



The Effect of Implementing Peripherally Inserted Central Catheter Educational Program on Nurses 'Knowledge, Practice, and Neonatal Outcomes

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ABSTRACT

Background: The peripherally inserted central catheters (PICCs) have become among the most common technologies employed in the intravenous therapy of neonates as they allow safe long-term intravascular access, comfort, and ease of transition to home therapy that contributed to the increased survival of those newborns. **Aim:** This study aimed to evaluate the effect of implementing peripherally inserted central catheter educational program on nurses' knowledge, practice, and neonatal outcomes. **Research design:** pretest-posttest quasi-experimental design was conducted. **Setting:** The study was conducted at neonatal intensive care units affiliated to Mansoura University Children Hospital (MUCH). **Subject:** The study included a convenience sample of (45) neonatal nurses working in the previously mentioned study setting with a purposive sample of (20) neonates admitted to NICU throughout six months and need PICC line insertion was enrolled in the study. **Tools of data collection:** Data were collected by using three tools: Peripherally inserted central catheter insertion questionnaire sheet, PICC line insertion and care observational checklist and neonatal assessment sheet. **Results:** Majority of studied nurses had poor knowledge, and more than half had competent skills about PICC before program implementation. There was more than half had average knowledge and two third had competent practices after program implementation. Also, there was decrease in the prevalence of neonatal complication. **Conclusion:** There was a post positive effect of the educational program on nurse's knowledge and skills as well as neonatal. **Recommendation:** Continuing of nursing education and practices about PICC lines.

Keywords: Educational Program, Knowledge, Neonates, Neonatal Nurse, Peripheral Inserted Central Catheter, Practice.

Introduction

The peripherally inserted central catheters (PICCs) have become among the most common technologies employed in the intravenous therapy of neonates as they allow safe long-term intravascular access, comfort, and ease of transition to home therapy (Jackson & Buttle, 2016). Although they were originally developed for delivery of parenteral nutrition, but the use of PICCs has been expanded to include chemotherapy administration, long-term intravenous

(IV) antibiotic treatment, and venous access when obtaining peripheral veins is difficult such as occluded peripheral veins, unusual venous anatomies (Wilson, Guardiola, Simonak & Wenhold, 2018).

At Neonatal Intensive Care Unit (NICU) the use of PICCs considered as a one of new technologies that increased life span of the newborns, taking into consideration that neonatal co-morbidity and mortality has a direct effect on the preterm (gestational age less than 37 weeks) and the newly born with low body

weight (less than 2,5 kg) (Bhargava, et al., 2020).

The central venous Catheter was described for the first time by the physician Forssmann in 1929 in Germany. It is an access inserted into the vein, via needle stylet or trucker, pass to the superior or inferior vena cava, which are considered as a central vein (Jackson, 2016). This access made from polyurethane or silicone, characterized by biocompatibility and low rate of thrombus formation, as it decreases the microorganism's colonization. It is usually utilized for middle and prolonged duration of treatment, if inserted into the peripheral system the nurse inserts the access in basilic vein because its easily features of the anatomy, another vein used is the cephalic vein (Paje, et al., 2018).

PICCs differ in size, lumens or numbers, brands and valves, nurses must make sure of the sort of peripherally inserted central catheters that each patient needs which may having one, two or three lumens for access. Catheters with many lumens have each single lumen enclosed in its own sheath, which makes the catheter look like having only 1 line. Every line allows the separated infusions via a separate lumen. (Hashimoto, Maruyama, Fukuta, Tanaka, Omura, 2017). In neonates, the use of landmarks is still often utilized in the placement of central lines, and cut downs are still used for central lines in some hospitals, While some studies showed the efficacy of using ultrasound for placement of central catheters, but these studies have shown efficacy in placement of catheters into the larger central vessels, therefore, The use of ultrasound guidance for placement of PICC lines or central catheters has become the gold standard in the adolescent patients (Mingkun, et al., 2019).

