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## Effect of educational hypermedia on peripheral venous puncture in nursing knowledge: a quasi-experimental study

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### ABSTRACT

**Aim:** to evaluate the knowledge of the nursing team of a university hospital before and after the use of an educational hypermedia about the peripheral venous puncture. **Method:** a quasi-experimental study with 57 nursing professionals from a university hospital in the city of Fortaleza, Ceará. The previous knowledge and acquired knowledge were verified after the use of hypermedia available in the Solar Platform of the Federal University of Ceará. For statistical analysis, the binomial test and  $p < 0.05$  were used. **Results:** the correct answers were statistically significant in all post-test questions of nursing technicians and in 46.6% of nurses' post-test questions. In the questions where there was no statistical difference, the increase in the number of correct answers was observed. **Conclusion:** the effectiveness of hypermedia for the teaching of the nursing team indicates that it is a resource that can contribute to professional qualification on peripheral venous puncture.

**Descriptors:** Nursing; Catheterization, Peripheral; Educational Technology; Internet.

## INTRODUCTION

Intravenous therapy is widely used in the hospital setting, especially through the insertion of peripheral catheters<sup>(1)</sup>. Annual use of about 200 million catheters is estimated in the United States<sup>(2)</sup>.

The technical-scientific knowledge of the nursing team about intravenous therapy contributes to the effectiveness of the treatment and the quality of care provided<sup>(3)</sup>, which points to the need to identify scientifically proven technologies and practices involving the procedure and its teaching for this professional category, which is supported by educational objects<sup>(4)</sup>.

Among the educational technologies that enable the implementation of the teaching-learning process and which can be used in the teaching of peripheral venipuncture, educational hypermedia is constructed and validated by Frota<sup>(5)</sup>, who addresses several aspects related to the procedure (anatomy of the venous network, types of catheters, steps, possible complications and nursing care) so that it is pertinent to analyze the impact of the use of hypermedia in order to provide the scientific, academic and professional community with scientific support for its use, besides encouraging and providing support to future studies that compare it with other strategies/teaching tools. Para a prática de cuidados diários da equipe de enfermagem, esta pesquisa é pertinente por contribuir com a capacitação profissional. Thus, the present study aimed to evaluate the knowledge of professionals of the nursing team of a university hospital before and after the use of an educational hypermedia about peripheral venous puncture.

## METHOD

This is a quasi-experimental study carried out in a university hospital in the city of Fortaleza, Ceará, Brazil.

The study population was composed of professionals who participated in the training promoted by the hospital's continuing education service in the month of March 2015. The inclusion criteria were to be a hospital server and to be a nursing professional. The exclusion criterion was to be on leave, vacation or other leave scheduled for the following 15 days, which would make it impossible to participate in the next stages of the study. Thus, the convenience sample of the study consisted of 57 professionals, of which 28 were nurses and 29 were nursing technicians.

The verification of the previous knowledge (pre-test) and the knowledge acquired after the educational strategy (post-test) occurred in two face-to-face meetings, conducted with a 15-day interval, in the hospital auditorium. In the first meeting the presentation of the teaching strategy and the application of the pre-test was performed, followed by the hypermedia setting, through the virtual access.

During the 15 days after the first meeting, the professionals had free access to hypermedia in the Solar Platform of the Federal University of Ceará (<http://solarpresencial.virtual.ufc.br/>). The access occurred through individual registration with username and password to login.

In the hypermedia homepage, the professionals had access to the classes, organized in six modules, which are subdivided into topics. These are: Module 1: Introduction to peripheral venous puncture; Module 2: Anatomy of the venous network; Module 3: Peripheral venous puncture procedure; Module 4: Local

and systemic complications of PVP; Module 5: Peripheral venous puncture in special patients; and Module 6: PVP non-compliance actions.

After 15 days, the second meeting, in which the post-test was applied, occurred. The instrument was built based on the Infusion Nurses Society<sup>(6)</sup>, validated by three nurses with care experience in a hospital environment. It consisted of 26 items that included venous anatomy, material used, procedure steps and their possible complications. The questions that composed the instrument were classified in scores according to the Theory of Response to the Item of form. The score 1.0 was assigned to 10 questions, the score 1.5 was assigned to 11 questions and the score 2.0 to 9 questions.

Data were organized into a Microsoft Excel 2010 spreadsheet and analyzed by the Statistical Package for the Social Sciences (SPSS), version 20.0. The binomial test was used and values of  $p < 0.05$  and the 95% confidence interval were considered statistically significant.

