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Designed nursing intervention protocol to reduce peripheral catheter cannula complications among adults patients

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Abstract

Background: Peripheral intravenous catheters are the most common invasive devices used during clinical care worldwide**.**

Aim of the study: To investigate the effect of implementing designed nursing intervention protocol to reduce peripheral catheter cannula complications among adult's patients.

Research design: A Quasi-experimental research design was utilized in this study conducted in the medical and surgical inpatient units in Minia University Hospital. Two hundred male and female adult inpatient (study and control groups).

Results: showed that the majority of the studied group did not develop any peripheral catheter cannulation complications and no pain, erythema, swelling, and no palpable hardening of vein at catheter site while control group more than one-third of them developed phlebitis, near to one quarter had painful I.V site with erythema, some degree of swelling and the minority of them had streak formation and no palpable cord with statistically significant differences.

Conclusion: Implementation of nursing intervention protocol was effective in reducing peripheral venous catheter complications.

Keywords: Adults patients, designed nursing intervention, peripheral catheter cannula complications

1. Introduction

Peripheral line placement, known as peripheral intravenous (IV) cannulation, is the injection into a peripheral vein of an indwelling single-lumen plastic tube via the skin. Depending on the region, these devices can be called peripheral IV (or venous) tubes, cannulas, or catheters. It allows for the direct introduction of fluids, medicines, and other therapies such as blood products into the cardiovascular system, bypassing other barriers to absorption and reaching most target organs very quickly. When implanted, a well-functioning line will stay in use for several days if required, eliminating the need for frequent needle insertion into the patient should it be necessary to continue treatment. Placing peripheral lines is the most widely performed invasive procedure in acute healthcare environments, with as many as 80 percent of hospital patients needing intravenous access at some point during admission, and more than 1 billion lines are used annually worldwide [1].

Most hospitalized patients worldwide have at least one intravenous peripheral catheter (PIVC) which makes PIVC insertion one of the most common clinical procedures. Physicians, specialized clinicians, and nurses implant more than 300 million of these machines into hospitalized patients annually in the United States. Despite their prevalence, PIVCs are associated with high complications rates, including difficulty in insertion, phlebitis, infiltration, occlusion, dislocation, and catheter-associated bloodstream infection (CABSI), known to increase risk of morbidity and mortality. These complications result in prolonged hospital stay, unnecessary diagnostic and treatment procedures, stress for patients and their relatives, increased workload for health personnel and economic losses [2].

The micro-organisms can be transmitted via direct or indirect contact. Universal infection control measures are recommended to prevent such transmission when accessing a cannula insertion site for the PIV catheter or during intravenous drug and/or fluid administration. Universal infection control measures include proper hand hygiene, putting on gloves, setting up a clean environment area, using sterile equipment, proper disposal of contaminated equipment and linen, and safe disposal of sharps [3].

Nurses play a vitally important function in infection prevention [4]. Some of the treatments and preventive measures like insertion, tracking, and assessment of peripheral venous catheter (PVC) sites are part of daily nursing care. The nurse will have correct information and intervention about IV Infusion and IV unit preparation and administration. Additionally, they should also be mindful of the prevention, diagnosis and management of local and systemic complications assisted by recommendations for complex evidence-based practice. One of the major threats

for phlebitis occurrence is due to the insufficiently trained workers putting and maintaining PVC [5]

Nurses have responsibilities such as determining the area to be intervened during peripheral intravenous administration, selecting the catheter number to be used, knowing the correct technique regarding peripheral intravenous intervention, maintaining the application by performing the necessary controls, maintaining intravenous catheter care, and following the complications. When evaluating the nurses' level of awareness about PIVC treatments, it was found that the nurses were in the center [3]

The nurses implement care packages and frequent training and behavioral change, which are very important for developing nursing competence and technical skills for peripheral intravenous catheter application. Evidence indicates that training programs should be offered to health professionals on a regular basis in the form of theoretical principles and practical presentations, and that the expertise and skills to be learned should be tested, the ability to ensure the execution of procedures should be acquired and intervention skills should be acquired [6].

