Experience Report

Training of nurses in the use of intravascular ultrasound in peripheral puncture

Capacitação de enfermeiros para uso da ultrassonografia na punção intravascular periférica

Capacitación de enfermeros en el uso de la ultrasonografía en la punción intravascular periférica

Ariane Ferreira Machado Avelar[1], Maria Angelica Sorgini Peterlini[2], Priscilla Sete de Carvalho Onofre[3], Myriam Aparecida Mandetta Pettengill[4], Mavilde da Luz Gonçalves Pedreira[5]

ABSTRACT

The objective was to explain, to the nurses training, procedures using vascular ultrasound for obtaining peripheral vascular access. The program consisted of theoretical and practical educational interventions developed over a period of six months. The strategies were developed and implemented by two nurses specialized in intravascular therapy, one doctor specialized in vascular ultrasound and, one biomedical engineer. Eight nurses participated in the training. The knowledge, skills and abilities acquired in the identification of arteries, veins, blood flow and catheter position, were evaluated. The strategy will enable that the pediatrician nurses acquiring skills to promote innovative interventions in peripheral intravascular puncture.

Keywords: Pediatric nursing; Training; Infusions, intravenous; Patient safety, Ultrasonography

RESUMO

Este artigo relata a estratégia de capacitação de enfermeiros para uso da ultrassonografia vascular na obtenção do acesso vascular periférico. O programa foi composto por intervenções educacionais teóricas e práticas desenvolvidas em um período de seis meses. As estratégias foram elaboradas e implementadas por dois enfermeiros especialistas em terapia intravascular, um médico especialista em ultrassonografia vascular e um engenheiro biomédico. Oito enfermeiros participaram da capacitação e, ao final, os conhecimentos, as competências e habilidades adquiridas na identificação de artérias, veias, fluxo sanguíneo e posicionamento de cateteres foram avaliados. A estratégia possibilitou que enfermeiros pediatras adquirissem competências capazes de promover intervenções inovadoras na punção intravascular periférica.

Descritores: Enfermagem pediátrica; Capacitação; Infusões intravenosas; Segurança do paciente; Ultra-sonografia

RESUMEN

Este artículo relata la estrategia de capacitación de enfermeros en el uso de la ultrasonografía vascular en la obtención del acceso vascular periférico. El programa estuvo compuesto por intervenciones educacionales teóricas y prácticas desarrolladas en un período de seis meses. Las estrategias fueron elaboradas e implementadas por dos enfermeros especialistas en terapia intravascular, un médico especialista en ultrasonografía vascular y, un ingeniero biomédico. Ocho enfermeros participaron de la capacitación. Al final, los conocimientos, las competencias y habilidades adquiridas en la identificación de arterias, venas, flujo sanguíneo y posición de catéteres, fueron evaluados. La estrategia posibilitó que los enfermeros pediatras adquiriesen competencias capaces de promover intervenciones innovadoras en la punción intravascular periférica.

Descriptores: Enfermería pediátrica; Capacitación; Infusiones intravenosas; Ultrasonografía

[1] *PhD. Nurse of the Pediatric Nursing Discipline of the Escola Paulista de Enfermagem - Universidade Federal de São Paulo – UNIFESP – Sao Paulo (SP), Brazil.*
[2] *Adjunct Professor of the Pediatric Nursing Discipline of the Escola Paulista de Enfermagem - Universidade Federal de São Paulo – UNIFESP – Sao Paulo (SP), Brazil.*
[3] *MSc. Nurse of the Pediatric Surgical Unit of the Sao Paulo Hospital – Sao Paulo (SP) Brazil.*
[4] *Adjunct Professor of the Pediatric Nursing Discipline of the Escola Paulista de Enfermagem - Universidade Federal de São Paulo – UNIFESP – Sao Paulo (SP), Brazil.*
[5] *Adjunct Professor of the Pediatric Nursing Discipline of the Escola Paulista de Enfermagem - Universidade Federal de São Paulo – UNIFESP – Sao Paulo (SP), Brazil.*

Corresponding Author: **Maria Angelica Sorgini Peterlini**
R. Napoleão de Barros, 754 - Vila Clementino - São Paulo - SP - Brazil
Cep: 04024-002 E-mail: maria.angelica@unifesp.br