The choice of this device should be based on the evaluation of clinical condition of the newborn and the therapeutic goals, since it allows the catheter to infuse

two drugs incompatible with one another, avoiding multiple venous access and reducing the frequency of venipunctures (Moureau & Chopra, 2016). peripherally inserted central catheters are the most commonly requested procedure in most interventional radiology departments (IR) nowadays, according to the statistical record of Mansoura University Children Hospital, there has been a steady increase in the number of peripherally inserted central catheters lines requested between 2009 to 2019 until now. The incidence ranged from 11% to 70% of the peripheral IVs inserted annually, affecting over 85% of hospitalized neonates in the intensive care units (Pereira Ferreira, et al., 2020).

Although peripherally inserted central catheters are generally considered safe devices, they are associated with the numerous complications that can occur at the time of peripherally inserted central catheters insertion, including injury to nerves and vessels as well as catheter malposition. Additionally, there are multiple complications that can occur following placement, including line infections, line migration, and venous thrombosis, stenosis and catheter fracture (Sudprasert, Porntheerapat & Pisittakarne, 2019). A comprehensive and details patient history is necessary to avoid potential complications, however peripherally inserted central catheters are contraindicated in neonate with frequent vomiting or coughing which can induce alternation in internal thoracic pressure causing catheter malposition, erosion or cardiac tamponade. As well as it must not be inserted in the presence of infected and impaired skin integrity at the insertion site that may be strong risk factor a bacterial infection. A need to find healthy site to insert the intravenous access away from area of skin that already has a bacterial problem (Clemence & Maneval, 2014).

The peripherally inserted central catheter is less expensive than ports or other percutaneously inserted central lines because it usually does not require surgery. However, the PICC catheter and insertion kit are considerably more expensive when compared to a peripheral intravenous cannula. There are several advantages of using a peripherally inserted central catheter compared to other surgically implanted central catheters, as it can be inserted in a patient's room and it may be replaced by using an over-the-wire technique. In addition to its safety (insertion), its non-surgical procedure, local use of anesthesia, presents a low risk of causing drugs' infiltration or chemical phlebitis, and allows the administration of high pH, vesicant, and hyperosmolar solutions (Schults, et al. 2019).

A number of strategies have been proposed to minimize the occurrence of complications associated with PICCs and leading to the good prognosis. Some strategies include antimicrobial-impregnated PICCs for prevention of central line-associated blood stream infection (CLABSI), and differences in catheter valve technology (in which, valved catheters may prevent catheter occlusion by preventing reflux of blood into the catheter relative to nonvalved catheters) and catheter flushing agents to potentially reduce catheter occlusion and line infection (Gonzalez, & Cassaro, 2019).

A special team of nursing that characterized by professional technical and knowledge to improve good quality of care for newborns is required. Neonatal nurses are responsible for access insertion, daily care, early detection and management of complications related to access insertion and using. However, recent developments in the area of peripherally inserted central catheters insertion and its associated complications prevention and management have focused on education, the neonatal nurses must be

educated and have competent skills in the insertion of intravascular catheters, use appropriate infection control measures to prevent intravascular catheter-related infections and consequently achieve positive pediatric patient outcomes (Hashimoto, et al, 2017).

Neonatal intensive care units routinely utilize peripherally inserted central catheters to provide nutrition and long-term medications to premature and full-term infants. While there has been much growth in understanding PICC practices and outcomes in adults, less has been learned in pediatric and neonatal populations. This leaves knowledge gaps regarding practice for neonates who are the smallest and most vulnerable (Sharpe, et al. 2017).

Therefore, applying educational program for nurses about peripherally inserted central catheters line insertion and care is very important for increasing their knowledge and reducing its associated complications.

Significant of the study:

Neonatal intensive care units routinely utilize peripherally inserted central catheters to provide nutrition and long-term medications to pre-mature and full-term infants (Sharpe, et al., 2017). The survival of an increasing number of very-low birth weight and critically ill neonates heightens the need for peripheral inserted central catheter to administer parenteral nutrition that support growth, as well as intravenous fluids and medications. As a result, nurses are continually being challenged to improve the methods by which they provide safe and consistent vascular access to those vulnerable populations. (Chopra, Ratz, Flanders & Krein, 2016). Few studies about the use of PICC lines in neonatology and pediatrics were found in the last 10 years, especially in terms of procedure and care (Nobre , Cardoso , Teixeira , Lopes , Fontenele , 2016).

Aim of the study:

Evaluate the effect of implementing peripherally inserted central catheter educational program on nurses' knowledge, practice, and neonatal outcomes.

