

Peripheral Intravenous Complication of Neonates: Effect of Educational Program for Nurses on Prevention and Management

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Abstract: The peripheral intravenous (PIV) catheter is the most used vascular access device for administration of medications in hospitalized neonates. To evaluate the impact of an educational program for nurses on assessment, management, and prevention of peripheral intravenous complication in neonatal intensive care unit. A quasi-experimental research design was used in the current study. The study sample consisted of a convenience sample including all available nurses (88) at University Hospital, General Hospital and Health Insurance Hospital at Beni-Suef. Two self-administered tools for nurses; part I, socio-demographic data for nurses, part II, nurses' knowledge regarding IV fluid and part III, nurses' knowledge regarding IV complications and neonate's needs of management and observational checklist for nursing practice about IV infiltration or extravasation in neonates. The findings revealed that there was a highly significant difference in the pre and post-intervention program and their knowledge and practice, the study stated that there was an improvement in their knowledge and practice towards prevention and management IV complications. Educational intervention had a significant role in increasing knowledge and practice of universal precautions among nurses. It is recommended to exert more efforts in developing and applying similar educational endeavors for nurses in NICUs these educational initiatives need to be boosted periodically to ensure sustainability of their positive effects on knowledge and practice

Keywords: Neonatal intensive care units, peripheral intravenous complication, educational program and management and prevention

INTRODUCTION

Peripheral intravenous therapy is the treatment method that carries liquid materials directly into a peripheral vein. The intravenous (IV) route of administration can be used for injections (with a syringe at higher pressures) or infusions (characteristically using only the pressure delivered by gravity). IV infusions are usually stated to as drops. The intravenous route is the fastest way to carry medications and fluid replacement throughout the body because the circulation transports them. IV therapy may be used for fluid replacement to correct dehydration, correct electrolyte imbalances, deliver medications, and for blood transfusions [1].

Insertion of a central venous line or PIV cannula permits patients to receive treatments such as chemotherapy, total parental nutrition, blood products, fluids, medications, blood product and blood sampling without the need for multiple venipunctures [2]. Infiltration, extravasation, and phlebitis are considered the most common complication of intravenous therapy, it injuries arise when fluids or medications or infection enter the tissue surrounding an intravenous (IV) catheter site and are a well-known complication of peripheral intravenous(PIV) use. Both injuries and complications end result from damage to vessel endothelium, which allows the fluid to pierce tissues surrounding an IV site [3].

The most common complication associated with PIV use in infants is infiltration and occurring in 23-78% of complications [4]. However, it is difficult to fix an exact value for infiltrating incidence due to differences among facilities and a lack of published data [5]. Although the significant variability in reported rates, it is clear that infiltration events happen more frequently in a newborn than in an infant or older children or adults. In hospitalized neonates, 95% of PIV catheters are detached due to complications such as leaking, occlusion, and infiltration. Infiltration rates among neonates are as high as 57%– 70% with extravasation occurring in 11–23% [6]. Both infiltration and extravasation are

damaging, make happen localized injury to the neonate's fragile skin and untreated bacterial phlebitis may lead to bloodstream infection [7].

Infiltration, extravasation, and Phlebitis may be affected by pharmacologic or chemical, mechanical, bacterial or physiologic factors, [8] the risk for PIV complications increased in the youngest children may be due to the brittleness and size of their blood vessels, lack of subcutaneous tissue, immunity condition and aseptic techniques [6]. In addition to their unique anatomy, infants' relative incapability to express pain and distress may have a major role in the predisposition of its. Therefore, unobserved infiltrates or extravasation can develop quickly in neonates, resulting in reduced tissue perfusion and finally tissue necrosis. Such injuries may need for surgical skin implantations, physical or occupational therapy to address any physical restrictions associated with damaging, and potentially loss of limb [5].

There are four altered scores or grade for PIV complications, each is dependent on Infiltration, extravasation, and Phlebitis (degree and site) [9]. Grade 4 of infiltration should always be considered extravasation on the infiltration scale; this includes any amount of vesicant, blood product [10].

