



Instrument validation for peripheral venous puncture with over-the-needle catheter

Validação de instrumento para punção venosa periférica com cateter agulhado

Validación de instrumento para punción venosa periférica con catéter con agujas

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Objective: to validate an instrument for the assessment of the peripheral venipuncture technique with over-the-needle catheter. **Methods:** methodological, transversal study developed with 24 judge nurses, professors of the subject semiology and/or physical examination techniques, with at least 1 year of experience in those disciplines in three stages: preparation of checklist; submission to the judges for evaluation; and content validation through the application of the Kappa index. **Results:** out of the 26 items of the instrument, only 2 did not have Kappa index and content validity index within the established parameters. Out of these 24 items, 7 showed perfect concordance index, 10 great and 7 good. **Conclusion:** the instrument had representation and extension about the area of interest.

Descriptors: Nursing; Catheterization, Peripheral; Validation Studies.

Objetivo: validar um instrumento para avaliação da técnica de punção venosa periférica com cateter agulhado. **Métodos:** estudo metodológico, transversal desenvolvido com 24 enfermeiros juízes, docentes da disciplina de Semiologia e/ou Semiotécnica, com, no mínimo, 1 ano de experiência nas disciplinas, em três etapas: elaboração da lista de verificação; submissão aos juízes para avaliação; e validação de conteúdo por meio da aplicação do índice Kappa. **Resultados:** dos 26 itens do instrumento, apenas 2 não obtiveram índice Kappa e Índice de Validade de Conteúdo dentro dos parâmetros estabelecidos. Desses 24 itens, 7 apresentaram índice de concordância perfeito, 10 ótimo e 7 bom. **Conclusão:** o instrumento teve representatividade e extensão acerca do domínio de interesse.

Descritores: Enfermagem; Cateterismo Periférico; Estudos de Validação.

Objetivo: validar un instrumento para evaluación de la técnica de punción venosa periférica con catéter con agujas. **Métodos:** estudio metodológico, transversal, desarrollado con 24 enfermeros jueces, maestros de la asignatura Semiología y/o semiótica, con, al menos 1 año de experiencia en las disciplinas, en tres etapas: desarrollo de la lista de verificación; sumisión a los jueces para evaluación; y validación del contenido mediante aplicación del índice de Kappa. **Resultados:** de los 26 ítems del instrumento, sólo 2 no obtuvieron índice Kappa e Índice de Validez Contenido según los parámetros establecidos. De estos 24 artículos, 7 señalaron índice de concordancia perfecta, 10 óptimo y 7 bueno. **Conclusión:** el instrumento tuvo representación y extensión acerca del dominio de interés.

Descritores: Enfermería; Cateterismo Periférico; Estudios de Validación.

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Introduction

The implementation of intravenous therapy through peripheral vascular access is a common action of health care institutions and, when properly implemented, it is related to clients' clinical improvement⁽¹⁾. However, its use may put patients at risk of complications, being the most frequent ones phlebitis, infiltration, hematoma, thrombosis and thrombophlebitis⁽²⁾.

Thus, performing this procedure requires scientific training of professionals, due to the high level of technical complexity, which requires knowledge, competence and psychomotor skills. When professionals are not trained properly, faults can occur in this process, a fact which, in turn, can generate many injuries related to the clients' recovery conditions⁽¹⁾.

Study of the National Health Surveillance Agency identified that bloodstream infections are among the most common related to health care, and that about 60% of the bacteremia are related to some intravascular device⁽³⁾.

In this sense, the patient care delivery is important to reduce this rate, depending not only on knowledge, and on practical situations, but also on the assessment of learning. Consequently, for each major intervention performed, one must use the best way to verify and measure the evolution of those being evaluated, assess their performance and indicate the necessary adjustments⁽³⁻⁴⁾.

Therefore, one realizes the need to build assessment tools that can generate good measures. Thus, the development of a checklist allows the user to record the presence or absence of each item described, in order to ensure that all the aspects of that action are addressed or completed, and it also emphasizes essential criteria that should be considered in a specific activity⁽⁵⁾.