The ethical aspects in research were respected, according to Resolution 466/12 of CONEP, with approval by the Ethics Committee of the Federal University of Ceará (protocol 666,368).

## RESULTS

The professionals' action time ranged from five to 20 years. The average hours worked weekly were 24 to 36 hours. As to the number of jobs, 38% had more than two jobs.

Regarding the four questions about skin anatomy, the improvement in the quantitative correct answers in the post-test was statistically significant in all questions for the nursing technicians and only in one of them for the nurses, as detailed in figure 1.

Regarding the material used in the procedure, of the four questions, three presented significance in the improvement of the correct answers by technicians and nurses. In the remaining question, the significance was found only in the technical category, as observed in figure 2.

The post testing accuracy of all questions regarding the stages of the peripheral venous puncture procedure was statistically significant for nursing technicians. For nurses, significance was found in nine questions, as observed in figure 3.

The three questions that addressed the complications related to the procedure had improvement of correct answers with statistical significance after the use of the educational technology by the technicians and the nurses, as shown in figure 4.

## DISCUSSION

The knowledge of the nursing team about intravenous therapy corroborates the quality of the care and the success of the treatment<sup>(7)</sup>. It is of fundamental importance the education of the health professionals on the indications for the use of intravascular catheter and the appropriate procedures for the insertion and maintenance of the catheters<sup>(8)</sup>.

The results of the present study demonstrated the effectiveness of the use of an educational hypermedia on peripheral venous puncture in the knowledge of nurses and nursing technicians. This finding corroborates with a study that evaluated the use of videotapes performing the technique of urinary catheterization of male delay in YouTube videos, since these are instruments that contribute to the teaching-learning process in nursing, as long as its use follows a planning with objectives,

**Figure 1.** Pre- and post-test scores for the anatomy of the venous network. Fortaleza/Ceará, 2016.

Anatomy of the venous network	NURSES						TECHNICIANS					
	PRE-TEST			POST-TEST			PRE-TEST			POST-TEST		
	Scores*		p†	Scores*		p†	Scores*		p†	Scores*		p†
	f	%		f	%		F	%		f	%	
1. Best vein to perform the PVP is the basilic and cephalic (T).	12	42,9	<0,00	16	57,1	0,00	18	62,1	0,00	23	79,3	0,26
2. The veins of the antecubital fossa are ideal for collection of blood (T).	18	64,3	0,00	22	78,6	0,23	16	55,2	0,00	21	72,4	0,05
3. Metacarpals are ideal for bolus medications (F).	12	42,9	<0,00	11	39,3	<0,00	18	62,1	0,00	17	58,6	0,00
4. In the elderly and children, digital and cephalic veins are the most recommended (T).	13	46,4	<0,00	15	53,6	<0,00	15	51,7	<0,00	21	72,4	0,05

\* Frequency and percentage of total hits before and after the intervention;

† Binomial test.

**Figure 2.** Pre- and post-test scores for the material used in Peripheral Venous Puncture. Fortaleza/Ceará, 2016.

Material used in PVP	NURSES						TECHNICIANS					
	PRE-TEST			POST-TEST			PRE-TEST			POST-TEST		
	Scores*		p†	Scores*		p†	Scores*		p†	Scores*		p†
	f	%		f	%		F	%		f	%	
5. Required material used in PVP (T).	22	78,6	0,23	25	89,3	0,81	18	62,1	0,00	28	96,6	0,99
6. The use of gloves is not required for experienced professionals (F).	23	82,1	0,41	26	92,9	0,93	20	69	0,02	26	89,7	0,83
7. The PPE's used in PVP are: lab coat, mask, glasses, gloves (T).	18	64,3	0,00	18	64,3	0,00	9	31	<0,00	24	82,8	0,44
8. The PPE's used in PVP are biosafety standards and devices (T).	23	82,1	0,41	26	92,9	0,93	15	51,7	<0,00	26	89,7	0,83

\* Frequency and percentage of total scores before and after the intervention;

† Binomial test.

to take advantage of them with all their potential<sup>(9)</sup>.

