Educational intervention to improve management of totally implanted vascular access device

Intervenção educativa para melhorar o manejo do dispositivo de acesso vascular totalmente implantado

Intervención educativa para mejorar el manejo del dispositivo de acceso vascular totalmente implantado

Nayara Narley Pires Vieira[1] https://orcid.org/0000-0002-8860-4073
Christiane Inocêncio Vasques[1] https://orcid.org/0000-0001-9586-9486
Paula Elaine Diniz dos Reis[1] https://orcid.org/0000-0002-9782-3366
Marcia Aparecida Ciol[2] https://orcid.org/0000-0001-6406-4706

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Corresponding author
Nayara Narley Pires Vieira
E-mail: nayaranarley@gmail.com

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Bartira de Aguiar Roza
(https://orcid.org/0000-0002-6445-6846)
Escola Paulista de Enfermagem, Universidade Federal de São Paulo, São Paulo, SP, Brasil.

Abstract

Objective: To evaluate the effect of an educational intervention for nurses to increase knowledge and practical skills of management of totally implanted vascular access devices.

Methods: A quasi-experimental study conducted in a teaching hospital. The intervention included exposure to a manual of procedures followed by a theoretical-practical training seven days later. Eighty-one nurses were evaluated at baseline, after self-exposure to the manual, and after receiving the theoretical-practical training. Participants were evaluated on their knowledge and practical skills of totally implanted vascular access device management. Descriptive statistics were performed for all variables. Paired t test was used to examine whether the mean score changed from the baseline to first and second assessments of knowledge, access, de-access and maintenance of catheter. Significance level was set to 0.05.

Results: Mean increases in scores after nurses were exposed to the manual were: 18.2 points for knowledge, 16.5 points for access technique, 15.5 for de-access technique, and 24.2 for catheter maintenance technique. After the theoretical-practical training, we observed a mean increase of 4.2 points for access, 3.9 for de-access and 4.2 for catheter maintenance.

Conclusion: The educational intervention for nurses increased mean scores of knowledge and practical skills. At the end of the intervention, 75% of the nurses reached at least 33 points out of 38 for knowledge, and 77%, 77%, and 78% had perfect scores for access, de-access, and maintenance, respectively. The educational intervention was effective in improving knowledge and practical skills for management of totally implanted vascular access devices.

Resumo

Objetivo: Avaliar o efeito de uma intervenção educativa para enfermeiros para aumentar o conhecimento e as habilidades práticas de manejo de dispositivos de acesso vascular totalmente implantados.

Métodos: Estudo quase-experimental realizado em um hospital universitário. A intervenção incluiu exposição a um manual de procedimentos seguida de treinamento teórico-prático sete dias depois. Oitenta e um enfermeiros foram avaliados no início do estudo, após autoexposição ao manual e após receberem treinamento teórico-prático. Os participantes foram avaliados quanto ao seu conhecimento e habilidades práticas no gerenciamento de dispositivos de acesso vascular totalmente implantados. Estatísticas descritivas foram realizadas para todas as variáveis. O teste t pareado foi utilizado para examinar se a pontuação média mudou desde a linha de base até a primeira e segunda avaliações de conhecimento, acesso, desacesso e manutenção do cateter. O nível de significância foi definido como 0,05.

[1]University of Brasília, Brasília, DF, Brazil.
[2]University of Washington, Seattle, WA, USA.
Conflicts to interest: none to declare.

Resultados: Os aumentos médios nas pontuações após a exposição dos enfermeiros ao manual foram de 18,2 pontos para conhecimento, com 16,5 pontos para técnica de acesso, 15,5 para técnica de desacesso e 24,2 para técnica de manutenção do cateter. Após o treinamento teórico-prático, observamos aumento médio de 4,2 pontos para acesso, com 3,9 para desacesso e 4,2 para manutenção do cateter.

Conclusão: A intervenção educativa para enfermeiros aumentou os escores médios de conhecimentos e habilidades práticas. Ao final da intervenção, 75% dos enfermeiros atingiram pelo menos 33 pontos de 38 para conhecimento e 77%, 77% e 78% obtiveram escores perfeitos para acesso, desacesso e manutenção, respectivamente. A intervenção educativa foi eficaz na melhoria do conhecimento e das habilidades práticas para manejo de dispositivos de acesso vascular totalmente implantados.