Numerous staging structures have been advanced to classify and guide the treatment of PIV complications. These scales typically sort from Stage 1, where no swelling is present, to Stage 4 infiltrates that result in marked swelling, weakened circulation, skin breakdown, or necrosis [11].

The nursing role is the application of proper techniques. This proper technique can be used to avoid many cases of its complication, such as hand hygiene and aseptic techniques, selecting appropriate IV site, examining the catheter or IV cannula before, during, and after administration of IV fluid or medication, sidestepping unnecessary coverage of the insertion site, confirming pump alarm sensitivity and documenting any complication or changes [6,12].

SIGNIFICANT OF THE STUDY

Peripheral intravenous complications are common in the neonatal intensive care unit and medical-surgical unit. From the clinical experience as a head nurse at Beni-Suef Hospitals, infiltration or extravasation is an important public health problem in NICUs, because of the most common complication associated with PIV that infiltration events occur more frequently in infants than in older children or adults. Although the potential for serious morbidity, there are very limited data published regarding severe injuries in neonates, 38 per 1000 babies established PIV complications which led to skin necrosis in a survey of regional neonatal intensive care units (NICUs) in the United Kingdom [13]. So, this study will be carried out trying to achieve the health needs, promote knowledge and practice for this group and increase their health awareness about the importance of infiltration or extravasation observation, treatment, and prevention. Nurse needs specific education and training to achieve the knowledge, assessment skills and technical tasks required to prevent and manage PIV complications.

AIM OF THIS STUDY

The aim of this study is to evaluate the effect of the educational program for nurses on prevention and management of peripheral intravenous complication in the neonatal intensive care unit

HYPOTHESIS

The research hypothesis was that the pediatric nurses who will attend the educational program will have an improvement in their knowledge and practice towards assessment, management, and prevention of peripheral intravenous complication

RESEARCH DESIGN

A quasi-experimental design was used in this study.

SUBJECTS AND METHODS

Research setting

This study was carried out in three different settings, at Neonatal intensive care units at (University Hospital, General Hospital, and Health Insurance Hospital) in Beni-Suef City.

Subjects

A convenience sample included all available nurses (88), who are working in University Hospital (24) nurses, which contain (12) beds in two rooms, (33) nurses at General Hospital, which contain (21) beds in three rooms and (31) nurses at Health Insurance Hospital, which contain (24) beds in three rooms. All of the nurses were willing to participate in the study. Their age ranged between (19- 45) years that are currently assigned and provide care

Tools for data collection

In order to fulfill the aim of the present study, two tools were used for data collection.

Tool one: "Peripheral intravenous complication nurses' knowledge Structured Interview schedule": It was constructed by the researcher after reviewing a related literature [17, 18] to assess the following parts.

- **Part I:** Demographic characteristic of nurses regarding age, education, occupation and year of experience in NICUS.
- **Part II:** Nurses' knowledge regarding intravenous therapy such as (importance, types, dose rate, problems of IV fluid, types of drug should be given through IV).
- **Part III:** Nurses' knowledge regarding Peripheral intravenous complication such as (definition, causes, clinical manifestation, types and complication) and neonate's needs of management according to the degree of IVP complications.

Scoring system

The scoring system was followed to obtain the outcomes of Nurses' knowledge.

- Knowledge contents were divided into 15 questions and each question was assigned a score and two score level if the participant final score obtained is considered correct or complete satisfactory = (1), below the final score, it considered unsatisfactory if participant does not know knowledge or incorrect knowledge = (0).
- The total score of knowledge' questionnaire responses was 100%, accordingly more than 80% was considered satisfactory, less than 80% was considered unsatisfactory.

Tool two: "Peripheral intravenous complication observational checklist":

It was modified [18] by the researcher to observe the actual assessment; management and preventing pediatric patient peripheral intravenous complication in intensive care units it includes two parts:

Part I: Peripheral intravenous complication nurses' practice (assessment, IV equipment, infusion sets, selection of vein, IV preparation and insertion technique, observation of IV fluid therapy and documentation date of infusion sets).