2. Significance of the study

Peripheral intravenous (IV) catheter insertion, the most common invasive hospital procedure performed worldwide, is associated with a number of complications and an unacceptably high overall failure rate, even in the best of circumstances, of 35 to 50 percent. Catheter failure is expensive for patients, careers and the health care system. Despite progress, analysis of the mechanisms that underlie the persistently high rate of peripheral IV failure reveals opportunities for improvement [7]. Currently, about 60% of hospital patients should have a PIVC implanted and up to 90% of patients visiting the emergency department (ED) would need a PIVC at any time during treatment. Nearly 70% of the catheter-related complications experienced by these patients, primarily infection, phlebitis, occlusion, dislocation, infiltration, and extravasation, resulting in extended hospital stay and costs and increasing the risk of vascular damage and bloodstream infections [8].

Complications and failure of peripheral intravenous cannulation commonly trigger the insertion of a replacement device and may entail significant costs. One example is CABSI linked to PIVC, where the cost of care was estimated to be between US$ 35,000 and US$ 56,000 per patient [2].

Approximately 70% of all acute hospital admissions require an average of 7-10 days of intravenous therapy [9]. Many hospital institutions across the nation have mandated a peripheral catheter replacement protocol every 72-96 hours in patients, irrespective of catheter patentability and lack of clinical symptoms of phlebitis and/or infection [10]

For this reason, the researcher shows that the procedure needs manual skills, professional competency, knowledge about the anatomy and physiology of vascular system and aseptic technique to reduce and early detection of complications to reduce length time of the patient to stay in hospital and reduce costs and to maintain health care team effort and provide comfort for the patient.

3. Aim of the study: To investigate the effect of implementing designed nursing intervention protocol on the prevention of peripheral catheter cannula complications among Adults patients.

4. Research hypothesis: the incidence of peripheral catheter complications will be lower among study group patients than those among control group one

5. Subjects and methods

5.1 Research design

A quasi-experimental research design was utilized in this study.

5.2 Setting

This study conducted in the medical and surgical inpatient units in Minia University Hospital

5.3 Study subjects

Two hundred male and female adult inpatient (study and control groups) admitted in medical and surgical departments

Inclusion criteria

- Patients connected with catheter cannulation
- Free from chronic illness
- Free from blood disorders.
- Not administered anticoagulated drugs

5.4 Data collection tools

Three tools were used to collect data which included

The tool I: Patient assessment sheet which included two parts

Part one: Demographic datasheet which included age, gender, and educational level.

Part two: Patient assessment sheet which included who inserted the cannula, vein size, site of insertion, duration of cannulation, the reason for removal, drug added to infusion, type of drug injection, and flushed after injection.

Part three: Peripheral catheter cannulation complications as hematoma, irritation, allergic reaction, extravasation, phlebitis, occlusion, dislodgment, thrombophlebitis, or infection.

Tool II: Cannula assessment scale: It developed by Osei-Tutu *et al.* [11] which included six items, scored from 0-5.

Zero score: Means no pain, erythema, swelling, and no palpable hardening of vein at the catheter site.

One score: Means painful I.V site/ erythema, no swelling no palpable hardening of the vein,

Two Score: Means painful I.V site with erythema, or some degree of swelling no both and no palpable hardening of the vein.

Three scores: Mean painful I.V site with erythema, and swelling, palpable hardening vein less than 7.5 cm above the I.V site.

Four scores: Mean painful I.V site, erythema, swelling, and palpable hardening.

Five score: Means thrombophlebitis of the vein, along with all the signs of grade 4, catheter infusion may have stopped running due to thrombosis.

Tool III: Phlebitis assessment scale: developed by Smeltzer, *et al*. [12]. It included four items grading from 0 to 3. This scale used to document the occurrence of phlebitis and to serve as a baseline for assessing further changes. The four items are:

Zero: Means no clinical symptoms.

One score: Means erythema with or without pain, edema may or may not be present, no streak formation, no palpable cord.

