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Closed Versus Open Peripheral Intravenous Cannulation: Predicted Incidence of Phlebitis

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Abstract: Studies that compared effect of closed versus open peripheral intravenous cannulation on the incidence of phlebitis are few. This study aimed to compare the effect of closed versus open peripheral intravenous cannulation on the predicted incidence of phlebitis. ***Setting*:** The study was carried out at the Medical and Surgical Departments at Alexandria Main University Hospital. A quasi-experimental research design was utilized. Data were collected from patients attending the pre-mentioned setting. Two hundred adults admitted and on IV therapy, were equally recruited into two groups (100 patients, each). One tool entitled, as "Peripheral Intravenous Cannulation(PIVC) site Observational Checklist" was used. It aimed to assess the PIVC site for the occurrence of phlebitis manifestations within the 72 hours of cannulation. Data were collected from the start of March 2014 to end of January 2015. Results: Statistical significance differences were detected between the two groups, in relation to incidence of phlebitis manifestations in the three days of PIVC site monitoring. Conclusion: the closed PIVC system has less incidence of phlebitis than the open. Recommendations: Replication of the study on larger probability samples and longer indwell time in different areas of specialties, as well as identifying local barriers hindering healthcare providers' application of the closed PIVC system use are advocated. More attention is needed in this area by training care providers on the closed PIVCs method.

Key words: Closed peripheral intravenous cannulation · Open peripheral intravenous cannulation · Phlebitis

INTRODUCTION

Intravenous (IV) therapy administration is one of the major nurses' responsibilities. Up to eighty percent of all patients admitted to hospital worldwide will receive a peripheral IV therapy [1]. According to Rickard *et al*. [2] who stated that; approximately 60% to 90% of hospitalized patients require an IV cannula insertion.

In most healthcare settings, peripheral IV (PIV) cannulas are critical tool in the delivery of patient care; it enables administration of IV therapies namely; antibiotic, IV solutions, pain relief and/or total parenteral nutrition (TPN) to reach patient effectively through the blood stream [3, 4].

Since the procedure involves breaking the skin and leaving a foreign body in the vein. Researches highlighted that IV therapy has many complications of which; infiltration, extravasation, phlebitis and thrombophlebitis. These complications should be recognized as early as possible by the nurse who is responsible for administering, monitoring, maintaining and recognizing potential drug interactions and complications [5].

The early detection by the nurse helps to reduce the risk of further IV therapy complications. Local IV access complications prone the patient for deprivation from medication and fluid need; this will lead to increase hospital stay, subsequent increase in cost [3, 6].

Many studies have demonstrated that; 20 to 80 % of patients receiving PIV therapy develop phlebitis [1, 4, 5]. Phlebitis is the inflammation of a vein; which can be superficial or deep. The peripheral intravenous cannulas (PIVCs) should not be painful; pain is the early symptom of phlebitis, which means that the PIVC should be removed [7]. Phlebitis is the most common IV access complication and is characterized by one or more of the following: pain, tenderness, redness, swelling, warmth, a

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red streak along the vein, hardness of the IV site and low grade fever [8].

Nurses can play a valuable role in minimizing the associated physical discomfort and complications that patients may experience as a result of having a peripheral cannula inserted through maintaining their knowledge and skills in relation to patient preparation, assessment and the care and management of the cannula. Peripheral intravenous cannulation is a most common nursing procedure performed, so**;** nurses should assess the IV access site every shift for incidence of phlebitis manifestations [9, 10].

A number of phlebitis scales and assessment tools have been developed to assist nurses throughout IV therapy assessment. The most commonly used tool in the UK is the Phlebitis Grading Scale; its score range from 0 to 4; in which "0" refers to no signs of phlebitis and "4" refers to advanced stage thrombophlebitis. Accordingly any incidence of phlebitis greater than grade 2 should be reported to the physician; for early management and cannula replacement, especially for those patients at highly at risk for IV phlebitis occurrence [8, 9].

The Centers for Disease Control and Prevention (CDC) guidelines recommend that; appropriate PIVCs securement should be acknowledged to decrease the risk of phlebitis and cannula dislodgement, which is advantageous in preventing blood stream infections (BSIs) [11].