Scoring system

- Practice contents were divided into 33 items and each item was assigned a score one and two score level if the participant final score obtained is considered done or competent = (1), below the final score it was considered incompetent if not done or incompetent = (0).
- The total score of practice' statement responses was 100%, accordingly more than 80% was considered competent, and less than 80% was considered incompetent.

Part II: (Intravenous Nursing Society (INS) complication scale; It was validated and developed by [19]. It is a modified version of the Intravenous Nursing Society (INS) complication scale for use with pediatric patients. It assesses each pediatric client according to 5 scales: no symptoms (0), slight pain near iv site or slight redness near iv site and edema (1), pain at iv site, redness and swelling (2), gross edema, pain along path of cannula, redness around site and swelling (3), pain along path of cannula, redness around site, swelling and palpable venous cord (4), pain along path of cannula, redness around site and swelling, palpable venous cord, pyrexia and gross edema (5). The total INS score ranges from 0 – 20 indicating risk; Mild risk ≤ 5 , Moderate risk 5-10, and High risk 10 - 20.

Procedure

- I. This study was conducted in five separate steps: developing the self-administered tool, pilot study, assessment of baseline knowledge and practice of nurses (pre-test), implementation of an educational program, and finally evaluation of knowledge and practice of nurses.
- II. An official permission to carry out the study was obtained from the institutional directors at the selected settings, after explaining the aim of the study.
- III. An ethical approval was taken from the ethics committee of faculty of Nursing of Beni-Suef.
- IV. The validity of the study tools was estimated by 5 experts in the Pediatric Nursing field to test content validity and its result was 95%. Modifications of the tools were done according to the judgment panel on the clarity of sentences, appropriateness of content and sequence of items.
- V. Reliability: Internal consistency of tool one was estimated by Alpha Cronbach test and its result was $R= 0.84$
- VI. A pilot study was conducted on 10% (8) nurses to test clarity, the feasibility of the two tools, and the necessary modifications were done accordingly.
- VII. Both tools one & two were used for studied students (except part one of tool one) for two times: before implementing the educational program (as baseline level) and immediately after conducting the educational program of both knowledge and practice that obtained by them.

Educational program

The main aim of this study is to evaluate the impact educational program for pediatric nurses on assessment, management, and prevention of peripheral intravenous complication in NICUs

- Conduction of theoretical part was performed through lectures and group discussions which were done in 2 sessions (each session lasted for 30-45 minutes) and covered the following items. The sessions covered the items of the educational program (importance, types, dose rate, problems of IV fluid, types of drug should be given through IV, definition, causes, clinical manifestation, types and complication) and neonate's needs of management according to the degree of IVP complications.
- Then conduction of practical part began at the previously mentioned settings. It was taken in 3 sessions (each session for one hour) and covers the program items. *First session:* the primary assessment. *Second session:* educational program (assessment of IVP complications` degree, Iv equipment, infusion sets, selection of vein, IV preparation and insertion technique, observation of IV fluid therapy and documentation date of infusion sets). *Third session:* secondary assessment
- The teaching methods used were brainstorming lectures, group discussion, role play and handouts of the educational program.
- It was verified for content validity by 5 experts in the field of pediatric nursing professors (University of Ain Shams and Beni-Suef). Omission, correction, and clarification of some items were done. The educational program was carried out in the following four phases:

I. Assessment phase:

It was carried out using tool one & two to collect baseline data and to detect nurses' knowledge/practice needs.

II. Planning phase:

The educational program was planned based on assessment phase and recent review of literature (17). It included goals & contents.

Each session was started by a summary about what has been discussed in the previous one and presenting the objectives of the new session, using simple Arabic language, also the session ended by a summary of its content and feedback from the nurses was obtained to ensure that they got the maximum benefit.