Resumen

Objetivo: Evaluar el efecto de una intervención educativa para enfermeros para aumentar los conocimientos y las habilidades prácticas de manejo de dispositivos de acceso vascular totalmente implantados.

Métodos: Estudio cuasi experimental realizado en un hospital universitario. La intervención incluyó la exposición a un manual de procedimientos, seguida de una capacitación teórico-práctica siete días después. Se evaluó a 81 enfermeros al comienzo del estudio, después de la autoexposición al manual y después de recibir la capacitación teórico-práctica. Los participantes fueron evaluados respecto a sus conocimientos y habilidades prácticas en la gestión de dispositivos de acceso vascular totalmente implantados. Se realizaron estadísticas descriptivas para todas las variables. Se utilizó el test-t pareado para examinar si el puntaje promedio cambió desde la línea basal hasta la primera y segunda evaluación de conocimientos, acceso, desacceso y mantenimiento del catéter. El nivel de significación fue definido como 0,05.

Resultados: El aumento promedio de los puntajes después de la exposición de los enfermeros al manual fue de 18,2 puntos en el conocimiento, con 16,5 puntos en la técnica de acceso, 15,5 en la técnica de desacceso y 24,2 en la técnica de mantenimiento del catéter. Después de la capacitación teórico-práctica, observamos un aumento promedio de 4,2 en el acceso, 3,9 en el desacceso y 4,2 en el mantenimiento del catéter.

Conclusión: La intervención educativa para enfermeros aumentó el puntaje promedio de conocimientos y habilidades prácticas. Al final de la intervención, el 75 % de los enfermeros alcanzó por lo menos 33 puntos de 38 en el conocimiento y el 77 % obtuvo puntaje perfecto en el acceso y en el desacceso y el 78 % en el mantenimiento. La intervención educativa fue eficaz en la mejora de los conocimientos y habilidades prácticas para el manejo de dispositivos de acceso vascular totalmente implantados.

Introduction

Totally implanted vascular access devices (TIVAD) are commonly used in cancer therapy. TIVAD is safe for chemotherapy infusion, parenteral nutrition, blood transfusion, and allows for less traumatic blood withdraw in cancer patients.[1,2] TIVAD facilitates the clinical management of these patients, but catheter-related complications, such as infections, occlusions and mechanical issues, extravasation, and venous thrombosis are frequent. Nurses play a key role in preventing the majority of these complications. For this reason, it is important that nurses are trained in a precise and standardized way in the management of TIVAD.[3,4]

Nurses involved in management of TIVAD need to have theoretical knowledge and practical skills to maintain the catheter patency and to use techniques that help preventing catheter-related complications. In a qualitative study carried out among nurses who worked in units that provided care for cancer patients with TIVAD in a teaching hospital in Brazil, the results showed a large deficit of knowledge about management of TIVAD. Deficits included lack of knowledge of access, de-access and maintenance techniques, as well as of recommendations for use of TIVAD, management of complications, and correct doses of heparin solution.[5]

The use of manuals in professional training of nurses has been considered as a good educational strategy to increase knowledge and practical skills.[6-8] The construction, validation and use of educational manuals have been relevant for training nurses in different areas.[8-10] Manuals also consists of an important tool to improve the compliance of actions implemented to maintain TIVAD.[11] Therefore, a manual of procedures about the management of TIVAD was developed.

A more recent approach to increase knowledge is to teach clinical procedures and techniques using a patient simulator. Lately, simulation-based training has increased in the nursing field as it provides a safe learning environment for both students and professionals without posing risk to human patients. Studies have shown that simulation-based training is effective in increasing knowledge and developing practical skills among health professionals.[12-14]

Clinical simulation is defined as a practical clinical activity or event replicated through scenarios, high- or medium-fidelity mannequins, standardized patients,

skills stations, or computerized critical-thinking simulations. Thus, clinical simulation is a teaching and learning modality that imitates real clinical situations, allowing the leaner to experience simple or complex situations in safe environments, before using the skills in human beings. Simulation is not limited to train only students, but can also be used to introduce new skills to professional nurses.[15,16] It has been shown that simulation allows for a better understanding of the practical steps of a procedure, allowing improvement of skills in practical performance and elucidation of questions that may arise in the real clinical scenario. Simulation helps professionals to gain more confidence during their work, and therefore, is an important strategy for training health professionals.[17]