Two score: Means erythema with or without pain, edema may or may not be present, streak formation, no palpable cord.

Three score: Erythema with or without pain, edema may or may not be present, streak formation, palpable cord.

5.5 Data collection procedure

Preparatory phase

a. Preparation of tools: after extensive literature review, tools for data collection were constructed review by a panel expert, then tested for its clarity and applicability on the pilot sample.

Pilot study

a. Before performing the actual study, a pilot study was carried out on five patients attached with the peripheral venous cannula to clarity the tools, estimate the time needed for data collection, test the feasibility of conducting this research. After analyzing the pilot study results, no medications were done
b. Protocol construction: after extensive literature review and conduction of the pilot study the intervention protocol was designed accordingly then tested by a panel of medical surgical nursing experts. This protocol covered 8 main areas as
    1. Safe, aseptic, short-term vascular access and administration.
    2. Select vein properly.
    3. Observe puncture site regularly.
    4. Catheter site change.
    5. Vascular access maintenance.
    6. Tubing changes.
    7. Solution changes.
    8. Special considerations.

Implementation phase

An official letter was issued from the dean of the faculty of nursing to the director of Minia University Hospital. meeting with physicians, nurses, and interns of medical and medical departments to explain the nature and purpose of the study. In addition, written consent obtained from each of the participating patients to be included in the study.

Clarification of the nature and purpose of the study was done on the initial interview with each legible patient. The data collection began in February 2019 ended in September 2019. The researchers spend 5 hours daily from 8 A.M to 1:00 Pm for 2 days/week or until cannula removed.

The patients were assigned randomly into study and control groups. Both study and control groups patients were exposed to the routine nursing intervention. In addition, study group patients received a designed nursing intervention protocol.

For study group patients: the researchers utilized the outlined steps in the designed protocol for vein selection, solution selection, preparation, venipuncture, and maintenance of catheter administration for each patient during the morning shift. The patient assessment sheet filled one time before started the study. Then each patient, cannula, and phlebitis scale were assessed daily (in all shifts) unit discharge or stop the infusion.

For control group patients: the researcher observed and recorded consequences and responses to cannulation and catheter therapy during all work shifts. The patient assessment sheet filled one time before started the study. Then each patient, cannula, and phlebitis scale were assessed daily (in all shifts) unit discharge or stop the infusion.

5.6 Statistical analysis

The collected data were tabulated & statistically analyzed using the software program and statistical package for social science (IBM SPSS 25.0). The statistical analysis included a percentage (%), mean, stander deviation (SD), and Chi-square (x^2). Chi-square (x^2) was used to test the association between two qualitative variables. Spearman's rank correlation was used to assess the interrelationships among the quantitative variables. The *P*-value of ≤ 0.05 indicates a significant result while the *P*-value of > 0.05 indicates a non-significant result Testing hypothesis was applied to check the significance of differences between the occurrence of catheter complications among study (after applied nursing interventions) and control groups.

6. Results

Table 1: Comparison between study and control groups patients concerning their categorical demographic data (n = 200).

Items	Study group (n= 100)		Control group (n=100)		X^2	*P*-value
	No.	%	No.	%		
Age/years						
18-28	30	30.0	33	33.0	.976	.781 NS
29-39	18	18.0	17	17.0		
40-50	24	24.0	19	19.0		
51-60	28	28.0	31	31.0		
Mean± SD	39.9 ±14.33		39.4 ± 14.5			

Gender						
Male	48	48.0	54	54.0	.001	.974 NS
Female	52	52.0	46	46.0		
Educational level						
Illiterate	42	42.0	51	51.0	6.832	.655
Read and write	25	25.0	11	11.0		
Secondary school	26	26.0	29	29.0		
University	7	7.0	9	9.0		

NS = Not statistically significance differences

Table (1): shows that the highest percentage of both study and control groups were aged between 18- 28 years old with mean ages 39.9 ±14.33 and 39.4 ± 14.5 years for both groups respectively and they were female patients. Also, 42.0%, 51.0% of the study, and control groups were illiterate respectively, with no statistical significance difference between both groups concerning their categorical demographic data.