III. Implementation Phase

- The educational program was conducted through four sessions; each was between 30-45 minutes according to the nurses' needs and condition in groups (place and time). At the beginning of the first session, the program content and its aim were explained to the students.
- The data were collected during a period of 12 months from the beginning of March 2015 up to the end of February 2016.
- Each nurse was interviewed individually by the researcher. The mean time needed for each sheet was about 25-35 minutes to complete a questionnaire.
- This study was showed in five separate steps: developing an interview questionnaire sheet, pilot study, assessment of baseline students' knowledge and attitude (pre-test), implementation of educational program and evaluation of students' knowledge and attitude after educational program intervention.
- Each session was started by a summary about what has been conversed in the previous one and presenting the objectives of the new session using simple Arabic language, also the session was finished by a summary of its content and feedback was gained to ensure that they got the maximal benefit.
- The total number of the subjects was 88 nurses; they were divided into 9 groups 9-10 nurses in each group. The program was presented to each group separately.
- The teaching methods used were group discussions, brainstorming, lecture, role play, demonstration and handouts of the educational program.
- The educational program was carried out in the following four sessions:
 - ✓ First session contents were (the aim of the program, importance, types, dose rate, problems of IV fluid, types of drug should be given through IV)
 - ✓ Second session contents were (definition, causes, clinical manifestation, types and complication) and neonate's needs of management according to the degree of IVP complications.
 - ✓ Third session contents were (assessment of IVP complications` degree by INS complications scale, IV equipment, infusion sets, selection of vein, IV preparation).
 - ✓ Fourth session contents were (insertion technique, observation of IV fluid therapy and documentation date of infusion sets).

VI. Program evaluation:

The effect of the program on the study subjects was carried out through comparing the pre and post immediately assessment score of students` knowledge & attitude.

Ethical considerations

- The aim of the study was explained to the nurses who participated in the research before applying the tools to gain confidence and trust.
- An oral consent was obtained from each subject participating in the program, informing them that they have the right to withdraw at any time without giving any reason.
- The study was conducted in a suitable place for nurses.
- Data were collected and treated confidentially.

Statistical Data Analysis

The data were computerized and analyzed using the statistical package for social science (SPSS), version 16.0 Data were presented using:

- Descriptive statistics in the form of number, percentage and standard deviation (Mean (SD)).
- Statistical tests included: Chi-square (χ^2) test for analysis of qualitative variables.
- The graphical presentation included Pie and column chart diagrams.
- Statistical significance was considered at P -value <0.001.

RESULTS

Table-1 presents the demographic data of nurses indicated that 37.5% of the studied nurses` age ranged between 25-30 years with mean age 26.86 ± 4.78 years and 67.5% of them were married. Regarding the level of education, more than half (65.0%) of the nurses had technical nursing education. As regards years of experience nurses, this table shows that less than three quarters (71.3%) and (73.8%) of them have more than 5 years of experience and don't take any training courses with mean age 9.29 ± 5.64 .

Tables-2, points out that there is an improvement in nurses' knowledge post-program mean scores and there were highly statistically significant differences ($P < 0.001$) between pre and after program implementation.

Figure-1 shows that 93.8% had an unsatisfactory level in their total scores of knowledge, while 6.2% had a satisfactory level before program implementation. However, the same figure shows that more than three-quarters of the studied nurses (76.2%) had satisfactory level in their scores of knowledge, while 18.8% had unsatisfactory level after program implementation

Table-3 points out that there are no statistically significant differences ($P > 0.05$) between knowledge score and their personal and professional characteristics about intervention program except in educational qualification and years of experience shows highly statistically significant between knowledge score and their personal and professional characteristics ($P < 0.001^{**}$).

Table-4 points out that there is an improvement in nurses' neglecting practice between pre and post-program mean scores and there were highly statistically significant differences ($P < 0.001$) between pre and post-program implementation

Figure-2 shows that 90.7% had incompetent in their total scores of practice while 9.3% had competent before program implementation. Furthermore, the same figure shows that more than three-quarters of the studied nurses (84.2%) had competent in their scores of knowledge while 15.8% had incompetent level after program implementation

Table-5 points out that there are no statistically significant differences ($P > 0.05$) between practice score and their demographic characteristics about the intervention program

Table-6 shows a statistically significant positive correlation between nurses` total knowledge scores before program implementation and their practice after program implementation.