According to the environment where it is performed, clinical simulation can be classified in three modalities. When simulation occurs outside the health environment, it is called off-site. When carried out in a health environment, but outside the unit where care will be applied, as for example in a classroom or simulation center, it is called intra-hospital care. Finally, when simulation is performed directly in the health unit or sector where nursing care is provided, it is called *in situ* simulation.[18]

Depending on the purpose of the simulation, mannequins or simulators can be used. Low-fidelity models are static mannequins without interaction or responses, which can represent the entire or a partial human body, allowing gross movements. Simulators that allow a greater proximity to reality such as, for example, those that represent respiratory and heart sounds, are considered of medium-fidelity. High-fidelity models are realistic, more expensive and represent the human body, with similarities in appearance, feelings and responses to care.[19,20] In some situations, it is possible to use scenic simulation, a modality that use simulated patients (actors), or standardized patients, who are members of the group who agree to assume the role of patient for a learning activity.[18,20]

The use of clinical simulation in teaching allows the student or professional to have the opportunity to practice a certain procedure several times, applying the theoretical knowledge learned before direct contact with the patient. Furthermore, this strategy offers immediate constructive feedback on their performances. Thus, clinical simulation techniques are important to promote the development of practical skills.[17]

The aim of this study was to evaluate the effect of an educational intervention for nurses to increase knowledge and practical skills of management of totally implanted vascular access devices.

Methods

This was a quasi-experimental study performed in a teaching hospital in Brazil. A sample of nurses were evaluated before and after receiving the educational intervention. Each individual was his/her own control. The intervention had two educational components: a manual titled "Management of totally implanted catheter: manual of procedures", and a theoretical-practical seminar using a medium-fidelity patient simulator. The manual was elaborated and validated in previous studies[5,6] and contains information about indications and counter-indications of the TIVAD, the most frequent catheter-related complications and how to prevent them, and step-by-step techniques for access, de-access and maintenance of the catheter. The manual was based on evidence from the literature and was validated by the target nurse audience for appearance and content, as well as for semantics.[6] The seminar covered the content of the manual and was ministered by the first author (NNPV), using slides in Microsoft PowerPoint. After the presentation, the procedures were demonstrated in a medium-fidelity simulator by the second author (Chester Chest, Civiam, which has a TIVAD in the left hemithorax).

All nurses who worked at the hospital in the medical and surgical clinics (except for pediatrics and gynecology/obstetrics), emergency room, and outpatient oncology unit were invited to participate in the study. We chose these clinics because their nurses have a high likelihood to provide care to patients with TIVAD. Nurses who were specialists on oncology were not included in the study, since they receive training specifically for catheter management during their specialization program, and

therefore, could bias the assessment of the effect of the educational intervention. Nurses who agreed to participate in the study signed an informed consent after receiving a detailed explanation of the study procedures.

Initially, we would like to compare the effect of the procedure manual versus the theoretical-practical training in a medium-fidelity patient simulator in the acquisition of knowledge about catheter management. However, this design could lead to contamination across groups, since overtime, nurses in the clinic could exchange information through conversations or sharing of the manual. Therefore, we opted to conduct a quasi-experimental study, where everyone was first exposed to the procedure manual, followed by the theoretical-practical training with simulation.

Participants were evaluated at three points in time: baseline assessment (prior to any intervention), first assessment (seven days later, after self-exposure to the manual and before exposure to theoretical-practical training in a patient simulator), and second assessment (after exposure to the theoretical-practical training in a patient simulator). The first and second assessment occurred in the same day.

After the baseline assessment, the nurses received a 32-page illustrated manual, providing information about TIVAD, including indications and counter-indications, catheter-related complications and how to prevent them, and step-by-step techniques for access, de-access and maintenance of the catheter. Participants were encouraged to study the manual during a seven-day period, which has been shown in other studies to be a sufficient time to evaluate knowledge retention.[21-23] Then, they were asked to return for the first assessment followed by a theoretical-practical training on TIVAD management using a medium-fidelity patient simulator. The training session lasted one hour and included a seminar covering the theoretical material from the manual, followed by a practical demonstration (by the second author) of the proper techniques for access, de-access and catheter maintenance, using the simulator. Immediately after the training session, the second assessment was performed. All interventions and outcome assessments were applied in a private room.

