dissections that prevent puncture can benefit and have a lower complication rate with vesicular access in the veins of the lower limbs, such as the GSV [10].

In the present report, five patients had several previous venous dissections, making it impossible to use vessels such as the femoral, jugular and axillary veins. The use of the GSV as an access is an alternative to save vessels, such as the left femoral and right axillary veins, owing to future interventions.

Another group of patients who can benefit from vascular access in GSV is those with congenital heart disease who have undergone alteration of the anatomical path, such as surgically created shunts [13,14].

Using the great saphenous vein as an alternative for venous access in children with nephropathy and hemodialysis is another advantage as it preserves future fistula sites and does not cause venous stenosis in the upper limbs.

Complication found in this study was bleeding at the puncture site, which was resolved with compressive dressing. However, another complication described in the literature related to vascular access in GSV is thrombosis. To reduce this risk, in this study, we measured vessel diameter, and the highest occupancy rate was 33%. To guide us in this decision, we used the recommendations of the Infusion Nursing Society [9], which provides a maximum occupancy of 45%.

The absence of complications related to the puncture technique in these five reports showed that the SVMS is a safe alternative for venous access in infants and/or bedridden children and is in agreement with the results of a previous study (15) that used the saphenous vein in 86 children with a mean weight of 9.98 kg, 81 children aged less than 2 years. No immediate complications occurred after catheter insertion and the median catheter stay was 15.8 (2-97) days. All catheters were removed prior to hospital discharge [14].

Another important piece of information was the anatomical location of the PICC tip after insertion, which was released for use after confirming the tip on chest radiography between T9 and T11 and/or the ideal position of the catheter tip in the distal inferior vena cava at the level of the diaphragm [14,15].

Conclusions

This case series suggests that the use of VSMS for venous access is safe in children and infants. As long as there is a nursing team trained and qualified to insert the PICC and attentive to early signs of complications during the permanence of the device.

The puncture of the VSMS using the ZIM Method was adapted to choose the ideal place for inserting the needle in the thigh, guided by ultrasound and the modified Seldinger technique in young and bedridden children with venous access failure. It presents a safe alternative when the veins, subclavian, jugular, and upper limb veins cannot be used.

The impact of using the technology combined with professional expertise resulted in almost 100% assertiveness in performing the procedure in the first puncture attempt, allowing efficient work, with the correct use of resources, without cost increases.

Conflicts of Interests

The authors declare no conflict of interest regarding the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, or publication of this article.

References

1. Germino KW, Gerard JM, Flood RG (2012) Greater saphenous vein location in a pediatric population. J Pediatr Nurs 27: 626-631.
2. Conselho federal de enfermagem (COFEN). Resolução nº258/2001. Rio de Janeiro: Coren-RJ; 2001
3. Pippus KG, Giacomantonio JM, Gillis DA, Rees EP (1994) Thrombotic complications of saphenous central venous lines. J Pediatr Surg 29: 1218-1219.
4. Doniger SJ, Ishimine P, Fox JC, Kanegaye JT (2009) Randomized controlled trial of ultrasound-guided peripheral intravenous catheter placement versus traditional techniques in difficult-access pediatric patients. Pediatr Emerg Care 25: 154-159.
5. Dawson RB (2011) PICC Zone Insertion Method™ (ZIMTM): A Systematic Approach to Determine the Ideal Insertion Site for PICCs in the Upper Arm. Journal of the Association for Vascular Access 16: 156–165.
6. Gorski LA, Hadaway L, Hagle ME, et al. (2021) Infusion Therapy Standards of Practice, 8th Edition. J Infus Nurs 44: S1-S224.
7. Chen CC, Tsao PN, Yau KI (2001) Paraplegia: complication of percutaneous central venous line malposition. Pediatr Neurol 24: 65-68.
8. Lavandosky G, Gomez R, Montes J (1996) Potentially lethal misplacement of femoral central venous catheters. Crit Care Med 24: 893-896.
9. Leteurtre S, Duhamel A, Deken V, Lacroix J, Leclerc F; Groupe Francophone de Réanimation et Urgences Pédiatriques (2015) Daily estimation of the severity of organ dysfunctions in critically ill children by using the PELOD-2 score. Crit Care 19: 324.
10. Hoang V, Sills J, Chandler M, Busalani E, Clifton-Koeppel R, Modanlou HD (2008) Percutaneously inserted central catheter for total parenteral nutrition in neonates: complications rates related to upper versus lower extremity insertion. Pediatrics 121: e1152-e1159.
11. Durand M, Ramanathan R, Martinelli B, Tolentino M (1986) Prospective evaluation of percutaneous central venous silastic catheters in newborn infants with birth weights of 510 to 3,920 grams. Pediatrics 78: 245-250.
12. Pirotte T (2008) Ultrasound-guided vascular access in adults and children: beyond the internal jugular vein puncture. Acta Anaesthesiol Belg 59: 157-166.
13. Eisen LA, Narasimhan M, Berger JS, Mayo PH, Rosen MJ, Schneider RF (2006) Mechanical complications of central venous catheters. J Intensive Care Med 21: 40-46.
14. Johnson EM, Saltzman DA, Suh G, Dahms RA, Leonard AS (1998) Complications and risks of central venous catheter placement in children. Surgery 124: 911-916.
15. Aria DJ, Vatsky S, Kaye R, Schaefer C, Towbin R (2014) Greater saphenous venous access as an alternative in children. Pediatr Radiol 44: 187-192.