Table-1: Distribution of demographic characteristics of the studied nurses about peripheral intravenous complications in neonatal intensive care unit. (No = 80)

	Frequency	%
Age in years		
Less than 20	5	6.3
20-	22	27.5
25-	30	37.5
≥30	23	28.7
Mean ±SD	26.86±4.78	
Marital status		
Single	18	22.5
Married	54	67.5
Divorced	8	10.0
Educational qualification		
Secondary nursing education	23	28.8
Secondary and technical nursing education	52	65.0
Bachelors of nursing	5	6.3
Years of experience		
Less than one year	2	2.5
1-	21	26.3
5-	57	71.3
Mean ±SD	9.29±5.64	
Training courses		
Yes	21	26.3
No	59	73.8

Table-2: Distribution of the studied nurses` knowledge about peripheral intravenous complications pre and post phases of program. (No =80)

	Pre-intervention		Post-intervention		Chi square Test (1)	P value
	Satisfactory	unsatisfactory	Satisfactory	Unsatisfactory		
	%	%	%	%		
Indication of iv solutions	11.2	88.8	75.0	25.0	53.32	<0.001**
Rate of iv effusion	0.0	100.0	60.0	40.0	42.49	<0.001**
Time and causes of iv line removed	3.8	96.2	67.5	32.5	71.45	<0.001**
Complication of iv fluid	8.8	91.2	71.2	28.8	84.38	<0.001**
Definition of PIV complications	11.2	88.8	70.0	30.0	66.69	<0.001**
Signs of PIV complications	6.25	93.75	77.5	22.5	86.03	<0.001**
Risk factors of PIV complications	3.8	96.2	71.2	28.8	71.45	<0.001**
Management of PIV complications	8.8	91.2	62.5	37.5	57.79	<0.001**
Precaution to prevent PIV complications	0.0	100.0	65.4	34.6	76.94	<0.001**
Nursing management of PIV complications (mild)	46.3	53.7	71.3	28.7	13.52	<0.001**
Nursing management of PIV complications (moderate)	10.0	90.0	60.0	40.0	23.12	<0.001**
Nursing management of PIV complications (severe)	17.5	82.5	82.0	18.0	40.83	<0.001**

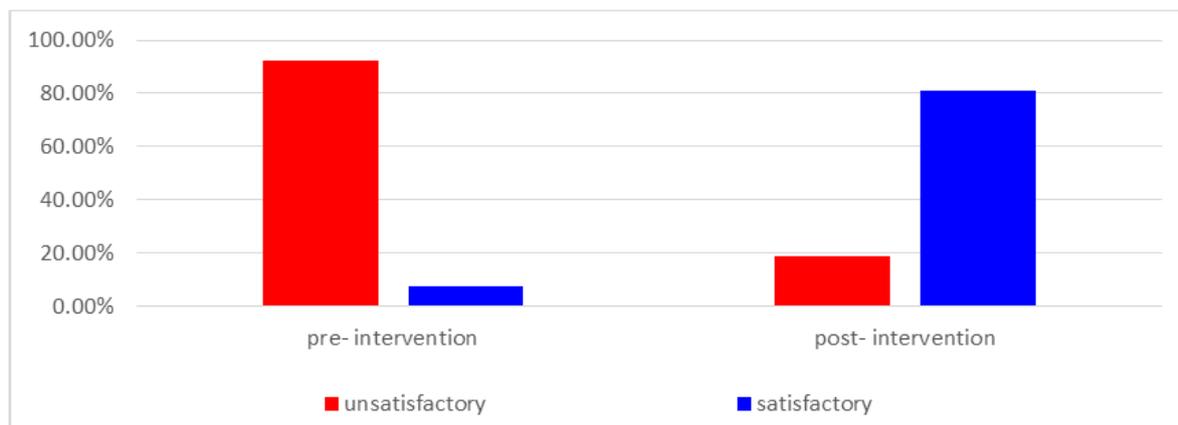


Fig-1: Percentage distribution of total knowledge score of the studied nurses about peripheral intravenous complications pre and post program (No = 80)

Table-3: Relation between Knowledge score and their demographic characteristics of studied nurses about peripheral intravenous complications educational program (No= 80)