Validity tests demonstrate the instrument's quality. Validity is a significance criterion of an instrument, which has various methods to collect

evidence. Content validity, one of the validation types, determines if the contents of a measuring instrument operates effectively the questions to measure a certain phenomenon to be investigated⁽⁶⁾.

Considering the importance of the peripheral venous puncture and the need to evaluate the implementation of this procedure in order to improve the quality of care, the following research question emerged: can the peripheral venipuncture technique with over-the-needle catheter be verified by an instrument that allows the identification of the technical performance and problems to be overcome?

The objective of this study was to construct and validate an instrument to assess the peripheral venipuncture technique with over-the-needle catheter.

Method

This is a cross-sectional, methodological study with quantitative approach to treatment and data analysis.

The first step consisted of the construction of the instrument, which aimed to evaluate the peripheral venipuncture technique with over-the-needle catheter from the literature review of guidelines recommended in scientific articles, books and dissertations. A checklist was created composed of 26 items, which include the steps of the technique.

To do so, one carried out a search in the electronic databases available in the Regional Library of Medicine (BIREME)/Virtual Health Library (VHL), specifically in the bases: Latin-American and Caribbean Center on Health Sciences Information (LILACS), International Literature on Health Sciences (MEDLINE), Nursing Database (BDENF), Spanish Bibliographic Index on Health Sciences (IBECS) and PubMed.

One used to assess the controlled descriptors of the health sciences descriptors (DeCS) and of the Medical Subject Headings (MeSH): "*catererismo periférico/peripheral catheterization*" and "*Enfermagem/Nursing*".

To perform the collection, one used an electronic structured form covering issues related to the research proposal, including type and place of publication, study type, year, country, steps of the technique described in the study and target audience of the study.

In the second stage, there was the identification, selection and invitation of research judges, from the contact with coordination of nursing undergraduate courses, in order to request contacts (e-mail and telephone) of all the faculty members of the subjects semiology and/or physical examination techniques for sending a letter of invitation by e-mail, containing the objectives of the study and the justification of the validation process.

The sample was selected by intentionality following these inclusion criteria: nurses, professors of semiology and/or physical examination techniques, with at least 1 year of experience in the discipline. Thus, 34 professors were invited, out of which 24 were available to participate in the research.

The survey judges evaluated the 26 items, classifying each one of them as "appropriate", "appropriate with changes" or "inappropriate". In the latter two cases, the judges, through code numbers from 1-10, explained the reasons of changing or inadequacy, according to the following requirements: usefulness/relevance (1), consistency (2), clarity (3) objectivity (4), simplicity (5), feasible (6), update (7), vocabulary (8), precision (9), and instructional sequence of topics (10). A space for suggestions was available at every step, so that items could be rebuilt or upgraded. The overall rating of the checklist was also held regarding the requirements mentioned above.

After the evaluation, one conducted the third stage of the study, which consisted of the content validation with application of the Kappa index (κ), to verify the agreement level and consistency of the judges regarding the presence or not of the instrument items. As acceptance criterion, one established concordance higher than 0.61 between the judges,

classified as a level of substantial agreement⁽⁷⁾.

One also used the Content Validity Index (CVI), which measures the agreement of the judges as to the representativeness of the items in relation to the content under study⁽⁸⁾. In this study, it was considered for the calculation of the CVI, the judgment of the items as appropriate. As acceptable, it was considered the minimum index of 0.75, for both the evaluation of each item and for the general assessment of the instrument, which was held from the sum of all the CVI calculated separately, dividing them by the number of items of each instrument. When below 0.75 one considered comments and suggestions for non-compliance, and the possibility of adjustments, with or without return to the participants, if they were based on the guidelines of manuals, dissertations and articles⁽⁹⁾.

The data collected were organized in spreadsheets and exported to a statistical program. After coding and tabulation, one analyzed the data with descriptive statistics. After the analysis, the instrument was redesigned according to the judges' guidelines and suggestions.