At baseline, first and second assessments, we evaluated the participants regarding their knowledge and practical skills about management of TIVAD. Knowledge was assessed using a self-administered instrument that we developed based on the manual. It consisted of 38 statements and after reading them, the individual chose one of three categories: true, false, or don't not know the answer. For each correct choice, the person received one point, for a possible total of 38 points.

Participants were also evaluated on their practical skills, through a clinical simulation where the professional was presented with a scenario using a medium-fidelity simulator representing a patient with TIVAD. Several situations were presented by the researcher to the professional, including: 1) the patient would need a puncture, during a possible hospitalization or for drug infusion in outpatient care; 2) patient would be discharged and would need to have the needle removed and; 3) the catheter needed maintenance in the oncology outpatient unit. According to the situation presented, the professional described how he would proceed and demonstrated the techniques of catheter access, de-access, and maintenance using the patient simulator. The participants were evaluated regarding correct use of clothing, materials for each procedure, step-by-step sequence of each procedure, and recording of the provided care.

Participants were supposed to follow the exact steps prescribed in the manual. One of the investigators (NNPV) observed the demonstration and, for each step, assigned a value of 1 if the person executed the step properly, and 0 if they executed incorrectly or forgot to execute it. Participants received a score of zero if they declined to demonstrate their practical skills (usually because they thought they were not able to perform the skill correctly). For each technique, the total number of correctly executed steps was the final score (27 points for access technique, 23 for de-access, and 32 for maintenance technique). To assess improvement, we calculated the changes from baseline to the first and to the second assessments for each one

of the four outcomes described above (knowledge, techniques of catheter access, de-access, and maintenance using the patient simulator).

The instruments for assessing knowledge and practical skills were evaluated by three specialists in the field of oncology nursing. The experts were invited by e-mail, where the objectives of these instruments were explained. After reading the instruments, the experts responded to the e-mail with the suggestions, which were incorporated into the knowledge assessment instrument. Most of the suggestions were to reformulate the writing of some items to avoid doubts of interpretation by the readers. Other suggestions were related to spelling corrections. In addition, the reorganization of some items according to the evaluation subgroup was also suggested. There was no modification for the practical skills assessment instrument, as the evaluative items followed exactly the step-by-step procedures for managing the TIVAD, as described in the manual delivered to the participants.

We collected the following information from each participant: age in years, sex, time since graduating from nursing school in years, working environment (surgical clinic, medical clinic, emergency department, oncology outpatient clinic), time working in the hospital in years, whether the person had worked with oncology patients in the past (yes or no), time working with oncology patients in years, whether they had received training in catheter management in the past (yes or no), and self-report level of knowledge about catheter management (none, partial, or complete).

Descriptive statistics were performed for all variables. Visual displays of individual data were plotted. Paired t test was used to test the changes in mean score from the baseline to first and second assessments of knowledge, access, de-access and maintenance of catheter. The t test is a robust test even when the data is not normally distributed but the distribution is symmetric. Graphs of the individuals differences in scores (not shown here) were reasonably symmetric. Since the main objective of the study was to demonstrate whether improvement in knowledge could be achieved regardless of the initial level of knowledge, the individuals who had a zero score at the baseline were not excluded from the analysis. Significance level was set to 0.05. Analyses were performed with SPSS (IBM, 2017), version 25 for Mac, and figures were created with RStudio (RStudio Team, 2015).

The study was approved by a Committee of Ethics in Research of the School of Medicine of the University of Brasilia (approval n. 047/2012).

Results

Ninety-one nurses were invited to participate in the study. Four nurses had specialization in oncology and were excluded and six did not return for the first or second assessments. The final sample consisted of 81 nurses. The sociodemographic characteristics of the participants are shown in table 1. The nurses were relatively young (mean age = 32.1 years old, standard deviation [SD] = 5.6) and with a mean professional experience of 7 years (SD = 4.5). The majority was female (80%), had never worked with cancer patients on previous jobs (85%), and had never received training for management of TIVAD (95%). Regarding the workplace within the hospital, 48% of nurses worked in the medical clinic ward, 41% in the emergency room, 7% in the surgical clinic ward and 4% in the oncology outpatient clinic. All nurses reported that their level of knowledge of catheter management was none or partial.