Generally; there are a range of different PIVCs devices; health care team choice has been improved recently, in order to ensure both patients and staff safety, through prevention of sharps injury, phlebitis, infection, leakage or extravasations through recommending the use of closed PIVC systems [12].

This integrated closed PIVCs system has a three-way valve to which is attached have a flow plug for venting out the air during insertion. Evidence has shown that closed PIVCs systems has advantages of lowering blood borne pathogen (BBP) exposure incidence, needle stick injury, has longer indwell times and reduce mechanical phlebitis up to 50%; thus it is more stable than open PIVCs systems [13].

The closed IV system includes a safety IV catheter, extension tubing with Y-connection with needleless access system. This gives more secure connection with the IV infusion line, syringe use for either flushing, administer medication or blood withdrawal. Upon withdrawal, the needle tip is automatically shielded; protecting the healthcare worker from injuries and avoid unnecessary blood contact [13, 14].

The IV administration is primarily delegated to the registered nurses who has been received special IV training; according to the settings' policies. Nurses often do the specific required PIVCs skills, act in a way which promotes and safeguards themselves and patients. Thus, nurses assist the patient 24 hours a day and have the responsibility to check the IV line status and monitor for complications as well as managing problems when arise [15, 16].

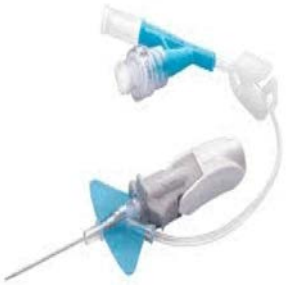

Fig. 1: Closed PIVCs [14]

Fig. 2: Open PIVCs [14]

Significance of the Study: Closed PIVCs management could be a groundbreaking approach that adds knowledge update for the scope of professional nursing practice for nurses involved in peripheral cannula patients' management and also will aid in decreasing phlebitis incidence, consequently benefit the holistic patient care. In common this scope needs to be investigated as it will help the practitioner nurse to conversant with relevant theory and research underpinning the practical aspects of nursing procedure.

Operational Definition

Closed PIVC: Is the use of closed PIVC device**;** which once it has been advanced into the vessel and the needle is removed, blood flow is contained and observed within the closed system without any blood spillage from the cannula's catheter hub. Thus; therapy was administered through a three way connection without PIVC disconnection**,** for the purpose of giving drugs or

changing infusion bottles or any other reasons.

Open PIVC: Is the routine PIVCs which is commonly performed in health care settings, the cannula comprised a small catheter tubing (1/2 – 2 inches) with an open port used as the connection point to an IV administration set.

Aim of the Study: This study aimed to compare the effect of closed versus open peripheral intravenous cannulation (PIVC) on the predicted incidence of phlebitis.

Research Hypothesis: Patients with closed PIVC would have less incidence of phlebitis than those with open PIVCs.

MATERIALS AND METHODS

Design: A quasi-experimental, research design was used for the purpose of study.

Settings: This study was conducted at the Medical and Surgical Departments**,** Alexandria Main University Hospital.

Subjects: Convenient sample of two hundred adult males/females patients admitted to the above mentioned settings and on PIV therapy; were included. Subjects were recruited, *provided that they met the following criteria:*

- Able to give consent and willing to participate
- Scheduled for IV therapy for at least 3 consecutive days, veins are accessible, easily detected by palpation &/or visual inspection.
- The cephalic and basilica veins of the forearm were utilized to avoid data bias and errors.
- No cannulas disconnection for 3 consecutive days was expected.

Exclusion criteria included the following:

- Presence of arm cellulitis, burn, arteriovenous fistula or radical mastectomy in the arm chosen for peripheral intravenous cannulas insertion.
- Fever for any reasons.
- Patients having known allergies to the adhesive tape.
- Veins which are tortuous, or sited near a bony prominence(s)
- Drugs that irritate the veins as well as anticoagulant therapy.
- Patients with cerebrovascular accidents; skin diseases; or paralysis.

Study subjects were equally and sequentially recruited into two groups (100 patients each) according to the peripheral intravenous cannulation as follows:

- Open peripheral intravenous cannula (PIVCs) system (control group).
- Closed PIVCs system (study group).