	Total knowledge								Chi square Test 1)	P value
	pre-intervention				post-intervention					
	Satisfactory		unsatisfactory		Satisfactory		unsatisfactory			
	No	%	No	%	No	%	No	%		
Age in years	0	0.0	80	100.0	61	76.2	19	23.8	0.787	>0.05
Marital status	0	0.0	80	100.0	64	80.0	16	20.0	2.56	>0.05
Educational qualification										
Secondary nursing	0	0.0	23	28.75	18	22.5	5	6.25	4.63	<0.001**
Secondary and technical nursing Education	2	2.5	50	62.5	50	62.5	2	2.5		
Bachelors of nursing	4	5.0	1	1.25	5	6.25	0	0.0		
Years of experience										
Less than on year	0	0.0	2	2.5	1	1.25	1	1.25	2.15	<0.001**
1-	2	2.5	19	23.75	19	23.75	2	2.5		
5-	8	10.0	49	61.25	55	68.75	2	2.5		
Training courses	5	6.25	75	93.75	70	87.5	10	12.5	0.108	>0.05

Table-4: Neglecting items of studied nurses’ practice about cannulation insertion and peripheral intravenous complications educational program. (No =80)

	Pre-intervention				Post-intervention				Chi square Test	P value
	Satisfactor		Unsatisfactory		Satisfactory		Unsatisfactory			
	No	%	No	%	No	%	No	%		
Apply a tourniquet – avoid nipping the patients skin	56	70.0	24	30.0	10	12.5	70	87.5	54.57	<0.001**
Clean the area with an alcohol swab for 30 seconds in circular motion	45	56.3	35	43.8	4	5.0	76	95.0	49.45	<0.001**
Secure the vein with your non-dominant hand from below	50	62.5	30	37.5	9	11.3	71	88.8	45.13	<0.001**
Warn the patient of a sharp scratch	55	68.8	25	31.3	9	11.3	71	88.8	55.10	<0.001**
Ensure cannula slides smoothly	67	83.8	13	16.3	14	17.5	66	82.5	70.23	<0.001**
Document date of removed/replaced	54	67.5	26	32.5	9	11.3	71	88.8	53.01	<0.001**
Evaluate and observe the cannula each shift	44	55.0	36	45.0	13	16.3	67	83.8	26.19	<0.001**
Insert cannula at 20-40° –	65	81.3	15	18.8	15	18.8	65	81.3	62.50	<0.001**