Table 2 shows the mean score of knowledge about catheter management at baseline, first, and second assessments, and mean changes in scores from baseline to first and to second assessments. Knowledge at baseline was fairly low (mean 12.1 points, SD = 6.1) reflecting knowledge of about 32% of the 38 questions. From baseline, mean score increased in 18 points after the nurses were exposed to the procedure manual (first assessment), an increase of 48% in the number of correct answers. A smaller increase (3.5 points) was observed from the first to the second assessment (representing the knowledge added by the theoretical-practical training in the simulator). There was a statistically significant difference in the mean score of knowledge between

Table 1. Sociodemographic characteristics of participants

Sociodemographic characteristics (n=81)	Mean(SD) or n(%)
Age in years, mean (SD)	32.1(5.6)
Median (Min., Max.)	30(24, 49)
Professional experience in years, mean (SD)	7.0(4.5)
Median (Min., Max.)	6(0.7, 25)
Sex, % (n)	
Male	16(20)
Female	65(80)
Time worked with cancer patients in previous work position, % (n)	
Never worked	85(69)
Less than 1 year	5(4)
From 1 to 5 years	9(7)
From 6 to 10 years	1(1)
Received training in catheter management in the past, % (n)	
No	95(77)
Yes	5(4)
Self-report level of knowledge about catheter management, % (n)	
None	52(42)
Partial	48(39)
Complete	0(0)
Working environmental, % (n)	
Medical clinic	48(39)
Emergency department	41(33)
Surgical clinic	7(6)
Oncology outpatient clinic	4(3)
Time working in the hospital in years, mean (SD)	3(1.4)
Median (Min., Max.)	3(1, 5)

*SD - Standard Deviation

the baseline and the first assessments (t = 23.4, p < 0.001, 95% Confidence Interval [CI]: 16.6 – 19.7), and between the first and second assessments (t = 9.1, p < 0.001, 95% CI: 2.7 – 4.2).

Table 2. Mean score of knowledge and changes from baseline to first and second assessments

Knowledge Assessment (n = 81)	Mean (SD*)	Median (Min., Max.)	t**	CI 95%	p-value
Baseline	12.1 (6.1)	12 (2, 26)	-	-	-
First assessment	30.3 (4.3)	31 (18, 37)	-	-	-
Second assessment	33.8 (2.3)	34 (25, 38)	-	-	-
Change from					
Baseline to first assessment	18.2 (6.9)	-	23.4	16.6 - 19.7	<0.001
First to second assessment	3.5 (3.4)	-	9.1	2.7 - 4.2	<0.001

Figure 1 shows the trajectory of the knowledge and practical skills scores by each individual at each assessment time. On the knowledge score, most individuals had score of 20 or less at baseline, and almost all of them had increases in score at the first assessment. Gains from first to second assessment (representing the addition of the theoretical-practical training) were modest, partially because the nurses were already showing high levels of knowledge after being exposed to the procedure manual. For the practical skills at baseline, 49 (60.5%) individuals had a score of 0 for all techniques assessed (given that they had no previous knowledge or practice related to the TIVAD and felt that they could not perform the skills in the simulator) while the other 32 (39.5%) individuals presented a large variation in scores. From baseline to first assessment, individuals showed great improvement for access and maintenance techniques, but less improvement for de-access. Gains from first to second assessment (representing the addition of the theoretical-practical training) were larger for de-access technique, while they were smaller for the access and maintenance techniques, mostly because the individuals already had high scores at first assessment. At the second assessment, participants had high scores in all techniques, with 75% of the nurses reaching at least 33 points out of 38 for knowledge, and 77%, 77%, and 78% with perfect scores for access, de-access, and maintenance, respectively.

Table 3 shows the mean and median scores of the three assessed practical skills by time, as well as the t tests results and a confidence interval of 95% for the difference in means. At baseline the mean score in the access was 6 points (22% correct); 3.3 points for de-access (14% correct) and 3.2 points for maintenance (10% correct). At baseline, 49 (60.5%) individuals received a score of zero because they did not feel that they could perform the practical skills in the simulator. In the first assessment the mean score in the access was 22.4 points (82.9% correct); 18.8 points for de-access (81.7% correct,) and 27.4 points for maintenance (85.6% correct). After the theoretical-practical training in the simulator, the mean scores in the second assessment were 26.6 points for access (98.5% correct); 22.7 points for de-access (98.6% correct) and 31.6 points for maintenance (98.7% correct). The mean change scores from baseline to first assessment were statistically different from zero for access (16.5 [8.4], p < 0.001), de-access (18.8 [3.8], p < 0.001), and maintenance (24.2 [4.4], p < 0.001). Mean changes from first to second assessment were statistically different from zero for access (4.2 [3.1], p < 0.001),