Sample Size Calculation: Epi info -7 programs was used to estimate the sample size using the following parameters: Population size = 360/ 3months, Expected frequency = 50 %, Acceptable error = 5%, Confidence co efficient=95% thus; Minimum sample size =200 patients.

Tool: One tool entitled as "Peripheral Intravenous Cannulation Site Observational Checklist" was utilized for purpose of the present study. It was developed by the researchers after a thorough review of related literatures to assess the PIVC site for the presence of signs and symptoms of phlebitis within the 3 days post cannulation [12-17]. It consisted of three main parts:

Part One: Patients socio-demographic data**:** this part included 'patients' age, sex, level of education and marital status.

Part Two: 'The peripheral intravenous cannulation assessment data'**.** This part compromised patient's diagnosis, PIVC insertion parameters namely: number of PIVC insertion attempts, site, type of PIVC used whether closed or open and timing of PIVC rupture. An attached sheet to document temperature for 3 consecutive days was added.

Part Three: 'Phlebitis Grading Scale'. This tool was adopted from the "Infusion Nursing Standards of Practice" developed by the Infusion Nurses Society**;** in 2011 [18]. This tool aimed to assess phlebitis grading at the PIVC site. It was described as four phlebitis grades range from 0 to 4. Based on this scale the PIVC site was observed for signs and symptoms of phlebitis namely; pain, erythema, swelling, streak formation and presence of palpable venous cord. Then this site assessment was graded as follows; Grade 0 for "No signs and symptoms", Grade 1 "Erythema at access site with or without pain," Grade 2 "Pain at access site with erythema and/or edema," Grade 3 "Pain at access site with erythema and/or edema,

streak formation" and Grade 4 "Pain at access site with erythema and/or edema, streak formation, palpable venous cord greater than one inch in length".

Method:

1. A permission to carry out the study was obtained from the directors and the responsible authorities of the identified setting, after explaining study aim.
2. Permission for the investigators to perform cannulation to both study groups was obtained from the wards' responsible authorities.
3. The study tool was developed, based on recent review of literature. Content and construct validity of the developed instrument was ascertained by a jury of 5 experts in the fields of Medical and Surgical Nursing. The necessary modifications were introduced accordingly.
4. A pilot study was conducted on 10% of subjects fulfilling the inclusion criteria to test feasibility, clarity and applicability of the developed tool and necessary modifications was done accordingly. Pilot study patients were excluded from the study sample. Reliability of the tool was tested using Cronbach's Alpha test; reliability test result was (0.912).
5. Study participants were given covering letters, preceding data collection which included a description of the purpose and nature of the study and a written consent to participate in the study. For illiterate patients, verbal explanation of the covering letter and patients' oral consents were secured. The studied patients were reassured that their participation in the study is voluntary and they could withdraw from the study at any time.
6. After obtaining patients' consents, they were sequentially recruited into either the control or the study group
7. Upon patients' enrollment, data was collected using the study tool; part I and II.
8. All intravenous therapies in both groups were performed by the researchers as follows:

- The PIVC anatomic insertion site selection, cannulas care as well as PIVC therapy administration were done.
- The cannulation date label was completed and attached to the cannula dressing.
- The PIVC site was checked every shift throughout therapy administration for signs and symptoms of phlebitis for 3 consecutive days.
- Routine PIVC site care for both groups' subjects was carried out. It comprised; doctor's written order for PIVC was checked and careful site selection and assessment (edematous, injured or inflamed sites were excluded) were carried out.
- Hand hygiene was performed prior to cannulation and throughout PIVC management.
- The appropriate size cannula was determined thereafter, prior to insertion followed by the PIVC site disinfection. The aseptic non touch technique was considered during PIVC insertion for both groups.
- The non-dominant forearm was used for peripheral cannulation with a gauge size from 16-22.
- The PIVC site was then covered by a semipermeable polyurethane sterile transparent dressing. Gauze dressing was used if patients couldn't tolerate the semi permeable dressing. Thereafter the PIVC dressing and site care were performed every 24 hours or if dressing become damp, visibly soiled or non-occlusive.
- PIVC flushing with 2ml normal saline was done after administering therapy/ medication.
- The site was assessed during drugs injection, on changing IV fluid bags or when checking the drip flow rates.
- If two or more signs of phlebitis were detected in either group subjects, the cannula was removed immediately and re-sited**:** date**,** time and reason for removal of the PVC were documented thereafter.
- The observational checklist items were filled accordingly.