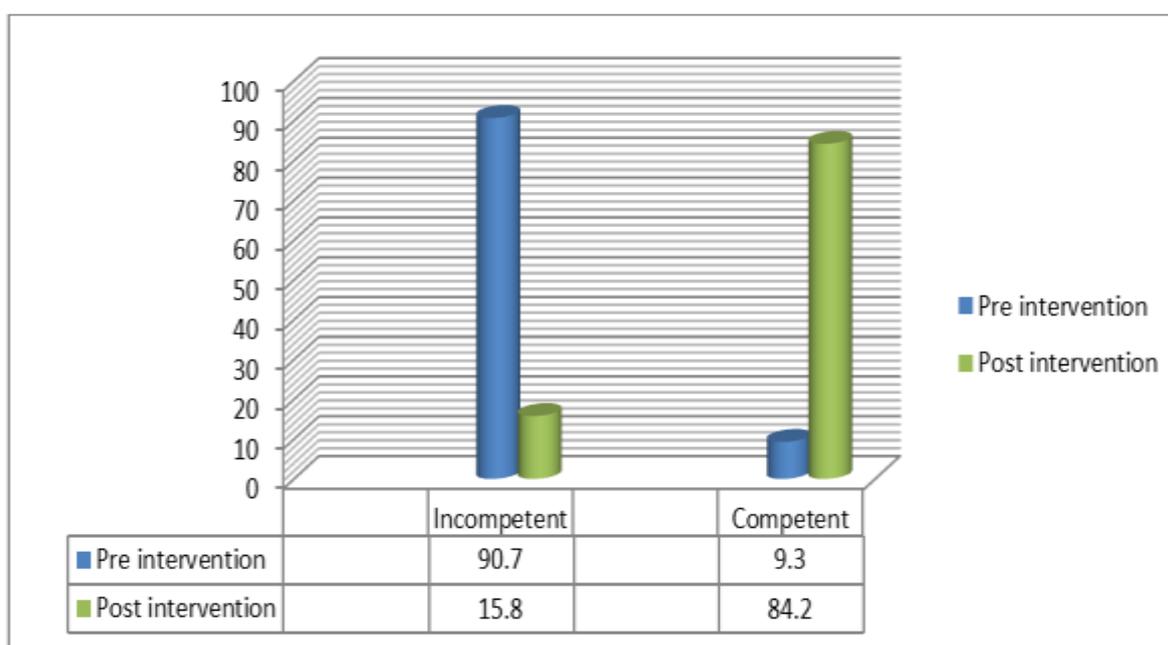


Fig-2: Percentage distribution of total practice score of the studied nurses regarding care of neonatal with peripheral intravenous complications educational program pre and post phases of intervention. (No=80)

Table-5: Relation between Practice score and their demographic characteristics of studied nurses about peripheral intravenous complications educational program (No=80)

	Total practice								Chi square Test(1)	P value
	pre-intervention				post-intervention					
	Competent		Incompetent		Competent		Incompetent			
	No	%	No	%	No	%	No	%		
Age in years	6	7.5	74	92.5	72	90.0	8	10.0	6.56	<0.05*
Marital status	5	6.25	75	93.75	65	81.25	15	18.75	8.88	<0.05*
Educational qualification	2	2.5	21	26.25	20	25.0	3	3.75	18.37	<0.001**
Secondary nursing										
Secondary and technical nursing education	3	3.75	49	61.25	50	62.5	2	2.5		
Bachelors of Nursing	4	5.0	1	1.25	5	6.25	0	0.0		
Years of experiee	2	2.5	0	0.0	2	2.5	0	0.0	0.935	>0.05
Less than on year										
1-	3	3.75	18	22.5	18	22.5	3	3.75		
5-	3	3.75	54	67.5	51	63.75	6	7.5		
Training courses	6	7.5	74	92.5	67	83.75	13	16.25	6.99	<0.05*

<0.001** highly statistically significant

<0.05* statistically significant

Table-6: Correlation between total knowledge and practice scores of studied nurses about peripheral intravenous complications educational program pre/post implementation (No=80)

Variable		Knowledge (pre)	Practice (Pre)	Knowledge (post)	Practice (Post)
Knowledge (pre)	Pearson Correlation		.319**	.134	.273*
	Sig. (2-tailed)		.004	.234	.014
Practice (pre)	Pearson Correlation	.319**		.024	.015
	Sig. (2-tailed)	.004		.835	.894
Knowledge (post)	Pearson Correlation	.134	.024		.018
	Sig. (2-tailed)	.234	.835		.873
Practice (post)	Pearson Correlation	.273*	.015	-.018	
	Sig. (2-tailed)	.014	.894	.873	

DISCUSSION

Infiltration and extravasation are the most common risks of intravenous administration therapy involving unintended leakage of solution and medication into the surrounding tissue. Consequences range from local irritation to amputation, [19] who stated that, infiltrates are a rising problem in our neonatal population in the NICUs.

Complications at venous sites during neo adjuvant treatment may be considered high. Infiltration and extravasation may also end in loss of function of the affected limb, pain, necrosis, ulcers, and the necessity for surgical intervention for skin grafting and increases the risk of developing cell carcinoma [12].

Teaching program management for nurses in NICUs whose high risk intravenous infiltration or extravasation is centered on nursing teaching and support, as well as actual treatment of intravenous complications and IV infiltrate detection rates would increase with increased awareness of the proper diagnosis and management of IV injuries.