Table 2: Comparison between study and control groups patients concerning their assessment sheet (n = 200).

Items	**Study group (n= 100)**		**Control group (n=100)**		X^2	***P*-value**
	No.	**%**	**No.**	**%**		
Cannula inserted by						
Bedside nurse	0	.0	77	77.0	121.396	.001**
Internship students	0	.0	23	23.0		
Researchers	100	100.0	0	.0		
Vein size						
Large	86	86.0	63	63.0	13.922	.001**
Small	14	14.0	37	37.0		
Site of insertion						
Right arm	10	10.0	53	53.0	42.846	.001**
Left arm	90	90.0	47	47.0		
Durations of cannulation						
10 min – 24 hours	0	.0	21	21.0	116.099	.001**
<4 days	91	91.0	14	14.0		
4- 8 days	9	9.0	65	65.0		
Reason for removal						
Routine change	94	94.0	3	3.0	9.64	.04*
Occur of complication	6	6.0	83	83.0		
Discharge	0	.0	14	14.0		
Drug added to the infusion						
Yes	50	50.0	47	47.0	.180	.671
No	50	50.0	53	53.0		
Type of drug injection						
Irritant	95	95.0	91	91.0	.520	.470 NS
Nonirritant	5	5.0	9	9.0		
Flushed after injection						
Yes	100	100.0	2	2.0	188.198	.001**
No	0	.0	98	98.0		

NS= not statistically significance differences
*statistically significance differences
**highly statistically significance differences

Table 2 illustrates that mainly equal percentage concerning added drug to infusion and administer irritant medication for study and control group subject (50% and 53%), all study group subject have flushed cannula after administering medication and inserted by the researcher in the left arm with percentage (100%, 100%, and 90%) while control group subject majority no flushed cannula and cannula inserted by bedside nurse in the right arm with percentage (98%, 77%, and 53%), use a large vein in insertion for study and control group subject with percentage (86%, 63%), and the majority of study group remove cannula before four days duration and removed by the research as routine care while control group subject remains cannula in site for about 4-5 days and reason to remove the cannula from complications occurred with percentage (65% and 83%) with significant *P* -value 0.001.

Table 3: Comparison between study and control groups patients concerning peripheral catheter cannulation complications (n = 200).

Complications	**Study group (n= 100)**		**Control group (n=100)**		X^2	***P*-value**
	No.	**%**	**No.**	**%**		
No complication	85	85	8	8.0	115.995	.00001**
Hematoma, irritation, allergic reaction	0	.0	18	18.0		
Extravagation	5	5.0	5	5.0		

Phlebitis	7	7.0	35	35.0		
Thrombophlebitis and occlusion	0	.0	21	21.0		
Dislodgment, bending and infiltration	3	3.0	13	13.0		

**highly statistically significance differences

Table (3): represents that, 85.0, 8.0% of the study and control groups patients did not develop any peripheral catheter cannulation complications and 7.0% of the study group vs 35.0% of the control group developed phlebitis as a peripheral catheter cannulation complication with P-value.

Table 4: Comparison between study and control groups patients concerning cannula assessment scale scores, and phlebitis assessment scale scores (n = 100).

Items	Study group (n= 100)		Control group (n=100)		X^2	*P*-value
	No.	%	No.	%		
Cannula assessment scale						
Zero	85	85.0	9	9.0	97.882	.00001**
One	11	11.0	14	14.0		
Two	4	4.0	24	24.0		
Three	0	.0	15	15.0		
Four	0	.0	19	19.0		
Five	0	.0	19	19.0		
Phlebitis assessment scale						
No clinical symptoms	93	93.0	65	65.0	27.240	.00001**
One	7	7.0	8	8.0		
Two	0	.0	17	17.0		
Three	0	.0	10	10.0		

**highly statistically significance differences

Table (4): notes that 85.0% of the study group not suffered from pain, erythema, swelling, or palpable hardening of vein at catheter site versus 9.0% of the control group with *P*-value .001. Phlebitis assessment scale, 93.0% of the study group don't suffer from any clinical symptoms of phlebitis versus 65.0% of the control group with *P*-value.