The study is in accordance with the ethical principles of research involving human subjects contained in Resolution 466/12, having obtained approval from the Research Ethics Committee/ Onofre Lopes University Hospital [*Hospital Universitário Onofre Lopes*] (protocol 385/09).

Results

Out of the 24 professors who evaluated the instrument, 83.3% were women, with an average age of 36.6 (\pm 9.3) years old. As for the title, most of them held an academic master's degree (70.8%) and acted exclusively in teaching (75.0%). The time of teaching experience had an average of 7.9 (\pm 8.0) years and, in the disciplines of semiology and/or physical examination techniques, 5.5 (\pm 6.7) years.

Out of the 26 items on the checklist, 7 showed perfect concordance index (CVI=1.00; κ = 1.00). They

were: performs hand hygiene (2; 11; 25); aspires SS 0.9%/ medication (7); inserts the catheter into the vein (19); organizes the environment (24) and registers the procedure in the medical chart (26). Ten items showed great concordance index, and seven had a rate considered as good. As for the CVI, 24 items showed concordance levels above 0.75 (Table 1).

During the judgement of the checklist about the peripheral venipuncture technique with over-the-needle catheter, no question was removed. However,

two items did not have level of agreement within the required level: angle of the needle (17) and position of the bevel (18), with $\kappa=0.57/CVI=0.71$ and $\kappa=0.54/IVC=0.67$, respectively. Those questions were not removed from the study, because they are key steps in the development of peripheral venipuncture technique, but also due to the suggestions of the judges, which are in their entirety related to improving the clarity and consistency of vocabulary items, not regarding the removal of items.

Table 1 - Judgement from the judges of the checklist items about the peripheral venipuncture technique with over-the-needle catheter

Steps	Judgement		κ	CVI
	Appropriate	Appropriate with changes		
	n (%)	n (%)		
1. Checks data on user's medical chart	23 (95.8)	1 (4.2)	0.92	0.96
2. Performs hand hygiene	24 (100.0)	1 (0.0)	1.00	1.00
3. Selects the material and instruments needed	19 (79.2)	5 (20.8)	0.7	0.8
4. Identifies himself/herself to the patient and explains the procedure to be performed	23 (95.8)	1 (4.2)	0.92	0.96
5. Disinfects the bottle/vial	21 (87.5)	3 (12.5)	0.77	0.88
6. Connects the syringe and needle	23 (95.8)	1 (4.2)	0.92	0.96
7. Aspire SS 0.9%/medication	24 (100.0)	1 (0.0)	1.00	1.00
8. Connects the syringe to the intravenous device	23 (95.8)	1 (4.2)	0.92	0.96
9. Fills in the catheter's bulb	20 (83.3)	4 (16.7)	0.71	0.83
10. Identifies the syringe	23 (95.8)	1 (4.2)	0.92	0.96
11. Performs hand hygiene	24 (100.0)	1 (0.0)	1.00	1.00
12. Uses gloves	20 (83.3)	4 (16.7)	0.71	0.83
13. Does the tourniquet	21 (87.5)	3 (12.5)	0.77	0.88
14. Selects the vein for puncture	23 (95.8)	1 (4.2)	0.92	0.96
15. Performs antisepsis of the chosen site	23 (95.8)	1 (4.2)	0.92	0.96
16. Performs skin stretching	21 (87.5)	3 (12.5)	0.77	0.88
17. Angle of the needle	17 (70.8)	7 (29.2)	0.57	0.71
18. Position of the bevel	16 (66.7)	8 (33.3)	0.54	0.67
19. Inserts the catheter into the vein	24 (100.0)	1 (0.0)	1.00	1.00
20. Removes the tourniquet	23 (95.8)	1 (4.2)	0.92	0.96
21. Fixes the intravenous device	22 (91.7)	2 (8.3)	0.84	0.92
22. Administers the medication	22 (91.7)	2 (8.3)	0.84	0.92
23. Removes the syringe	19 (79.2)	5 (20.8)	0.7	0.8
24. Organizes the environment	24 (100.0)	1 (0.0)	1.00	1.00
25. Performs hand hygiene	24 (100.0)	1 (0.0)	1.00	1.00
26. Records the procedure in the chart	24 (100.0)	1 (0.0)	1.00	1.00

κ : Kappa index; CVI: Content Validity Index; SS: saline solution

Figures 1 and 2 present the suggestions made by the judges to the items of the checklist and the acceptance of these suggestions by researchers.