Received article **25/02/2008** and accepted **25/08/2008**

INTRODUCTION

Insertion of peripheral intravascular catheters constitutes one of the most frequently performed interventions in hospitalized patients. For its achievement, it is necessary to develop clinical competence and technical skills in nursing professionals in order to prepare them to implement the various aspects of intravascular therapy[1-2]. The introduction of new technological approaches, such as the use of ultrasonography (US) to guide intervention procedures, can increase the success in venous or arterial puncture, and implantation of peripherally inserted central venous catheter (PICC) in patients with difficult venous access. US, therefore, contributes to the improvement of nursing practice, professional performance and patient safety promotion. Studies report that training programs for healthcare professionals should include theoretical concepts, practical demonstrations and periodic evaluations of skills and knowledge to develop competence to enable them to perform the procedures and interventions efficiently, effectively and safely[3-4]. The use of US in the treatment of patients undergoing intravenous therapy has been recommended for patient safety promotion. Through the use of the image it is possible to improve results in relation to the certainty of the intravenous puncture of the central and peripheral vessels, reducing the number of puncture attempts and complications, promoting greater satisfaction of the patient and their family[5-8].

US allows the visualization of vessels and surrounding anatomic structures prior to and during the insertion of catheters, enabling the identification of anatomical variations, presence of thrombi, transfixation of the vessel by the device, and the prevention of inadvertent arterial puncture among other events[9-10]. However, professional training is necessary for the utilization of US. Ultrasonography is a recently introduced technique in nursing interventions, and thus requires a multidisciplinary approach to promote its use in clinical practice. The training must foster understanding of the principles of physics, image interpretation, as well as the acquisition of manual skills to perform venipuncture through the analysis of the image shown on the equipment screen[9,11]. Nurses who use US for the insertion of venous catheters must also have advanced technical knowledge and skill in intravenous therapy. Knowledge of vascular anatomy and physiology provide a basis for the clinical decision making of professionals, minimizing the occurrence of tissue lesions and preventing complications related to the therapy implemented[11]. Educational strategies and processes of practicing with mentors should be provided by trained professionals. Studies show that the learning process must involve the steps of theoretical education, practical skill development and promotion of opportunities for repeated use of technology, in order to promote the professional expertise in the use of US to guide peripheral vascular access[11-15].

Ultrasonography has historically been performed by radiologists for diagnostic purposes, most recently being used to guide various percutaneous procedures[16]. Research has described its use in emergency units by nurses, to obtain peripheral vascular access in patients with difficult venous access[17-19]. Based on these investigations, it can be stated that the use of US can contribute to achieving more effective intravenous punctures. New portable equipment can be used at the bedside by nurses, improving their performance during the procedure and, consequently, patient care[20].

The aim of this study was to describe an educational strategy designed to empower pediatric nurses in the use of vascular US with Doppler, to direct peripheral intravascular puncture.

Presentation of the educational strategy

The training of nurses for the use of US in peripheral intravascular puncture characterized one of the stages of a research project conducted with the support of the National Council of Technological and Scientific Development (CNPq). The strategy was prepared and conducted by two nurse specialists in intravascular therapy, a physician specialist in vascular ultrasonography and a biomedical engineer, for a period of six months, being divided into four stages: theoretical, practical, evaluation and reevaluation. Eight pediatric nurses, who took part in the research group, participated in the training, some of whom worked in a pediatric surgery unit of a university hospital in São Paulo, the place of strategies developed implementation.

The theoretical stage lasted one month and consisted of reading texts about US and ultrasound equipment, and scientific articles on its clinical use in intravenous therapy by nurses and other health professionals, in the form of intervention. Later, content related to the principles of the US physics and DOPPLER was taught, by nurses, along with anatomy and physiology of the vascular system of the child; demonstrations concerning the operation of ultrasound equipment and peculiarities of US Doppler were performed by a biomedical engineer; content concerning vascular images, artifacts and implanted catheters were approached by a physician. Thereafter, began the practical stage, lasting five weeks. At this time, under the guidance and supervision of a vascular surgeon, a specialist in vascular US, the nurses were instructed in the handling of equipment during the procedure, the visualization of images and the identification of the structures projected on the screen using the knowledge acquired during the theoretical stage. At the evaluation stage each nurse carried out the US and

recorded 25 images in arteries, veins and implanted catheters. The images obtained were analyzed, discussed and validated by the physician and specialist nurses. At the end of this stage of the program, nurses were evaluated regarding the knowledge, skill, ability to identify arteries, veins, blood flow and positioning of catheters, thus, they were able to continue to the last step.