Research Hypotheses:

- 1- Nurses may have better knowledge about PICC line after implementation of the educational program.
- 2- Nurses' practices regarding the insertion and the care of peripherally inserted central catheters may be improved after implementation of the educational program.
- 3- The prevalence of the complications associated with peripherally inserted central catheters peripherally inserted central catheters may decreased after applying the educational program

Subjects and Method

The methodology was discussed under the subsequent four main design:

- I. Technical design.
- II. Operational design.
- III. Administrative design.
- IV. Statistical design.

I. Technical design:

It includes research design, setting, subjects, as well as tools of data collection.

Research design

A quasi-experimental design (one group pre-posttest) was utilized.

Setting

This study was conducted at Neonatal Intensive Care Units affiliated to Mansoura University Children Hospital (MUCH), which provides health services to neonates from Mansoura and the surrounding areas at

Dakhlia governorate. NICU consist of 21 incubators in 5 rooms (3 rooms consist of 12 incubators for ICU care and 2 rooms consists of 9 incubators for ordinary care). The nurse to neonate patient ratio in the morning shift was 1:1(1 nurse to 1 neonate patient) and while; in the afternoon and night shifts was 1: 2 (1 nurse to 2 neonate patients).

Subjects:

A convenience sample of (45) neonatal nurses working at the previous mentioned setting who were providing care for neonates in neonatal intensive care units during the periods of data collection regardless their age, qualification, years of experience and willing to participate voluntarily with a purposive sample of (20) neonates admitted to NICU throughout six months and need peripherally inserted central catheters line insertion was enrolled in the study.

Tools of Data Collection:

Tool 1: Peripherally inserted central catheter insertion questionnaire. It was developed by the researcher after reviewing related literature to assess the nurses' knowledge about the peripherally inserted central catheters line insertion, its care and how to prevent its complication Dougherty, (2014) and Velissaris, et al. (2019). Questions were in the form of close-ended questions to collect data it was divided into two parts:

Part I: Characteristics of studied nurses (5items). It included questions about age, sex, level of education, years of experience and previous attendance of training program about the peripherally inserted central catheters.

Part II: Neonatal Nurses Knowledge about the PICC line (pre- post Format). It was composed of (32) questions about definition of the peripherally inserted central catheters, indications, most common insertion sites, and precaution during insertion. Care of

peripherally inserted central catheters, complications, catheter removal and prevention of its complications.

Scoring system:

Each complete/ correct answer of knowledge was given (2) marks, the correct incomplete answer was given (1) mark and (0) mark if not known. Total score of knowledge was obtained, and then converted to a percent score. Total knowledge scores of nurses about the PICC line were (64) marks. The total level of nurse's knowledge about the PICC line was categorized according to (Hegazy and Abusaad, 2019) into:

- Good knowledge for score more than 75% (>48 score)
- Average knowledge for score 75% - 60% (38.4-48 score)
- Poor knowledge for score less than 60% (0- 38.3 score)

Tool II: PICC line insertion and care observational checklist (pre- post format). This tool was adapted from (Bowden, Greenberg, (2016), Westergaard, Classen, & WALTHER-LARSEN (2013). and Delarbre, et al. (2014). The observation checklists were used to assess and evaluate the pediatric nurses' practice about the insertion technique (20 items), PICC site care and dressing change (13 items), maintaining patency of the PICC (5 items) and removal technique (29 items).

Scoring system:

Scores were used to evaluate nurses' practice in which each step of practice done correctly was given (2) marks, (1) mark if done incorrectly and (0) mark if not done. Total practices of nurses were divided according to (Hegazy and Abusaad, 2019) into:

- Competent practice if the nurse had score more than 75% (100.5- 134 score).

- Incompetent practice if the nurse had score less than 75% (0-100.4 score).

Tool III: Neonatal assessment sheet. This tool was developed by the researcher after reviewing related literature to assess neonatal clinical data and evaluate the most common complications that may occur from the peripherally inserted central catheters. It divided into two parts:

Part I: Characteristics and clinical state of the neonates. It included information about the neonate such as gender, gestational age, diagnosis, date of admission, date of discharge, method of insertion (elective or urgent), site of insertion and place of the insertion of peripherally inserted central catheters.