Items	Judges' suggestions	Researchers' Acceptance
3. Selects the materials and instruments needed	Change to "material and medications" (1)*	No
	Change to "collects necessary material" (1)	Yes
	Change to "selects the material and medications needed" (1)	No
	Delete the word "instruments" (1)	Yes
5. Disinfects the bottle/vial	"Performs disinfection of bottle/vial" (1)	No
	Add "with 70% alcohol" (1)	No
6. Connects the syringe and needle	Add "without contaminating" (1)	No
8. Connects the syringe to the intravenous device	Change to "Removes the needle and connects the syringe to the intravenous device" (1)	Yes
9. Fills in the catheter bulb	It could have been said that it could fill with medication or blood (1)	Not
	Identify the substance which should be placed to fill the device (1)	Not
	Fill the catheter's bulb with the solution (1)	Not
10. Identifies the syringe	It should be after the item "2.3" (1)	Not
12. Uses gloves	Change to "Wears gloves" (1)	Not
	Change to "Uses procedure gloves" (1)	Yes
	Identify the type of gloves (1)	Yes

* The parentheses indicate the number of times that the same suggestion was made by the judges

Figure 1 - Checklist items, judges' suggestions and acceptance of suggestions by the researchers

Items	Suggestions of judges	Acceptance of researchers
13. Does the tourniquet	Change to "Puts the tourniquet" (1) *	No
	Add "In the location selected for puncture" (1)	No
15. Performs antisepsis	Add "with 70% alcohol" (1)	No
16. Performs skin stretching	Add "setting the vessel" (1)	Yes
	"Stretches the skin to facilitate puncture" (1)	No
	Change to "Performs setting of the vessel" (1)	No
17. Angle of the needle	Explain the angle (3)	Yes
	Change to "Punctures maintaining the angle of the needle and the bevel position correct" (1)	No
	Change to "Angles the needle" (1)	No
18. Position of the bevel	Explain the position (5)	Yes
	Change to "Places the bevel" (1)	Yes
20. Removes the tourniquet	Add "By showing blood return" (1)	Yes
21. Fixes the intravenous device	Explain the material used (2)	No
22. Administers the medication	Add "Slowly" (1)	No
	Explain speed (1)	Yes
23. Removes the syringe	Change to "Removes the intravenous device" (5)	Yes
	Add "Compresses with dry gauze" (1)	No

* The parentheses indicate the number of times the same suggestion was made by the judges

Figure 2 - Checklist items, judges' suggestions and acceptance of suggestions by the researchers

In the final opinion of the judges about the checklist, based on the ten requirements for evaluation, all the requirements obtained appropriate κ and CVI (Table 2). Usefulness/relevance, objectivity, simplicity and feasible received maximum score of agreement. However, the item vocabulary received special attention and the suggestions and comments of the judges should be incorporated before the final version of the instrument.

Table 2 - Final report of judges about the technical checklist of peripheral venous puncture with over-the-needle catheter, according to the assessed requirements

Requirements	Final opinion		κ	CVI
	Appropriate	Appropriate with changes		
	n (%)	n (%)		
Usefulness /relevance	24 (100.0)	0 (0.0)	1.00	1.00
Consistency	22 (91.7)	2 (8.3)	0.8	0.92
Clarity	22 (91.7)	2 (8.3)	0.8	0.92
Objectivity	24 (100.0)	0 (0.0)	1.00	1.00
Simplicity	24 (100.0)	0 (0.0)	1.00	1.00
Feasible	24 (100.0)	0 (0.0)	1.00	1.00
Update	23 (95.8)	1 (4.2)	0.9	0.96
Vocabulary	19 (79.2)	5 (20.8)	0.7	0.79
Precision	22 (91.7)	2 (8.3)	0.8	0.92
Instructional sequence of topics	23 (95.8)	1 (4.2)	0.9	0.96

κ : Kappa index; CVI: Content Validity Index

In the overall assessment, the checklist of the peripheral venipuncture technique with over-the-needle catheter obtained CVI of 0.91 and κ of 0.85, which demonstrated the high reliability and fidelity of the instrument for the assessment of the peripheral venipuncture technique with over-the-needle catheter.