The average time needed for tool completion was around 20-30 minutes.

9. Data were collected throughout a period of eleven months from the beginning of March 2014 up to end of January 2015.
10. Ethical Considerations: The current study was approved by the Research Institutional Review Board and Ethical Committee-Faculty of Nursing, Alexandria University.
11. Statistical Analysis: Data were revised, coded and fed to statistical software SPSS version 16. The findings were tabulated with the appropriate statistical tests presentation. Statistical analysis alpha error of 0.05. $P < 0.05$ was considered significant.

RESULTS

Table (1) reveals that; in comparing the study group (closed system) and the control groups (open system);

Table 1: Comparison between the studied groups according to their socio-demographic and clinical data.

	Groups according to assigned PIVC system					
	Study group (Closed system) (n= 100)		Control group (Open system) (n= 100)			
Socio-demographic and clinical data	No.	%	No.	%	x^2	P
Age (years)						
Min.– Max.	18.0 – 60.0		20.0 – 60.0	1.672	0.096	
Mean ± SD	42.30±12.35		45.62±15.55			
Sex						
Male	69	69.0	79	79.0	2.599	0.107
Female	31	31.0	21	21.0		
Level of Education						
Literate	91	91.0	95	95.0	1.229	0.268
Illiterate	9	9.0	5	5.0		
Marital status						
Single	30	30.0	27	27.0	5.717	^{MC}p=0.070
Married	69	69.0	65	65.0		
Widow	1	1.0	8	8.0		
Surgical diagnosis						
Umbilical hernia	48	48.0	43	43.0	5.998	0.199
Lung cancer	7	7.0	4	4.0		
Colostomy	20	20.0	28	28.0		
Total	75	75.0	75	75.0		
Medical diagnosis						
Abdominal pain	15	15.0	21	21.0		
Cardio vascular disease	10	10.0	4	4.0		
Total	25	25.0	25	25.0		

x^2, p: x^2 and p values for Chi square test for comparing between the two groups
^{MC}p: p value for Monte Carlo for Chi square test for comparing between the two groups
t, p: t and p values for Student t-test for comparing between the two groups
p: p value for comparing between the two studied groups at $p \leq 0.05$
*: Statistically significant

Table 2: Comparison between the studied groups according to their peripheral intravenous cannulation assessment data

	Groups according to assigned system					
	Study group (Closed system) (n= 100)		Control group (Open system) (n= 100)			
Peripheral intravenous cannulation assessment data	No.	%	No.	%	x^2	P
- Cannulation Site:					2.013	0.156
Cephalic vein	49	49.0	59	59.0		
Basilic vein	51	51.0	41	41.0		
- Insertion parameters:						
a- Number of PIVC attempts						
First	72	72.0	68	68.0	1.932	0.381
Second	21	21.0	28	28.0		
Third	7	7.0	4	4.0		
b-Timing of rupture:					0.188	0.665
At insertion	16	57	21	65.6		
At puncture	12	43	11	34.4		
– Peripheral intravenous cannulation use						
Antibiotics	77	77.0	83	83.0	1.125	0.289
Analgesics	64	64.0	55	55.0	1.681	0.195
Diuretics	9	9.0	15	15.0	1.705	0.192
Maintenance fluid	79	79.0	86	86.0	1.697	0.193

x^2: value for Chi square
*: Statistically significant at p = 0.05

no statistically significant difference was found between both groups regarding patients' socio-demographic characteristics.