There was a better performance of post-test scores among nursing technicians (79.3%) compared to nurses (57.1%) on the best vein for venipuncture (basilic and cephalic). The peripheral venous catheter is commonly inserted into the cephalic or basilic veins of the lower forearm or, alternatively, into the metacarpal vein of the hand<sup>(10)</sup>. The learning of such information is relevant since, according to a study result that investigated phlebitis

in patients with peripheral venous catheter, only 16.4% of the complications associated with the procedure were present in the accesses located in the cephalic veins, so that the majority of complications occurred in the veins of the forearm, the back of the hand, the dorsal venous arch, and the median vein, in which the venous catheters were installed<sup>(11)</sup>. Thus, knowledge about the preference for the basilic and cephalic veins for venipuncture, in addition to contributing with the greater chance of success in the procedure, contem-

**Figure 3.** Pre and post-test scores for Peripheral Venous Puncture Procedure. Fortaleza/Ceará, 2016.

PVP Procedure	NURSES						TECHNICIANS					
	PRE-TEST			POST-TEST			PRE-TEST			POST-TEST		
	Scores*		p†	Scores*		p†	Scores*		p†	Scores*		p†
	f	%		f	%		f	%		f	%	
9. Considered a sterile procedure (F).	18	64,3	0,00	19	67,9	0,01	20	69,0	0,02	24	82,8	0,44
10. It should be performed by inspection and palpation (T).	22	78,6	0,23	23	82,1	0,41	18	62,1	0,00	26	89,7	0,83
11. They should begin in the proximal and then distal portion (F).	12	42,9	<0,00	15	53,6	<0,00	15	51,7	<0,00	23	79,3	0,26
12. After fixing the device, the identification is performed (T).	24	85,7	0,62	25	89,3	0,81	17	58,6	0,00	26	89,7	0,83
13. The tourniquet is a dispensable item in the procedure (F).	21	75,0	0,11	25	89,3	0,81	13	44,8	<0,00	24	82,8	0,44
14. The distance from the insertion site to the tourniquet is 10 to 15 cm (T).	16	57,1	0,00	22	78,6	0,23	19	65,5	0,00	27	93,1	0,94
15. The tourniquet should be used with caution in the elderly (T).	21	75,0	0,11	26	92,9	0,93	15	51,7	<0,00	24	82,8	0,44
16. The needle catheter is ideal for bolus medication (T).	17	60,7	0,00	20	71,4	0,04	13	44,8	<0,00	26	89,7	0,83
17. The needle catheter is ideal for tortuous veins (F).	19	67,9	0,01	21	75	0,11	11	37,9	<0,00	24	82,8	0,44
18. The flexible catheter is used up to 72 hours (T).	23	82,1	0,41	25	89,3	0,81	14	48,3	<0,00	26	89,7	0,83
19. The flexible catheter is rated with odd numbers (F).	15	53,6	<0,00	20	71,4	0,04	19	65,5	0,00	26	89,7	0,83
20. The SF 0.9% is recommended when doing the procedure (T).	20	71,4	0,04	22	78,6	0,23	13	44,8	<0,00	25	86,2	0,65
21. Puncture of fistula limb is avoided (T).	21	75,0	0,11	25	89,3	0,81	20	69,0	0,02	26	89,7	0,83
22. Gauze is used to assist PVP with flexible catheter (T).	15	53,6	<0,00	19	67,9	0,01	14	48,3	<0,00	23	79,3	0,26
23. The "ballerina vein" is a myth and there is no evidence in the literature (F).	15	53,6	<0,00	18	64,3	0,00	19	65,5	0,00	25	86,2	0,65

\* Frequency and percentage of total scores before and after the intervention;

† Binomial test.

plates a lower probability of the appearance of possible complications associated with it.

Another issue in which hypermedia-enabled teaching is related to the reduction of complications was the reference to the indication of the needle catheter for *bolus* medication. In this question, it was observed that the nursing technicians doubled the number of correct answers in the post-test (44.8% to 89.7%). The selection of catheter type should

occur through analysis of the possibility of complications and duration of intravenous therapy<sup>(8)</sup>. Faced with such criteria, the Scalp-type catheter (with steel needles) should be avoided for long-term intravenous therapies, as the extravasation of the medications can cause irritation and necrosis in the vessel<sup>(12)</sup>.

Regarding the specific questions about the complications of the procedure, there was a significant improvement in the post-test for

**Figure 4.** Pre- and post-test scores for complications related to Peripheral Venous Puncture. Fortaleza/Ceará, 2016.

PVP-related complications	NURSES						TECHNICIANS					
	PRE-TEST			POST-TEST			PRE-TEST			POST-TEST		
	Scores*		p†	Scores*		p†	Scores*		p†	Scores*		p†
	f	%		f	%		f	%		f	%	
24. After checking the venous return, the tourniquet is removed (T).	22	78,6	0,23	26	92,9	0,93	18	62,1	0,00	26	89,7	0,83
25. The complications of PVP can be local and systemic (T).	20	71,4	0,04	22	78,6	0,23	15	51,7	<0,00	27	93,1	0,94
26. Complications are related to chemical and physical factors (T).	22	78,6	0,23	27	96,4	0,98	15	51,7	<0,00	25	86,2	0,65

\* Frequency and percentage of total scores before and after the intervention;

† Binomial test.

technicians and nurses. Satisfactory learning about complications is relevant in terms of their frequency and severity and the contribution of nursing to the reduction of such complications.