Discussion

As for the judges' suggestions, regarding the checklist, they were all analyzed, and the instrument

was modified based on the guidelines of manuals, dissertations and articles.

In order to make the instrument more concise and easy to understand, there was a change in item 3, "Selects materials and instruments needed", which was changed to "Selects the necessary material" according to the judges' suggestions. The term "material" also includes the word "instruments", thus making it unnecessary to use the two terms in the item description.

The literature suggests the preparation of the material before performing the procedure, as this makes it safer, faster, and does not offer risks to the maintenance of the correct technique nor to the client neither to the professional⁽¹⁾.

According to a study that evaluated the venipuncture technique developed by nursing professionals, during the preparation of the basic material for puncture there was the material preparation before the procedure in 80% of the cases, and in only 20%, the material was not previously prepared. Most of the times, the tray was not used because it did not exist in the sector, a fact that made it difficult for the professional to carry the material⁽¹⁰⁾.

In items 5, "disinfects the bottle/vial," and 15, "Performs antisepsis of the chosen site," the suggestion of the judges to add "with 70% alcohol" was not accepted." The same occurred in item 6, "Connects the syringe and needle", in which was not accepted the suggestion to add "without contaminating" in order to make the description of the items in the checklist less extensive and thus more objective.

The 70% alcohol, when used properly, has excellent germicidal action, especially on bacteria in the vegetative form, has little toxicity, is easy to apply, and is a great alternative to reduce the risk of contamination in the event of administration of injections⁽¹¹⁾.

In relation to the friction movement during antisepsis, some authors state that, when conducted in the direction of venous return, i.e., against the direction of hair, it favors the removal of microorganisms,

considering that there is a significant presence of bacteria in hair follicle⁽¹²⁾.

However, the National Health Surveillance Agency advises that antiseptics should be performed using circular movements, unique and from the center to the outside⁽¹¹⁾.

In item 8, "Connects the syringe to the intravenous device", it was accepted the suggestion to change this description by "Removes the needle and connects the syringe to the intravenous device," since it would make the item clearer, a fact that should improve the applicability of the instrument.

In step 9, "Fills in the catheter's bulb" the suggestion to identify the substance which should be placed to fill the device was accepted, aiming, however, to make the checklist more objective. This identification was carried out in the figure that contains the criteria adopted as appropriate for evaluation of the technique.

Regarding the identification of the syringe, in item 10, one suggested a readjustment of its positioning, and one proposed that this item should stay after item 7 "Aspire SS 0.9%/medication." However, such readjustment could not be accepted, since the items 8, "Connects the syringe to the intravenous device," and 9 "Fills in the catheter's bulb" subsequent to item 7, still referred to the preparation of the medication and of the intravenous device, so this preparation should not be stopped to make the identification of the syringe.

Item 12 was also changed, "Uses gloves", which, after suggestion of the judges, changed to "Uses procedure gloves".

The use of gloves is a type of standard precaution that protects professionals from exposure to biological material, a fact that reduces the chance of contamination with potentially infectious agents⁽¹³⁾.

In a study that aimed to describe the practice of nursing undergraduate students as to the conduction of the peripheral venipuncture procedure, it was identified that about 80% wore gloves in the puncture moment⁽¹⁾.

Regarding the item 13, "Does the tourniquet", it was suggested the description of the place where it should be done. Thus, the item was rewritten to "Does the tourniquet 5 to 15cm away from the site to be punctured."

According to the literature, the tourniquet 5 to 15cm away from the site to be punctured provides dilation of the vein, causing an increase in blood flow and facilitating its visualization. However, it requires attention in relation to its permanence for excessive time⁽¹⁴⁾.