Table (2) illustrates the comparison between the two studied groups in relation to the peripheral intravenous cannulation (PIVC) data, No statistical significance

Table 3: Comparison between the two studied groups according to perceived phlebitis manifestation throughout peripheral intravenous cannulation

Perceived phlebitis manifestation	Groups according to assigned system	24 hours after Cannula insertion		48 hours after Cannula insertion		72 hours after Cannula insertion	
		No.	%	No.	%	No.	%
Pain at site	Study group (closed system)						
	Absent	100	100.0	95	95.0	77	77.0
	Present	0	0.0	5	5.0	23	23.0
	Control group (open system)						
	Absent	92	92.0	85	85.0	40	40.0
	Present	8	8.0	15	15.0	60	60.0
	x^2(p)	8.333*(^{FE}p=0.007*)		5.556*(0.018*)		28.195*(<0.001*)	
Redness at site	Study group(closed system)						
	Absent	100	100.0	95	95.0	77	77.0
	Present	0	0.0	5	5.0	23	23.0
	Control group (open system)						
	Absent	92	92.0	85	85.0	40	40.0
	Present	8	8.0	15	15.0	60	60.0
	x^2(p)	8.333*(^{FE}p=0.007*)		5.556*(0.018*)		28.195*(<0.001*)	
Swelling around the insertion site	Study group (closed system)						
	Absent	100	100.0	98	98.0	85	85.0
	Present	0	0.0	2	2.0	15	15.0
	Control group (open system)						
	Absent	97	97.0	88	88.0	61	61.0
	Present	3	3.0	12	12.0	39	39.0
	x^2(p)	3.046(^{FE}p=0.246)		7.680*(0.006*)		14.612*(<0.001*)	
Red "Streaking" Around the site	Study group (closed system)						
	Absent	100	100.0	95	95.0	77	77.0
	Present	0	0.0	5	5.0	23	23.0
	Control group (open system)						
	Absent	100	100.0	85	85.0	65	65.0
	Present	0	0.0	15	15.0	35	35.0
	x^2(p)	–		5.556*(0.018*)		3.497(0.061)	
Vein being hard &cord like	Study group (closed system)						
	Absent	100	100.0	100	100.0	100	100.0
	Present	0	0.0	0	0.0	0	0.0
	Control group (open system)						
	Absent	100	100.0	100	100.0	77	77.0
	Present	0	0.0	0	0.0	23	23.0
	x^2(p)	–	–	25.989*(<0.001*)			

x^2, p: x^2 and p values for Chi square test for comparing between the two groups

^{FE}p: p value for Fisher Exact for Chi square test for comparing between the two groups

*: Statistically significant at p ≤ 0.05

differences was found between both study and control groups regarding PIVC data at P≤ 0.05.

The table reveals that; nearly half of the study (49%) and more than half of the control group (59%) had their PIVC in the cephalic vein, which was used for maintenance fluid, antibiotics and analgesics administration in both groups represented in the study group by (79, 77 and 64%) respectively, while in the control group it was (86%, 83% and 55%) respectively.

Table (3) shows a highly statistically significant differences between two groups regarding their perceived phlebitis manifestation on the 3rd day of PIVC therapy administration, in relation to pain sensation, redness, swelling and the feeling of hard and cord like vein at site of PIVC since P≤ <0.001 respectively.

Table (4) explains the comparison between the two studied groups using the adopted phlebitis grading scale to grade PIVC phlebitis incidence. It can be noted that; no incidence of phlebitis was observed in the study group, while only 8% of the controls developed grade “2” phlebitis in the first day of PIVC site monitoring.

While in day two; 5% of patients in the study group were rated grade "3" phlebitis, despite the fact that 12% of the control group was rated in grade "4". On the other

Table 4: Comparison between the two studied groups according to phlebitis grading in the three days of PIVC site monitoring.

	Closed PIVC group (n= 100)		Open PIVC group (n= 100)			
Phlebitis scale grade	No.	%	No.	%	x^2	P
24 hours after cannula insertion						
Grade 0	100	100.0	92	92.0	8.333*	FEp=0.007*
Grade 1	0	0.0	0	0.0		
Grade 2	0	0.0	8	8.0		
Grade 3	0	0.0	0	0.0		
Grade 4	0	0.0	0	0.0		
Phlebitis scale grade						
48 hours after cannula insertion						
Grade 0	95	95.0	85	85.0	14.761*	MCp= <0.001*
Grade 1	0	0.0	0	0.0		
Grade 2	0	0.0	0	0.0		
Grade 3	5	5.0	3	3.0		
Grade 4	0	0.0	12	12.0		
Phlebitis scale grade						
72 hours after cannula insertion						
Grade 0	77	77.0	40	40.0	41.290*	<0.001*
Grade 1	2	2.0	0	0.0		
Grade 2	13	13.0	25	25.0		
Grade 3	8	8.0	12	12.0		
Grade 4	0	0.0	23	23.0		

x^2, p: x^2 and p values for Chi square test for comparing between the two groups