After a period of two months, the implementation of US in practical care began. All procedures for peripheral intravenous and arterial puncture guided by US were performed by two skilled professionals, under the supervision of a nurse specialist, with the intention of revalidating the knowledge. Periodic consultations were held with the professional who participated in the training, to permit the analysis of information acquired during initial training and to discuss images that raised questions in the group as to the interpretation of the findings. After four months of training the nurses were considered able to use US to guide venous and arterial punctures in children.

ULTRASONOGRAPHY IN PERIPHERAL INTRAVASCULAR PUNCTURE

The introduction of a new technique, procedure or technology into clinical practice should be preceded by training of professionals, with the need to develop programs designed for this purpose. In 2003 a proposal was published for training nurses working in emergency units in the use of US for the direction of peripheral intravenous punctures performed in patients with difficult peripheral venous access. This training consisted of theoretical and practical concepts in order to qualify the professionals for the use of ultrasonography[19]. A study developed in the United States of America exemplifies the process of training of nurses working in emergency units in the US use. The author indicates the training with two hours, being a 45-minute lecture on the principles of the physics of US, vascular access techniques and illustrative videos on the insertion of catheters guided by imaging and 75 minutes to demonstrate the use of equipment and performance of the procedure on a phantom for the achievement of vascular punctures[4]. It is recommended that US is only performed by professionals who have undergone formal training. The prioritization of training, even if rapid and informal, in the principles of ultrasonography, ways to perform the technique and interpretation of images, provides significant benefit to health care, which results in the development of skills and the improvement of performance in obtaining and interpreting images[21].

The main difficulty demonstrated by nurses in the implementation of the method was the change in technique that the professional was accustomed to when performing vascular puncture. Nurses reported the need to develop hand-eye coordination, as with the use of US the puncture is no longer carried out looking at the site of catheter insertion, but at the equipment monitor, resulting in the need to perform the procedure many times to acquire the ability[18]. A study on the use of US by nurses, found that they report a decrease in perceived difficulty in obtaining peripheral intravenous access guided by US, when they become accustomed to using this new technology in practical care. Professionals stated that after familiarization with the equipment and performing of the technique, both for visualization of the venous network, and for catheterization, the use of US occurred in a quick and easy way[18].

The American College of Emergency Physicians proposes a training model for use in US in the training of emergency specialist professionals. The method consists of learning the basics of US and the acquisition and interpretation of 25 ultrasonographic images documented and validated by an experienced professional, with duration ranging from one to two days. They emphasize that training, often, cannot be defined with numerical targets, as some professionals can acquire theoretical knowledge to a greater or lesser ease and the acquisition of technical skills also varies among professionals, requiring individual analysis of the acquisition of competence to perform intervention autonomously[22].

CONCLUSION

The use of US for peripheral vascular puncture guidance characterizes an innovation in nursing practice. The educational strategy proposal was essential to promote the training of the professionals for the autonomous use of this technology in their practice. Educational programs should include themes related to anatomy, physiology, physics principles and vascular images interpretation, as well as skill in operating the equipment. The use of ultrasonography for obtaining intravascular access is a technique that aims to improve the performance of nurses and promote the safety of the patient submitted to intravascular therapy. Prospective, randomized and controlled studies are being conducted by the research group for the analysis of results from the introduction of US in peripheral vascular puncture performed by nurses, to promote innovative nursing practices based on evidence.

Acknowledgments: CNPq, for promoting the project entitled "Study of interventions and technology applied to nursing care to promotion of safety of patient submitted to intravascular therapy", process no. 476295/2004-1 of the Research Group - SEGTEC - Safety & Technology.