The studied nurses' knowledge and practice for newborn infants with PIV complications according to the process standard measures. Regarding to the studied nurses' knowledge about indication, rates, causes, clinical manifestation, time of IV line removed, risk factors of increasing the problem such as drug, complication of IV fluid, definition, signs, methods of management and prevention) of PIV complications in NICUs the present study showed that

more than half of the studied nurses had unsatisfactory answers. According to [20] who found that “95% of PIV catheters are removed due to complications”. Additionally, [21] who stated in his study that, the nurses had inadequate knowledge and practice about intravenous drug preparation and administration error and need to training courses. However, the researcher viewed the PIV complication depend on the fragile nature of the neonate’s vascular system. Assessing the site appropriately and the nurse must be made frequently observing the catheter before, during, and after administration of IV fluid or medication and changing it in documented time before any complications to decrease in the IV problems rates and the severity of it. According to [22] who stated that many factors play a role in the potential development of extravasations or infiltration including, injection technique, experience of personal administrating injection, fragility of patient’s veins, number of vein puncture attempt prior to establishing an operational intravenous line, site of cannulation, intravenous rate, dose and drug characteristics

In the present study there were highly statistically significant relation between pre educational program and post educational program in improved nursing knowledge and practice in this respect, [23] who supported the result in her study who found statistically significant relation between pre educational program and post educational program in improved nursing knowledge, practice and personal and professional characteristics.

Regarding the studied nurses' level of knowledge and practice in pre and post educational program implementation; the findings of the current study showed that, more than three quarter of the studied nurses had unsatisfactory level in their scores of knowledge and practice in program implementation. This unsatisfactory score findings may be attributed to the fact that nurses didn't emphasize for updating their knowledge and practice and didn't take training course about NICUs practice by attending training programs. This finding was in accordance with [24] who found that, nurses' knowledge scores were generally low. While after program implementation, the current study shows an improvement in the level of nurses' knowledge and practice. This study supported by [25] who found an improvement in the level of nurses` knowledge and practice after educational program implementation in her study.

The present study showed that, there was no statistical significant relation between total studied nurses' knowledge in pre and post educational program and their demographic characteristics. While there was a highly statistical significant relation between total studied nurses' knowledge in pre and post educational program mean scores and their level of education and years of experience with $p \leq 0.001$. More than there was statistical significant relation between total studied nurses' practice in pre and post educational program and their demographic characteristics $p \leq 0.001$ except no statistical significant relation in years of experience $p > 0.05$. This finding supported by [23] who found a statistical significant relation between nurses' knowledge and their level of education with $p < 0.05$. This could be related to acquiring more practical experience through in the bachelor degrees' curriculum which educating practice as 60% of the study's hour, as well as being more familiar with medical terminology utilized in the unit and their practice easily gained by increasing in (age, experience) years and training course. This parallel with [24] who found that the total score of adequate practices of bachelor degree nurses was higher than diploma nurses and this study unsupported by [26] who stated that nurses with a diploma degree had higher performance than the bachelor degree. While there was no statistically significant relation between total studied nurses' practice and their years of experience characteristics about intervention program.

The observation being held in the present study showed that there was a highly statistically significant correlation between total nurses' knowledge and their total practice with $p < 0.001$, the present study shows before the program implementation that the majority of studied nurses had unsatisfactory level of knowledge and practice and then show an improvement in nurses' knowledge and practice and highly satisfactory of nurses` knowledge and practice, this result of giving educational program and training course program for nurses dealing with neonatal PIV complications in NICUs, similarly [27] who mentioned that importance of educational program and training program in her study. Additionally, [28] who stated that an evidence-based guideline for the enhanced surveillance, prevention, and management of PIV complications, with corresponding educational interventions for faculty and staff. By introducing the use of a checklist for compliance with guidelines.

Regarding neglecting items of Nurses' knowledge and practice about inserting IV cannula and IV fluid therapy for neonatal in ICUs for neonatal; the findings of the current study showed that there is an improvement in nurses' knowledge and practice about neglecting items between pre and post-program mean scores and there were highly statistically significant differences ($P < 0.001$) between pre and post-program implementation.

CONCLUSION

The educational program had a significant role in increasing the level of knowledge and practice of peripheral intravenous complications in NICUs

RECOMMENDATIONS

It is recommended to exert more efforts in developing and applying similar educational endeavors for nurses in NICUs these educational initiatives need to be boosted periodically to ensure sustainability of their positive effects on knowledge and practice.

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