Part II: Complications associated with PICC line. It included the most common complications that occurred during the insertion such as bleeding from insertion site or complication after 24 hours such as filtration, thrombosis, inflammation and edema as well as later on complications such as mechanical phlebitis, associated infections, occlusion of the peripherally inserted central catheters and thrombosis.

II - Operational design

It includes the preparatory phase and the exploratory phase.

1- Preparatory phase

This phase included a review of the past and current related literature and studies, using available books, magazines and articles to get acquainted with the various aspects of the study research problem and develop the study tool. The researcher prepared the guiding booklet. It was specially designed to meet the needs of nurses in a simple Arabic language. A panel of 5 experts in the field of nursing has evaluated and revised the content validity of the study tools for their clarification, sequence of items and content relevance.

The required modifications were done, according to their suggestions. The internal consistency of the study tools was tested by using Cronbach's alpha coefficient test; $r = 0.82$ for tool I, $r = 0.71$ for tool II, and $r = 0.63$ for tool III.

2- Exploratory phase

It includes pilot study and field work

Pilot study:

Pilot study was carried out on 5 nurses and 4 neonates (10% of the participants) in order to assess the clarity, feasibility and applicability of the tool. No modifications were done consequently, therefore the pilot study were included in the study sample.

Field work:

I. Data collection:

The actual fieldwork started after an approval that was obtained to conduct the study from the director of MUCH to facilitate data collection. Once the permission was granted to proceed in the study. The researcher began by introducing himself to the nurses and explaining the study aim in brief. The researcher attended five days per week in the study setting at morning and afternoon shift. Data collection of this study was carried out over a six months period that started from march 2019 to the end of september 2019. Data collection was conducted through four phases (assessment phase, planning, implementation and evaluation phase)

A. Assessment phase: -

Each nurse was interviewed individually before applying the educational program in order to collect nurses' data base line, their knowledge about the peripherally inserted central catheter using tool I. Nurses' practices about PICC line insertion technique, peripherally inserted central catheters site care and dressing change, maintaining patency of the

peripherally inserted central catheter and removal technique by using tool II. And assessment of the complication that occur from the PICC line such as thrombosis, inflammation, edema, mechanical phlebitis, associated infections, occlusion of the peripherally inserted central catheters peripherally inserted central catheters and thrombosis by using tool III.

B. Planning phase:

Depended on the work completed in the assessment phase; goals, priorities, and expected outcomes were formulated to meet nurses' needs regarding the PICC care. The investigator designed the educational program depend on the real need assessment of the studied nurses via reviewing of associated literature and on the basis of updated relevant on the PICC line. The program covered theoretical and practical skills related to PICC in NICU. A booklet containing the content of the program was designed by the researcher; it was written in simple Arabic language and supplemented by photos and illustrations to help nurses understanding the content.

General aim of the program:

Improve the neonatal nurses' knowledge and practices about the PICC line and decline its complication among newborns at neonatal intensive care unit.

Specific objectives of the program:

- Define the peripherally inserted central catheter.
- Enumerate the indication of the peripherally inserted central catheters insertion.
- Determine the contraindication of the peripherally inserted central catheters insertion.
- List the most common sites of the insertion of the peripherally inserted central catheters.

- Describe the advantage of peripherally inserted central catheters insertion.
- Identify the most common complication of the peripherally inserted central catheters. Demonstrate the technique of the PICC line insertion.
- Demonstrate the care of the peripherally inserted central catheters line.
- Apply infection control measures during the insertion of the peripherally inserted central catheters.
- Apply precautions that must be taken during the removal of the peripherally inserted central catheters.

The program consisted of theoretical knowledge about:

1. Definition of peripherally inserted central catheter.
2. Indication of peripherally inserted central catheter.
3. Contraindication of the peripherally inserted central catheters.
4. Sites of the peripherally inserted central catheters insertion.
5. Advantage of peripherally inserted central catheters.
6. Complications of peripherally inserted central catheters.
7. Methods of prevention of the complications.