For item 16, "Performs skin stretching", a suggestion of the judges was accepted requesting the addition of the term "fixing the vessel." In the skin stretching, it is recommended that professionals should pull on the distal skin to the site of venipuncture with the non-dominant hand, in order to avoid the displacement of the vein during the procedure, and to reduce trauma during the puncture⁽¹⁴⁻¹⁵⁾.

The steps 17, "Angle of the needle", and 18 "Position of the bevel", reached the lowest levels of the instrument, with $\kappa=0.57/CVI=0.71$ and $\kappa=0.54/CVI=0.67$, respectively. Such steps had lower values than those considered acceptable in this study. However, as already explained in the results, they remained in the study due to the nature of the judges' suggestions, which concerned mostly the specification of the angle of the needle and position of the bevel, that is, suggestions that, in its entirety, aimed at improving the clarity, the vocabulary and the consistency of the items.

At these stages, the judges' suggestions were accepted, namely: explain the angle in item 17 and explain the position of the bevel in item 18.

One chose to adopt, in this study, the angle from 5 to 30°⁽¹⁵⁾ with bevel up position, being the superficiality of the vein inversely proportional to the insertion angle.

Regarding item 20, "Removes the tourniquet" after suggestions of the judges, one added the words "when blood return is shown" in order to improve it regarding the clarity and ease of use of the instrument.

The removal of the tourniquet is recommended only after the blood return is shown, to make it sure for the professional that the device is inside the vein. It is also worth to highlight that the permanence of the tourniquet, after the puncture, can cause the loss of the venous access⁽¹⁵⁾.

In a study conducted with nursing students one identified that 40% of the respondents did not release the tourniquet after the catheter's insertion, 10% did not do it because they had not used the tourniquet, 10% released it after securing the device and the other 40% did not release the tourniquet at any moment⁽¹⁾.

One has also changed step 22, "Administers the medication" to "Administers medication according to medical prescription", and also in this stage, one rejected the suggestion of a judge to add the term "slowly" to that item, once the rate of drug administration depends on its characteristics and on the patient's conditions⁽¹⁶⁾.

For step 22 to be considered correct, the professional/student who performs the puncture technique must first administer saline solution 0.9% observing signs of infiltration and making sure that the device is inside the vein, and then administer the medication, according to the medical prescription, observing the patient, the reactions presented and the venous return.

When administering the medication, it is essential that nursing professionals have the necessary knowledge of its indication. However, a study conducted with nursing professionals identified that many were using medications without legal support and without the necessary knowledge about its indication⁽¹⁷⁾.

According to item 23, "Removes the syringe" five judges called attention to what happened in the description of that step, once the correct item description is "Removal of the intravenous device."

Finally, it was also suggested by the judges, and accepted by the researchers, the inclusion of one more

item in the instrument: "Presses the puncture site with dry cotton". The compression after venipuncture is important, because it avoids possible bleeding and hematoma formation⁽¹⁸⁾.

Conclusion

The checklist about the peripheral venipuncture technique with over-the-needle catheter proved to be valid. Out of the 26 items of the instrument, only two did not have level of agreement within the prescribed level (Content Validity Index > 0.75 and Kappa index > 0.61) and were modified in accordance with suggestions of the judges.

There were changes in nine items of the instrument, especially regarding consistency, clarity, vocabulary and precision. In this overall assessment, the Content Validity Index was 0.91 and Kappa was 0.85, well above the acceptable values.

Peripheral venous puncture with over-the-needle catheter is one of the most frequently performed procedures in the daily routine of health services, and it is essential for professionals responsible for its implementation to be trained and prepared for proper performance of this technique, in order to eliminate possible health risks to their clients.

In this sense, it is expected that the validated instrument is made available and disseminated for use in educational and health institutions, in order to promote better skills to students and professionals in this area.

Collaborations

Oliveira AKA, Melo GSM and Torres GV contributed to the design, data collection, analysis, data interpretation, article writing and critical review. Vasconcelos QLDAQ and Melo MDM contributed to the data collection. Costa IKF and Torres GV contributed to the approval of the final version to be published.

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