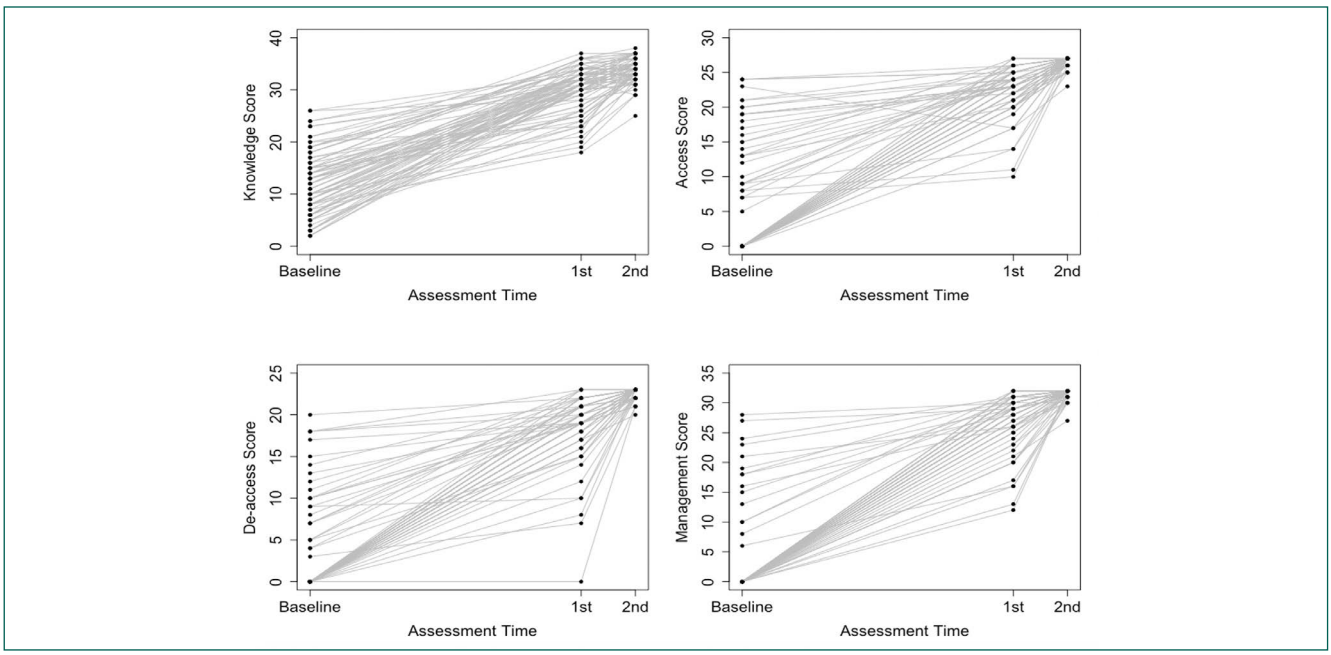

Figure 1. Individual scores for knowledge, access, de-access, and maintenance of catheter at baseline (prior to exposure to procedure manual), 1st assessment (seven days after baseline), and 2nd assessment (immediately after theoretical-practical training). The distance between 1st and 2nd assessments in the x-axis is smaller than between baseline and 1st assessment, to reflect that there was only about one hour between the two later assessments. Points may represent observations for several individuals

de-access (3.9 [3.6], $p < 0.001$), and maintenance (4.1 [4.1], $p < 0.001$).

Discussion

Nurses play a primary role on the catheter management, since they are the professionals responsible for all the care related to maintenance of catheter patency and to apply procedures that help preventing catheter-related complications after its insertion. Therefore, nurses need to update their knowledge and constantly maintain technical competence to provide effective care, help ensure comfort, and reduce risks of complications in persons with TIVAD.[24]

This study aimed to evaluate the effect of an educational intervention to increase the knowledge of nurses about the management of TIVAD and to improve their practical skills to perform access, de-access and catheter maintenance techniques. At baseline, the nurses had a higher mean score of knowledge about TIVAD than the mean score of practical skills for the access, de-access and catheter maintenance technique, showing the need for

Table 3. Mean scores of practical skills according to the techniques, and changes from baseline to first and second assessments