The practical skill was included the following procedure:

1. Insertion technique of PICC line.

2. PICC site care and dressing change.

3. Maintaining patency of the peripherally inserted central catheters.

4. Removal technique of PICC line.

C. Implementation phase:

The developed educational program was applied at Neonatal Intensive Care Unit in three sessions; one theoretical and two practical sessions; each session was taken in 30- 45 minutes. Nurses were divided into small groups; (8 in each group) for theory and practical sessions and the re-demonstration on practical sessions were done individually for each nurse. Various teaching methods were used in the form of lectures, group discussion, demonstration and re-demonstrations. The teaching media used were colored posters, power point, video and hand out. Moreover, the instructional booklet was given to each nurse to attract her attention, motivate her and help for reviewing at home and support teaching and practice at home. As well as, each neonate with PICC line was observed for 10 days before and after program implementation.

D. Evaluation of the educational program:

Nurses' knowledge and practice were evaluated 3 months after implementation of the program using the previously mentioned (pretest) study tools I & II. Also, neonates' complications from the PICC line were after educational program using tool III.

II - Administrative design

An official approval was achieved from the Research Commission of Mansoura Faculty of Nursing, to hold out the study. A letter was submitted from the researcher to the director of MUCH to obtain a permission to apply the research study.

Ethical considerations:

After describing the aim of the research, informed oral consent was obtained from. Each nurse for her

participation, anonymity and confidentiality of collected data were ensured and used only for research purposes. Participants were informed that participation in the study is voluntary and they have the right to withdraw from the study at any time freely with none responsibilities.

I V- Statistical design

The collected data was coded and inserted into a data file using the Excel program for Windows. Frequency analysis and manual review were used to detect errors. After full insertion, the raw data were introduced into the version of the Statistical Social Science Package (SPSS) by which the analysis was carried out with the application of frequency and percentage. The data has been revised, coded and analyzed. Qualitative data were presented as precented number. The Chi-square test was utilized to compare among groups. Use of Wilcoxon signed rank test to compare relation between the two groups & the paired t test was used to compare two paired groups, while the correlation between continuous parametric data was used with the Pearson correlation. Quantitative data for parametric and median data for non-parametric data were explored as mean \pm standard deviation. They were testes for normality by Kolmogorov-Smirnov test. All test were carried out at significance level ($p \leq 0.05$), highly significant when ($p < 0.001$).

Results:

Table (1) showed that, 48.9% of the studied nurses aged from 20 to less than 30 years old with the mean age of 32.28 ± 5.03 years. The majority of them (91.1) were female and 82.2% of them were bachelor degree of nursing. As regards to years of experience, more than half (53.3%) of the studied nurses had more than 10 years of working in the Neonatal intensive care unit (NICU). In addition, more than half of them 53.3% did not receive any training program about PICC line.

Table (2) showed that 80% of the studied children were between 28 w to 37 weeks of gestational age, with mean of 23.48 ± 21.6 weeks. In relation to gender, 55% of them were male. All of them (100%) had elective method of PICC insertion with half of them had Antecubital veins and the other half had saphenous veins for insertion.

Table (3) indicated that 95.6% of studied nurses had poor knowledge and 4.4% had average knowledge about PICC line care for neonates before program implementation, but after program implementation more than half of studied nurses (53.3%) had average knowledge and more one third (37.8%) of them had good knowledge and only 8.9% had poor knowledge after program implementation with statistical significant difference in total score of nurses knowledge before and after educational program ($p = 0.007$).

Table (4) showed that, the mean score of the studied nurses' total performance to insertion and care of PICC line was 80.044 ± 6.71 before program implementation which improved to 104.2 ± 21.3 after 3 months of implementation of educational session with highly statistically significant differences regarding removal of PICC line mean scores and total score pre- and post-implementation of educational session ($p = 0.00$). As well as there was statistically significant difference regarding insertion technique, site care and dressing change and maintaining patency of PICC line mean score before and after program implementation ($p > 0.05$).

Table (5) indicated that more than half of nurses (53.3%) had competent score before program regarding PICC line insertion and care. But after program implementation about two third of them (71.1%) had competent practice after program implementation with statistically significant difference ($p = 0.01$)

Table (6) indicated that there were a highly statistically significant differences between before and

after implementation of educational session ($p < 0.001$) in relation to early complications at the first 3 days of PICC line insertion, in which most of neonates 75% and 50% of them were suffer from bleeding from insertion site and filtration before implementation of educational session which decreased after implementation of educational session. While the minority of them 30% and 10% suffer from occlusion of PICC line, thrombosis and air embolism respectively before program which eliminated after program implementation.