Table 5: Correlation between patient age, educational level, and their phlebitis assessment scale (n=200)

Items	Study group		Control group	
	Phlebitis assessment scale		Phlebitis assessment scale	
	r	*P*-value	r	*P*-value
Age	.325	.05*	.517	.004**
Educational level	-.387	.04*	.625	.003**

Table (5): showed that there a fair positive association between patient age and their phlebitis scale (r =.325& P-value 0.05), and there was a negative fair association between patient education level and their phlebitis scale (r= -.387 & P- value among study group 0.04). There were a moderate positive association between patient age, their educational level and their phlebitis scale (r= .517& *P*-value 0.004 and r= .625 & *P*- value .003 respectively) among control group.

Table 6: Relation between phlebitis assessment scale among the studied group with their vein size, site of insertion, and durations of cannulation (n= 100).

Items	Phlebitis assessment scale				Test of significance	
	Study group (n= 100)				X^2	*P*-value
	No clinical symptoms (n=93)		One (n =7)			
	No.	%	No.	%		
Vein size						
Large	85	91.4	1	14.3	32.151	.00001**
Small	8	8.6	6	85.7		
Site of insertion						
Right arm	7	7.5	3	42.9	9.029	.003**
Left arm	86	92.5	4	57.1		
Durations of cannulation						
<4 days	90	96.8	1	14.3	54.086	.00001**
4- 8 days	3	3.2	6	85.7		

*statistically significance differences
**highly statistically significance differences

Table (6): presented that there were statistically significant differences between the occurrence of phlebitis and vein size, site of insertion, and duration of cannulation among the studied group with *P* – value ≤ .0001, .003, & .00001 respectively.

Table 7: Relation between phlebitis assessment scale among the control group with their vein size, site of insertion, and durations of cannulation (n= 100).

Items	Phlebitis assessment scale									
	Control group (n=100)								X^2	*P*-value
	No clinical symptom (n=65)		One (n =8)		Two (n= 17)		Three (n=10)			
	No.	%	No.	%	No.	%	No.	%		
Vein size										
Large	55	84.5	2	25.0	4	23.5	2	20.0	37.279	.00001**
Small	10	15.5	6	75.0	13	76.5	8	80.0		
Site of insertion										
Right arm	37	56.9	3	37.5	8	47.0	5	50.0	1.450	.694 NS
Left arm	28	43.1	5	62.5	9	53.0	5	50.0		
Durations of cannulation										
10 min-24 hours	20	30.8	1	12.5	0	.0	0	.0	6.9843	.322 NS
<4 days	7	***10.8***	1	12.5	3	17.6	3	30.0		
4- 8 days	38	58.4	6	75.0	14	82.4	7	70.0		

NS= not statistically significance differences

**highly statistically significance differences

Table (7): noted that there were statistically significant differences between the occurrence of phlebitis and vein size which large vein size decrease occurrence of peripheral intravenous cannulation complication among the control group with *P*-value ≤ .00001.

7. Discussion

Peripheral intravenous catheters (PIVC) are the most common invasive devices used during clinical care worldwide. At present about 60% of hospital inpatients would have a PIVC inserted [8]. The present study clarifies that regularly provide nursing intervention for peripheral intravenous cannula inserted to hospitalized patients will reduce the occurrence of peripheral catheter cannula complications and maintain comfort for the patients. The present study investigated 200 patients attached to peripheral intravenous cannula calcified to two groups (study and control groups).

The present results showed that the highest percentage of both study and control groups were aged between 18- 28 years old with mean ages 39.9 ±14.33 and 39.4 ± 14.5 years for both groups respectively and they were female patients. This result incongruent with Abhijit and Raghu [13] who reported that one hundred fifty patients were included in their study, out of which 89 were male (59.33%) and 61 were female (40.7%). More than half of the patients were aged less than 60 yrs (54%).