Practical Skills Assessments (n=81)	Practical Skills Scores				
	Mean (SD)	Median (Min., Max.)	t**	p-value	95% CI***
Access					
Baseline *	6.0 (8.2)	0 (0, 24)	-	-	-
First assessment	22.4 (3.3)	23 (10,27)	-	-	-
Second assessment	26.6 (0.7)	27 (23, 27)			
Change from					
Baseline to first assessment	16.5 (8.4)	-	17.7	0.001	14.6 - 18.3
First to second assessment	4.2 (3.1)	-	12.2	0.001	3.5 - 4.9
De-access					
Baseline *	3.3 (5.6)	0 (0, 20)	-	-	-
First assessment	18.8 (3.8)	20 (0, 23)	-	-	-
Second assessment	22.7 (0.6)	23 (20, 23)	-	-	-
Change from					
Baseline to first assessment	15.5 (6.1)	-	22.5	0.001	14.1 - 16.8
First to second assessment	3.9 (3.6)	-	9.7	0.001	3.1 - 4.7
Maintenance					
Baseline *	3.2 (7.3)	0 (0, 28)	-	-	-
First assessment	27.4 (4.4)	29 (12, 32)	-	-	-
Second assessment	31.6 (0.8)	32 (27, 32)	-	-	-
Change from					
Baseline to first assessment	24.2 (7.8)	-	27.8	0.001	22.5 – 26.0
First to second assessment	4.2 (4.1)	-	9.2	0.001	3.3 - 5.1

*Forty-nine individuals received a score of zero at baseline for the skill assessment because they did not feel confident to perform it; * From paired t test; ***CI - Confidence Interval

improvement in the practical skills. This could be explained by the fact that most nursing undergraduate programs do not cover procedures to manage central venous catheters and as a result, the nurses are not sufficiently trained to deal with TIVAD when they begin their professional life.[25-27] It is not reasonable to assume that the nurses will acquire the needed knowledge and skills on the job, because this acquisition depends on of many variables, such as, for example, the length of time a nurse worked at the hospital, the existence of discussion groups that address new procedures, and having senior staff that can pass the knowledge to junior staff.[24] Therefore, it is expected that nurses who did not specialized in oncology present lower scores when evaluated regarding the knowledge and practical skills to perform the catheter management techniques, even if they are working in clinical practice.

In this study, the percentage of accuracy of practical skills were always smaller at the than of knowledge at the baseline. These low mean values were mostly due to scores of zero that were attributed to 49 individuals who did not feel competent enough to perform some or all of the management techniques, since they had never manipulated this type of catheter. Some of those participants performed access and de-access techniques but could not demonstrate the maintenance procedure, lowering the mean scores at baseline. The inability to perform the practical skills procedures did not mean necessarily that the nurses were not knowledgeable, but that they were not confident in performing those tasks. However, those nurses are working in units where these techniques are constantly needed for patient care and highlights the importance of their continuing education and training.

There are a few studies that addressed the deficiency in knowledge about management of TIVAD among oncology nurses. Sharour[27] showed that the more specialized the nurse is, the better is his/her level of knowledge. However, the author points out that nurse professionals might have limited time and lack of resources to identify recent studies that can contribute to increased knowledge. Therefore, continuing education is a means to keep these nurses up to date on their skills, especially for nurses who work with oncologic patients but did not have specialization or residency in this area.

Fonseca and colleagues[28] designed a protocol for care of catheters, jointly with nurses from the chemotherapy department of a Unit of High Complexity in Oncology. The active participation of the nurses can lead to protocols that address the needs of the nurses and to a higher adherence to the recommended protocols. In this study, the validated manual that directed the educational intervention was also a product of needs previously identified.[5,6]

Sharour and colleagues[29] tested an educational program in oncology nurses with theoretical and practical presentations on management of TIVAD. Nurses' knowledge and practical skills improved after receiving the educational program. This and other studies demonstrate the benefits of continuing education through educational programs.[11,24,30]

Compared to baseline, we observed that the exposure to the procedure manual considerably increased both the knowledge and the practical skills of nurses, especially regarding the catheter maintenance technique, even without the additional skills training. The large increase in maintenance skills might have occurred because the nurses' initial scores were very low. Most of them worked in inpatients settings where only the access and de-access techniques were executed, and for this reason, may not have previous experience with the catheter maintenance technique, which is usually performed in outpatient settings.