The contribution of the professionals is cited by the authors of a study carried out in Saudi Arabia that showed the presence of phlebitis, pain, extravasation or occlusions in patients with peripheral venipuncture and the responsibility of health professionals in the procedures that may minimize the possibility of such complications was highlighted<sup>(13)</sup>. In a study that evaluated the presence of complications related to peripheral venous puncture, the results showed that the training of the professionals contributed to the success in reducing the complications and the authors highlight the process of training and updating as a key component to obtain such results<sup>(14)</sup>. Thus, the relevance of the use of technologies that are effective for nursing teaching on the complications of the procedure is ratified and such effectiveness found in educational hypermedia is relevant.

Regarding the question about the choice of antecubital fossa vein for the collection of exams, both nurses and nursing technicians performed well in the post-test (78.6% and

72.4%, consecutively). Regarding the effectiveness of hypermedia to teach the professional, such information is relevant, since puncture in the antecubital fossa should be avoided because it is a region that presents higher rates related to failure and risk of complications<sup>(15)</sup>.

Among nurses and nursing technicians there was an increase in the post-test scores on the mandatory use of gloves throughout the venipuncture. Nursing knowledge on glove need is ratified by an integrative review study about the adherence of nursing professionals to contact precautions<sup>(16)</sup>.

The use of the gloves becomes indispensable since they form the same physical barrier to microorganisms that can be transmitted through the hands and integrates the basic items for standard biosafety precautions<sup>(17)</sup>. In view of the above, the efficacy of hypermedia in teaching the use of gloves corroborates occupational safety and patient safety.

Also, in the context of patient safety, another item that had statistical significance in the post-test was the information regarding the need to identify the venous access after the procedure. The correct identification must be legible and include the date and time of the catheter installation, besides its caliber and the name of the professional who performed

it. This measure deals with the communication between health professionals and safety in the administration of medicines<sup>(18)</sup>.

In the post-test, there was an improvement in the percentage of correct answers about the non-obligatory sterility of the venipuncture, especially in the group of nursing technicians, which evolved from 69% to 82.8%. Puncture is not a sterile procedure, but the nursing team must pay attention to the maintenance of aseptic technique during the procedure<sup>(8)</sup>, since the insertion of a catheter into the intravascular lumen offers direct access to the bloodstream, which, despite being obtained for the infusion of fluids, drugs or blood products<sup>(19)</sup>, also becomes a potential gateway for microorganisms.

In this context, reducing the incidence of complications and the occurrence of multiple or new punctures is a great challenge for the nursing team and a pressing need to improve the quality of care and patient safety<sup>(20)</sup>. Thus, adherence to preventive measures for infection or failure in the procedure is pertinent. Such measures include antisepsis of the hands and forearms of the professional; the use of disposable gloves; antisepsis of the catheter insertion zone; the good fixation after the procedure and the guarantee of observation of the place of insertion<sup>(19)</sup>.

The importance of the periodic evaluation of the knowledge of the professionals who are responsible for the insertion and maintenance of the catheters, as well as adherence to the guidelines of infection prevention are highlighted<sup>(8)</sup>. In addition, the use of technologies that are effective in teaching the nursing team on peripheral puncture is important to contribute to the professional training success. About patient care, the improvement in the knowledge of professionals may imply a reduction in the rates of complications, for

which the involvement of the nursing team becomes necessary.

## CONCLUSION

The practice of peripheral venipuncture is one of the procedures of responsibility of the nursing team and demands technical and scientific knowledge on the subject from professionals. In this sense, a good preparation of the professional, from educational supports directed to qualified assistance, becomes pertinent.

From this point of view, the approach to the subject with nursing professionals through a hypermedia was effective, since it was possible to identify the statistical significance in the scores of the post-test, and when this significance did not occur, there was an increase in the amount of scores.

As a limiting factor, there is the fact that this study was performed in a hospital, with only one care reality. Therefore, future research with the use of hypermedia in distinct scenarios is suggested, in addition to the comparison with other educational technologies.

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