Table (7) indicated that there were a highly statistically significant differences between before and after implementation of educational session ($p < 0.001$) in relation to late complications after 3 days of PICC line insertion, in which most of neonates 75% and 70% of them were suffer from mechanical phlebitis and filtration before implementation of educational session which decreased after implementation of educational session. While the minority of them 25%, 20% and 15% suffer from occlusion of PICC line, thrombosis (blood clots) and infection respectively before program, which eliminated after program implementation.

Table (1): Percentage distribution of the studied nurses according to their characteristics.

Nurses' characteristics		No=45	
		No.	%
Age /year	20-<30	22	48.9
	30-<40	14	31.1
	≥40	9	20.0
	Mean ± SD	32.28± 5.03	
Sex	Male	4	8.9
	Female	41	91.1
Educational Level	Nursing Technical Institute	8	17.8
	Bachelor Degree	37	82.2
Years of Experience	1-<5	13	28.9
	5-<10	8	17.8
	≥10	24	53.3
	Mean ± SD	6.94 ± 3.80	
Previous attendance of training program	None	24	53.3
	One course	15	33.3
	Two courses	4	8.9
	Three and more	2	4.4

Table (2): Percentage distribution of the studied neonates according to their characteristics.

Child characteristics		No= 20	
		No.	%
Gestational Age / weeks	Less than 28	3	15.0
	28 to less than 32	8	40.0
	32 to 37	8	40.0
	More than 37	1	5.0
	Mean± SD in weeks	23.48±21.6	
Gender	Male	11	55.0
	Female	9	45.0
Method of PICC line insertion	Elective	20	100.0
Site of Insertion	Antecubital veins	10	50.0
	Saphenous veins	10	50.0

Table (3): Percentage distribution of total nurses' knowledge score about PICC line before and after 3month of educational session

Item	pre		Post		Chi square	P value
	No	%	No	%		
Good knowledge	0	0.0	17	37.8	5.43	0.007
Average knowledge	2	4.4	24	53.3		
Poor knowledge	43	95.6	4	8.9		
Total score Mean± SD	31.13±5.056		45.80±4.836			

Table (4): The mean scores of the studied nurses' performance to PICC line insertion and care before and after 3 months of educational session.

Practical Skills Items	Total number of nurses =45				
	Mean Scores				
	before	After 3 months	Test of significance		
	Mean ± SD	Mean ± SD	t	P	
1. Insertion Technique	30.54±12.31	36.6± 9.78	2.31	0.01*	
2. Site care and dressing change	16.22± 6.32	22.9± 4.98	8.34	0.02*	
3. Maintaining patency of PICC line	5.98±1.87	7.21±2.11	14.21	0.07*	
4. Removal of PICC line	25.18±7.19	37.14±4.22	9.76	0.000**	
Total score Mean ± SD	80.044±6.71	104.2±21.3	19.87	0.000**	

(*) statistically significant at $p \leq 0.05$

(**) highly statistical significance at $p < 0.001$

Table (5): Percentage distribution of the total practice score of studied nurses to PICC line insertion and care before and after 3 months of educational session

Total Practical Categories	Total number of nurses =45				Test of Significance	
	Total Practical Scores					
	Pre		Post		t	P
	No.	%	No.	%		
Competent	24	53.3	32	71.1	11.6	0.01*
Incompetent	21	46.7	13	28.9		

(* statistically significant at $p \leq 0.05$ - t = paired t test.

Table (6): Percentage distribution of early complications at the first 3 days of PICC line insertion before and after 3 months of the educational session

Early Complication	Total No= 20				Test of significance	
	Pre-session implementation		Post 3 month of session implementation			
	No	%	No	%	t	P
1. Bleeding from the insertion site	15	75.0	4	20.0	10.33	0.000**
2. Blood clots (thrombosis)	2	10.0	0	0.0	3.58	0.000**
3. Filtration	10	50.0	6	30.0	4.58	0.000**
4. Mechanical Phlebitis	2	10.0	0	0.0	3.58	0.000**
5. Occlusion of PICC line	6	30.0	2	10.0	5.73	0.000**
6. Air embolism	2	10.0	0	0.0	1.39	0.001*