MCp: p value for Monte Carlo for Chi square test for comparing between the two groups

FEp: p value for Fisher Exact for Chi square test for comparing between the two groups

*: Statistically significant at $p \leq 0.05$

Table 5: Correlation between mean patients' body temperature in each group and mean phlebitis scale grade (n = 100)

			Mean Phlebitis scale grade	
Days of measured mean temperature		Mean Temperature	r_s	P
24 hours after Cannula insertion	Study group	36.93 ± 0.29	-	-
	Control group	36.93 ± 0.48	0.124	0.219
48 hours after Cannula insertion	Study group	37.16 ± 0.38	0.161	0.11
	Control group	37.14 ± 0.44	-0.179	0.075
72 hours after Cannula insertion	Study group	37.29 ± 0.45	-0.022	0.829
	Control group	37.56 ± 0.39	0.396*	<0.001*

r_s: Spearman coefficient

*: Statistically significant at $p \leq 0.05$

hand; on the 3rd day a higher percentage in the controls representing (25%, 12% and 23%) were rated in grade (2, 3 and 4) phlebitis respectively.

A statistical significance differences were observed between the two studied groups, in relation to phlebitis grading scale in the three days of PIVC site monitoring.

Table 5 illustrates the correlation between mean patients' body temperature and mean phlebitis scale grade in both groups. A statistical significant negative correlation was declared in the control group 72 hours after PIVC insertion between mean patients' body temperature and mean phlebitis scale grade where r=0.396* at p<0.001*.

A slight elevation of the temperature mean and standard deviation at the third day was noted in the control group than the study group; which reached 37.56 ± 0.39 and 37.29 ± 0.45 respectively.

DISCUSSION

Concerning the cannulation site, the present study showed that**,** cephalic and basilic veins site selection was unified for both groups. This finding is in accordance with Culverwell [19] and Royal College of Nursing[20] who stated that; cephalic vein is excellent choice for cannulation and can accommodate a large bore cannula 14-16 gauge; whereas basilic vein can accommodate 16- 22

gauge bore cannula. In addition, Dougherty and Lister [21] stated that; basilic and cephalic veins of the forearm are the most commonly veins used, which allow the placement of a variety of different sized cannula in an area.

Weinstein [22] stated that basilica and cephalic veins are easily immobilized and do not cause too much restriction in patient activity. Also, Alexandrou *et al.,* [23] stated that; the basilic vein generally being the vein of choice due to its diameter and position away from artery and median nerve.

In relation to cannula gauge; McCallum & Higgins [24], Furtado [25] and Dychter *et al.,* [26] stated that smaller-gauge cannulas are associated with a lower phlebitis rate, as presumably the relatively smaller catheter leaves more buffer room around the catheter and catheter tip, allowing for decreased direct traumatic interaction with the vessel wall. This results stands with our study.

*In relation to attempt cannula insertion***,** the present study showed that**,** first attempt cannula insertion success in more than two third of both group patients. This finding is nearly similar to the finding of Sabri *et al.,* [27]; who reported that first-attempt IV cannula insertion fails in less than third of his subjects, which lead to vessel trauma that increases the risk of phlebitis. In accordance with our study result; Weinstein [22] mentioned that; the first attempt of IV cannulation mainly fails in the majority of adult patients, thus IV cannulation attempts should not exceed three unsuccessful attempts on one patient at any given time unless the urgency of the case demands.

In contrast, Phillips *et al*., [28] reported that; when inserting a cannula, the introducer should never be reinserted as this may cause the distal part of the sheath of the cannula to shear off and enter the circulation system. In addition, a cannula, following an abortive attempt, should never be re-inserted as this increases the risk of phlebitis.