Our written material was presented via illustrations and detailed step-by-step procedures, which have been shown to make these type of material more attractive to the reader, with more adherend to the protocol and better outcomes.[31,32] The low cost of the manual and its availability in digital form allows for easy use by the professionals and in continuing education programs.[8,30,33]

Several studies evaluated written material, in manual form, that showed improvement in knowledge and practice when used. Among them, we can cite an educational manual for management of TIVAD,[30] a manual of procedures for medical residents during clinical cases that required quick

thinking and intervention,[34] a pocket-book guide to physical exam procedure for medical students,[35] and a manual of procedures in an emergency situation in a preoperatory unit written for the anesthesiology teams.[36]

In our study, the manual presented step-by-step procedures, and this might have contributed to the high increase in scores from baseline to the first assessment. The manual was written to address recurrent questions from the professionals, taking into account the work routine of the institution, and was advertised in the internal electronic systems and distributed in printed form to the relevant sectors of the institution.

Compared to the first assessment, the second assessment showed the effect of the theoretical-practical training in a medium-fidelity simulator in nurses that had already been exposed to the procedure manual. We observed that the theoretical-practical training increased, on average, 3.5 points in the mean score of knowledge, and about 4 points in the mean score of each one of the techniques evaluated. The scores obtained by the nurses after the exposure to the manual were close to the maximum possible score, and therefore, only a small increase was possible after exposure to the simulator training (a ceiling effect).

When compared to traditional educational methods, simulation has been shown to be effective as an educational tool for nursing students by itself,[37] or in combination with other methods.[38] Simulation results in good increase in knowledge and a high level of satisfaction, self-confidence, motivation, and sense of safety when perfroming in practice.[17,39-41] A randomized trial comparing the effectivity of seminar presentations versus simulation to capacitate nursing students to perform procedures to prevent infection related to TIVAD, showed no difference between the two groups in theoretical knowledge.[11] However, the group exposed to simulation had better practical performance. Other studies have corroborate that result[38,39,41] however, simulation equipment is expensive,[11,41] and the training needs to be given in small groups, requiring the availability of the professional in specified times. These factors might be hindrances to a larger dissemination of the simulation methodology.

While the capacitation of nursing professionals using manuals can provide theoretical knowledge, the simulation can add self-confidence to the professional and a layer of safety to the patient. The cost of simulation is high for certain institutions, but a cost-benefit analysis could be done in order to establish if the cost of equipment and of personnel is higher or lower than the cost of catheter-related adverse events, such as infections and loss of catheters, for example.

This study has some limitations. We cannot separate the effects of the exposure to the procedure manual from the theoretical-practical training. To achieve that, we would need to randomize nurses to receive one or the other and the chance of contamination among the two groups would be very high in our setting. A second limitation is that the retention of knowledge and practical skills by the participants was not evaluated in our study.

Some authors have demonstrated that after three months of receiving simulation training, there might be a decline in the knowledge and practical skills acquired during intervention.[42-45] Also, knowledge may decline drastically after six months to one year post-training.[45-48] In addition, a study has found that combining theoretical content with simulation seems to maintain the professional self-confidence for longer periods of time.[44]

We believe that continuing education programs are important and could be designed to provide annual training combining theoretical presentations with simulation in order to maintain the nurse team updated on the techniques for care of patients who have TIVAD. In addition, the manual should be updated regularly and be easily available to the nursing personnel for consultation any time it is deemed necessary.

Despite the limitations, our study makes important contributions to the field. We showed that simply having access to a procedure manual improves nurse knowledge and some practical skills for the care of individuals with TIVAD. Additionally, it is a very low-cost strategy that can be implemented in services that do not have a nurse training center

with high fidelity resources, as for example, patient simulators.

Conclusion

The exposure to the manual of procedures significantly increased the score of knowledge and practical skills of the nurses. The combination of being exposed to the manual and the theoretical-practical training in simulator improved the participants' scores of knowledge and practical skills. The educational intervention evaluated in this study has a relative low cost and is easy to implement, especially the manual of procedures, which alone is an important tool that can be made easily available in a hospital intranet. The study also suggests that there is a need for continuing education programs, especially when nurses have not received previous training but are required to care for patients with specific needs, such as those who have a TIVAD.

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Collaborations

Vieira NNP, Vasques CI, Reis PED and Ciol MA contributed to the design of the study, analysis and interpretation of data, writing of the article, relevant critical review of the intellectual content and approval of the final version to be published.

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