(* statistically significant at $p \leq 0.05$

(**) highly statistical significance at $p < 0.001$

Table (7): Percentage distribution of late complications after 3 days of PICC line insertion before and after 3 months of the educational session

Late Complication	Total No= 20				Test of significance	
	Pre-session implementation		Post 3 month of session implementation			
	No.	%	No.	%	t	P
1. Blood clots (thrombosis)	4	20.0	0	0.0	2.58	0.000**
2. Filtration	14	70.0	8	40.0	7.58	0.001**
3. Mechanical Phlebitis	15	75.0	4	20.0	5.48	0.000**
4. Occlusion of PICC line	5	25.0	0	0.0	2.91	0.000**
5. Infection	3	15.0	0	0.0	1.68	0.001*

(* statistically significant at $p \leq 0.05$

(**) highly statistical significance at $p < 0.001$

Discussion:

The results of the present research showed that nearly half of the participant nursing staff belonged to the age group 20 and less than 30 years and majority of them were female (table1). This finding was in line with (Se & LS, 2016). Who found in his study about “Nurses’ Knowledge and performance concerning to Peripheral Intravenous Catheter Care” 45 (54%) respondents aged between 21-26 years and 39 (46%) who were more than 26 years? Also, Xu, et al., 2020) made study about “Nurses’ information regarding peripheral central catheter nursing care and its effects on keeping it patent, China: a cross-sectional survey” found that the largest age group average among 25 and 34 (51.6%), followed by those aged less 25 (30.9%).

Concerning educational level of studied nurses, the current results clarified that most of them had bachelor's degree. From the researcher point of view, this finding may be due to head nurse of NICU requesting large number of highly qualified nurses always and the governmental tendency for highly qualified nurses working in ICU which emphasize the fact that bachelor degree nurses recruited to care for critical care setting patients. These results contradicted with Se & Ls (2016) who found that most of the participant (60; 71%) possessed Diploma in Nursing, and 24 (29%) held bachelor of Nursing.

As regards to years of experience, more than half of the studied nurses had more than 10 years working in the neonatal intensive care unit. This result was contradicted with Deshnukh, & Shinde (2014) who found that the most of the participants 71.67 % had less than 5 years of clinical experience.

The present study showed that more than half of nurses did not receive any training program concerning PICC. This finding may be due to several nurses are recently experienced at the neonatal intensive care unit

and they haven't had the opportunity to attain training programs because of workload at NICU. The finding is in an agreement with Mohammed & Abdelfattah (2018) and revealed that, two thirds had not attained any previous training courses. Similarly, Abd El- Aal, (2018) on a study about "Effect of self-development program on nurses' performance regarding quality standers of neonatal care" reported that, most of the studied nurses did not attain any previous training courses related to neonatal care.

Concerning the characteristics of the studied neonates, the current study clarified that most of them were between 28 w to 37 weeks of gestational age with an equal chance of insertion using Antecubital and Saphenous veins which was electively inserted in all of studied neonates (Table 2). These results agreed with Nobre, et al. (2016) who stated that the majority of infants weighing less than 1000 grams and at less than 28 weeks gestation will have at least one, and in some cases several, PICC lines throughout their hospital stay using Antecubital and Saphenous veins. Another study by Ho, Liew & Tang (2016) found that most of the insertions (31 – 52.0%) were located in the saphenous vein, followed by basilic vein (14 – 25.0%). A study performed in Turkey, with retrospective data analysis of the insertion of the peripherally inserted central catheter through venous cannula as the introducer and scalpel between 2004 and 2010, showed 95 percent of the success of insertion in the saphenous vein; 86 percent in the first puncture and 7.7 ± 5.6 days of stay. A study made by Li, et al. (2019) in China about: application of peripherally inserted central catheters in critically ill newborns experience from a neonatal intensive care unit found that the mean gestational age of studied neonates were 30.9 ± 2.7 (range: 24–41 week).

According to total nurse's knowledge level about

PICC before and after educational program implementation, the current results revealed that majority of studied nurses had poor knowledge before program implementation while after program more than half of them had average level of knowledge with a statistical significance in total score of nurse's knowledges before and after educational program ($p=0.007$) (Table 3). This results accordance with Kun, et al. (2017) who study "Effect of specialty training on nursing staff's KAP on PICC and catheter maintenance" in china found improvement in the knowledge, attitude, and skills on PICC prior training are very low which means that the nurses are had no enough knowledge regarding PICC before training, which significantly improved after intervention showing that the proper training improved their understanding on the physical structure of human blood vessels, standardize their technique, and allow the nurses to have a professional experience in PICC catheterization.