REFERENCES

1. Peterlini MAS, Chaud MN. Órfãos de terapia medicamentosa: a administração de medicamentos por via intravenosa em crianças hospitalizadas. Rev Latinoam Enferm. 2003;11(1):88-95.
2. Machado AF, Pedreira MLG, Chaud MN. Estudo prospectivo, randomizado e controlado sobre o tempo de permanência de cateteres venosos periféricos em crianças, segundo três tipos de curativos. Rev Latinoam Enferm. 2005;13(3):291-8.
3. Weinstein SM. Plumer's principles and practice of intravenous therapy. 5th ed. Philadelphia: J.B. Lippincott; 1993. 663p.
4. Blaivas M. Ultrasound-guided peripheral i.v. insertion in the ED. Am J Nurs. 2005;105(10):54-7.
5. Tibbles CD, Porcaro W. Procedural applications of ultrasound. Emerg Med Clin North Am. 2004;22(3):797-815. Review.
6. Constantino TG, Parikh AK, Satz WA, Fojtik JP. Ultrasonography-guided peripheral intravenous access versus traditional approaches in patients with difficult intravenous access. Ann Emerg Med. 2005;46(5):456-61.
7. Abboud PA, Kendall JL. Ultrasound guidance for vascular access. Emerg Med Clin North Am. 2004;22(3):749-73. Review.
8. Calvert N, Hind D, McWilliams R, Davidson A, Beverley CA, Thomas SM. Ultrasound for central venous cannulation: economic evaluation of cost-effectiveness. Anaesthesia. 2004;59(11):1116-20. Review.
9. National Institute for Clinical Excellence – NICE. Guidance on the use of ultrasound locating devices for placing central venous catheters. 2002 .Technology Appraisal Guidance No. 49. September, 2002.[cited 2010 Apr 20]. Available from: http://www.nice.org.uk/nicemedia/live/11474/32462/32462.pdf.
10. Moraes D. Análise espectral de fluxo arterial. In: Zwiebel WJ, editor. Introdução à ultra-sonografia vascular. 3ª ed. Rio de Janeiro: Revinter; 1996. p. 7-19.
11. Nichols I, Doellman D. Pediatric peripherally inserted central catheter placement: application of ultrasound technology. J Infus Nurs. 2007;30(6):351-6.
12. Hornsby S, Matter K, Beets B, Casey S, Kokotis K. Cost losses associated with the "PICC, stick, and run team" concept. J Infus Nurs. 2005;28(1):45-53.
13. Royer T. Nurse-driven interventional technology. A cost and benefit perspective. J Infus Nurs. 2001;24(5):326-31.
14. Donaldson JS, Morello FP, Junewick JJ, O'Donovan JC, Lim-Dunham J. Peripherally inserted central venous catheters: US-guided vascular access in pediatric patients. Radiology. 1995;197(2):542-4.
15. Doellman D. Pharmacological versus nonpharmacological techniques in reducing venipuncture psychological trauma in pediatric patients. J Infus Nurs. 2003;26(2):103-9.
16. Calvert N, Hind D, McWilliams RG, Thomas SM, Beverley C, Davidson A. The effectiveness and cost-effectiveness of ultrasound locating devices for central venous access: a systematic review and economic evaluation. Health Technol Assess. 2003;7(12):1-84.
17. Brannam L, Blaivas M, Lyon M, Flake M. Emergency nurses' utilization of ultrasound guidance for placement of peripheral intravenous lines in difficult-access patients. Acad Emerg Med. 2004;11(12):1361-3.
18. Blaivas M, Lyon M. The effect of ultrasound guidance on the perceived difficulty of emergency nurse-obtained peripheral IV access. J Emerg Med. 2006;31(4):407-10.
19. Blaivas M, Brannam L, Fernandez E. Short-axis versus long-axis approaches for teaching ultrasound-guided vascular access on a new inanimate model. Acad Emerg Med. 2003;10(12):1307-11.
20. Pedreira MLG, Peterlini MAS, Pettengill MAM. Ultrasonografia na punção intravenosa periférica: inovando a prática de enfermagem para promover a segurança do paciente. Acta Paul Enferm. 2008;21(4):667-9.
21. WHO – World Health Organization. Training in Diagnostic Ultrasound: Essentials, principles and standards.Genebra: WHO; 1998. 52 p. [Report of a WHO Study Group Technical Report Series, No 875].
22. Atkinson P, Boyle A, Robinson S, Campbell-Hewson G. Should ultrasound guidance be used for central venous catheterisation in the emergency department? Emerg Med J. 2005;22(3):158-64. Review.