All studied group inserted cannulation by the researcher that evidenced by Hugill, [14] who reported that optimal outcomes in IV therapy require an interprofessional team approach (primarily nurses and phlebotomy technologists reporting to managing physicians), with prompt placement when required, regular monitoring of line function, considering the ongoing need for venous access, removing lines when their presence is no longer clinically indicated, and early intervention if complications are suspected.

Various sites around the body can be successfully cannulated with a peripheral venous line. The non-dominant upper extremity is commonly chosen, because of comfort, reduced risk of dislodgement, and lower incidence of thrombosis or thrombophlebitis [15]. Veins should be selected on the non-dominant forearm (especially if the catheter is to remain in position for any length of time) [16]. Also, Marsh, *et al.*, [17] mentioned that, the basilic or cephalic veins on the posterior (dorsal) forearm are the preferred site for catheterization. This agrees with the present study that clarifies the most common site for an insertion was in the left arm with 90% to reduce complications associated with peripheral intravenous catheter insertion and promote comfort.

Regarding the duration of cannulation; the present results showed that the most studied group removed cannulation before 4 days of insertion while the minority of the control group at the same time. This finding evidenced by some healthcare facilities traditionally mandated that IV lines should be removed and replaced as a matter of practice after a certain period, such as 48 or 72 hours, to reduce the risk of complications. A recent systematic review of the literature with meta-analysis found no evidence that routine replacement of IV lines reduces the incidence of thrombophlebitis, catheter-related bloodstream infections, pain, or mortality (although it likely reduces rates of catheter blockage), and such practice may increase overall healthcare costs associated with line placement [10].

Regarding the occurrence of peripheral venous cannulation complications, the present study presented that the minority of the studied group had phlebitis and more than one-third of the control group followed by thrombophlebitis and occlusion in the one-fifth of control group occurs after peripheral catheter insertion. This result in the same line with Braga, *et al.* [18] determined the incidence rate and risk factors for the nursing-sensitive indicators phlebitis and infiltration in patients with peripheral venous catheters (PVCs) reported that the incidence of phlebitis was 1.25% while using a peripheral intravenous catheter, and 1.38% post-infusion. The incidence of phlebitis while using PIC was associated with the length of time the catheter remained in place, whereas post-infusion phlebitis was associated with a puncture in the forearm and Carr, *et al.* [19] mentioned that phlebitis ranked first among complications with the

occurrence of 44%, followed by infiltration of 16.3%, while the incidence of occlusion and catheter dislodgement was 7.6% and 5.6%, respectively. This result due to flush cannula by 0.9 normal saline after every used and decrease length time of remain cannula in site to reduce the incidence of complications in the studied group.

Regarding the relation between vein size and occurrence of peripheral intravenous cannulation complication, the present study found that occurrence of complications in the small vein size more than a large vein size with statistically significant relation in the control group. That evidenced by Carr *et al.* [19] mentioned that in assessing the occurrence of phlebitis, the multivariate analysis highlighted the presence of comorbidity, current infection, catheter size, time in situ and the number of administrations of infusion solutions associated with risk, whereas 20-gauge catheter, two or more attempts at cannulation and administration of a high-risk solution during the first day have been singled out with regard to infiltration.

Toshiaki, *et al*., [20] explained that, the findings supported the hypothesis confirming the effectiveness of the care bundle in catheter failure prevention based on vein diameter measurement and appropriate catheter tip position. This could be explained by mechanical irritation reduction because of selecting large diameter of vein and appropriate catheter tip position, it was possible not only to achieve mechanical stimulation, but also potentially prevent thrombus formation due to those vessel's enhanced blood flow.

8. Conclusion

Implementation of nursing intervention protocol was effective in reducing peripheral venous catheter complications.

9. Recommendations

1. Applying nursing interventions protocol on a large sample and other different departments in hospitals and locations and measuring the effect of nursing intervention on reducing both local and systemic complications.
2. Designing and implementing an educational training program for nurses to improve the quality of care before, during, and after insert of a peripheral venous catheter.