Concerning nurses' performance to PICC insertion and care before and after educational program, the results indicated that the mean score of studied nurses performance to insertion technique, site care with dressing change, maintaining patency and removal of PICC was higher after educational program implementation than before with statistical significant difference regarding insertion technique, site care and dressing change and maintaining patency of PICC line mean score before and after program implementation ($p > 0.05$) (table 4). From the researcher view it is necessary to improve experience that help nursing staff to satisfy the special demands of infants in the use of catheters placed in peripheral vein that consequently reduce the occurrence of adverse events during hospitalization. These results come in the line with Xu (2020) results that indicated that the nurses' level of

mastery concerning different dimensions was different, followed by catheter removal (0.81 ± 0.117), PICC flushing and locking (0.76 ± 0.222) and complication management (0.71 ± 0.167).

As regards nurse level of competency before and after educational program implementation, the present results clarify that less than half of studied nurses had incompetent performance level before educational program implementation while after program near to three quarter of them had competent level of performance (table 5). This results in the line with Deshmukh and Shinde (2014) who found that the maximum of 75 % of subjects scored between 14-17 (Average) practice score in the pre-test before structured education and 48.33 % subjects scored between 18-25 (Good) practice score in the post-test after structured education. It indicates that the educational program is effective in enhancing the clinical skills scores of staff nurses concerning venous access care. Also, this results congruent with study of Woody & Davis (2013) about "Increasing Nurse Competence in Peripheral Intravenous Therapy" and found that insertion and caring of the PIC are considered essential nursing experience for all clinical nurses' staff.

The current study clarified early complications at the first 3 days of PICC line insertion pre, post educational program implementation, and showed that half and most of neonates suffer from bleeding from insertion site and filtration before implementation of educational session, which decreased post 3 month of educational session implementation. While the minority of them suffer from occlusion of PICC line, thrombosis and air embolism respectively before program, which eliminated after 3 month of program implementation. (table 6). These results come in the line with studies by Kun, et al. (2017) And Can, Salihoglu, Ozturk (2014)

& (Johnson, Thomas, Grove, Jarboe (2016) who illustrated that the Initial complication with PICC line insertions are relatively low. The complications related to initial placement include hematoma formation, injury to surround structures including nerves and arteries, and mal positioned lines. Additionally, there are multiple complications that can occur following placement, including line infections, line migration, and venous thrombosis and stenosis

Concerning late complications after 3 days of PICC line insertion, the current results showed that almost three quarters of neonates were suffering from mechanical phlebitis and filtration before implementation of educational program, which decreased after 3 month of educational session implementation. While the minority of them suffers from occlusion of PICC line, thrombosis (blood clots) and infection respectively before program, which eliminated after 3 months of program (table 7). These results contradicted with Colacchio, et al, (2012) who found that later complications include line infection, catheter migration, vessel stenosis and deep venous thrombosis.

Finally, implementation of an educational program improved nurse's knowledge and practices regarding peripherally inserted central catheter also, neonatal health outcomes improved after educational program implementation.

Conclusion:

Based on the findings of the study results. It is concluded that:

More than half of the studied nurses possessed average knowledge towards the care of PICC after educational program implementation. More than 71% of nurses had competent practice towards the care of PICC at NICU which indicate the effectiveness of the educational program. Also, the prevalence of

complication either early or late significantly decreased after educational program implementation.

Recommendations:

The following recommendations were suggested:

- Nurses should be encouraged and given the opportunity to attend continuing nursing education in order to gain more updating knowledge and practice about PICC care.
- Standardized guidelines for dealing with PICC associated complication must be available for all nursing staff at NICU.
- Provision of adequate supervision of nurses during their practices and providing teaching on spot with motivation and feedback.
- Further studies required to explore the relation between PICC associated problems and neonate's health condition.
- Ongoing in-service educational program about PICC should be designed and implemented at all NICU to improve nurses knowledge and practices on the basis of nurses actual needs.

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