10. References

1. Piper R, Carr PJ, Kelsey LJ, Bulmer AC, Keogh S, Doyle BJ. The mechanistic causes of peripheral intravenous catheter failure based on a parametric computational study. Sci Rep. 2018; 218(1):3441.
2. Alexandrou E, Ray-Barruel G, Carr PJ, Frost SA, Inwood S, Higgins N, Rickard CM. Use of short peripheral intravenous catheters: characteristics, management, and outcomes worldwide. J Hosp Med. 2018; 13(5):E1-E7.
3. Nickel B. Peripheral intravenous access: applying infusion therapy standards of practice to improve patient safety. Critical care nurse. 2019; 39(1):61-71.
4. Osti C, Wosti D, Pandey B, Zhao Q. Ventilator-Associated Pneumonia and Role of Nurses in Its Prevention. Journal of the Nepal Medical Association. 2017, 56(208).
5. Arbaee I. Nurses knowledge and practice towards care and maintenance of. Qualitative Research. 2016; 1(3):385-405.
6. Oren B, Cuvadar A. The Effectiveness of Training for Peripheral Venous Catheter Application in Intensive Care Units of a University Hospital. International Journal of Caring Sciences. 2020; 13(1):163.
7. Helm RE. Accepted but Unacceptable: Peripheral IV Catheter Failure: Follow-up. Journal of Infusion Nursing. 2019; 42(3):149-150.
8. Panel M, Angel R, Calero I, Mavillard J, Miguel M, Asencio F. Defining risk factors associated with difficult peripheral venous Cannulation: A systematic review and meta-analysis. 2020; 49(3):273-286.
9. Morrison K, Holt KE. The effectiveness of clinically indicated replacement of peripheral intravenous catheters: an evidence review with implications for clinical practice. Worldviews on Evidence-Based Nursing. 2015; 12(4):187-198.
10. Webster J, Osborne S, Rickard CM, Marsh N. Clinically-indicated replacement versus routine replacement of peripheral venous catheters. Cochrane Database of Systematic Reviews. 2019, (1)23;1:CD007798.
11. Osei-Tutu E, Tuoyire DA, Debrah S, Ayetey H. Peripheral intravenous cannulation and phlebitis risk at cape coast teaching hospital. Postgraduate Medical Journal of Ghana. 2015; 4(1):11-18.
12. Smeltzer SC, Bare BG, Hinlke JL, Cheever KH. Brunner and Suddarth Text book of Medical Surgical Nursing. 12th ed. New Delhi (India): Wolters Kluwer. 2010; 1:308-9.
13. Abhijit M, Raghu K. Study on incidence of phlebitis following the use of the peripheral intravenous catheter, J Family Med Prim Care. 2019; 8(9):2827-2831.
14. Hugill K. Preventing bloodstream infection in IV therapy. Br J Nurs. 2017; 26(14):S4-S10.
15. Beecham GB, Tackling G. Peripheral Line Placement. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing, 2020.
16. NSW Ministry of Health. Guideline for Peripheral Intravenous Cannula (PIVC) insertion and post insertion care in adult patients, 2013.
17. Marsh N, Webster J, Rickard C, Mihala G. Devices and dressings to secure peripheral venous catheters to prevent complications (protocol). The Cochrane Library, 2014, (4).
18. Braga LM, Parreira PM, Oliveira AS, Mónico LS, Arreguy-Sena C, Henriques MA. Phlebitis and infiltration: vascular trauma associated with the peripheral venous catheter. Rev. Latino-Am. Enfermagem. 2018; 26:3002.
19. Carr PJ, Higgins NS, Cooke ML, Rippey J, Rickard CM. Tools, Clinical Prediction Rules, and Algorithms for the Insertion of Peripheral Intravenous Catheters in Adult Hospitalized Patients: A Systematic Scoping Review of Literature. J Hosp Med. 2017; 12(10):851-858.
20. Toshiaki T, Ryoko M, Mari A, Maki M, Chiho K, Miwa N *et al*. Preventing peripheral intravenous catheter failure by reducing mechanical irritation. Scientific Reports volume 10, Article number, 2020, 1550.