Also it was noted that; more than three quarters of patients in both groups had PIVC for administering antibiotic as well as maintenance fluid; this is on same line with Dougherty and Lister [21] who stated that; PIVC is mainly used for maintenance or correction of hydration levels transfusions, likewise for the administration of IV medicine as antibiotics prescribed to treat systemic infections.

Regarding the clinical signs of phlebitis, the current study revealed that the majority of the studied groups have no clinical signs of phlebitis and all clinical signs of phlebitis appeared in both groups after 72 hours of cannula insertion. This is in accordance to Malach *et al.,* [29] and Powell *et al.,* [30] who stated that the dwell time for an inserted cannula was restricted to 72 hours, a limit based on observational data suggesting that the risk of phlebitis and infection which is increased by the length of time the cannula left in place.

Many studies recommended that*,* IV lines must be replaced frequently, as the complication rates of infiltration and phlebitis increase dramatically with increased dwell-time [31, 32]. In order to reduce the possibility of phlebitis, the Centers for Disease Control and Prevention recommends replacing peripheral venous cannulas and rotating the site at least every 72 hours [11].

Recently, the concept of acceptable cannula dwell time has undergone a reevaluation, with a shift toward a strategy of leaving well-functioning cannulas in place longer, re-siting cannula only when "clinically indicated." [32, 33] This is contradicted with Clinical Quality and Patient Safety Unit, Queensland Ambulance Service [34] which reported that; all intravenous cannula should be removed and re-sited every 48 hours to reduce the risk of phlebitis.

A significant differences between two groups regarding their *perceived phlebitis manifestation on the 1st, 2nd and 3rd day of PIVC therapy administration* was noted in relation to pain sensation, redness, swelling and the feeling of hard and cord like vein at site of PIVC. This result was supported by Maki *et al.,* [35] who reported that open systems have a higher risk of phlebitis during initial setup and administration than closed systems.

Concerning the Phlebitis Grading Scale; this study shows a clear superiority of closed PIVCs system over the open system; in which phlebitis rate was significantly lower with closed PIVCs system. This is in accordance with Gonzalez-Lopez *et al.,* [36] who found that; closed PIVCs system is less likely to cause phlebitis than open system. On same line Graves *et al.,* [37] analyzed the impact of the introduction of a closed infusion system in the ICUs and found that the closed system not only reduced phlebitis rates but also reduced costs.

Concerning body temperature and mean phlebitis scale grade; a slight elevation of the temperature mean and standard deviation at the third day was noted in the control group rather than the study group; this is in accordance to Gonzalez-Lopez *et al.* [36] who illustrated that; evidence suggests occurrence of phlebitis in open PIVC if left in place for longer periods exceeding 72 hours; which consequently raises body temperature exposing the patients to unnecessary risk.

Thus; there is a clear need to provide direction for clinicians adopting the closed PIVC in health care settings, so the health care team switches from open to closed PIVC system which is found to be reducing the rate of phlebitis.

CONCLUSION

Patients with closed PIVC method displayed lesser incidence of phlebitis at insertion site than those who received open method on the 3rd day of PIVC therapy. This was noted through assessing patients in both groups and comparing their phlebitis grading scale in the three days of PIVC.

Recommendations: The nursing staff in-service training regarding the proper use the closed PIVC system as well as phlebitis assessment is highly recommended. Developing procedural manual and standards specific to the closed PIVC system patient's safety in Arabic is highly necessary.

Replication of the study on larger probability samples and longer indwells time in different areas of specialties, as well as identifying local barriers hindering healthcare providers' application of the closed PIVC system use.

REFERENCES

1. Rivera, A., K. Strauss, A. Zundert and E. Mortier, 2007. Matching the peripheral intravenous catheter to the individual patient. Acta Anaesthesiol Belg., 58: 19-25.
2. Rickard, C., J. Webster, M. Wallis, N. Marsh, M.M. cGrail, V. French, L. Foster, P. Gallagher, J. Gowardman, L. Zhang, A. McClymont and M. Whitby, 2012. Routine versus clinically indicated replacement of peripheral intravenous catheters: a randomised controlled equivalence trial. Lancet, 22: 1066-1074.
3. McCallum, L. and D. Higgins, 2012. Care of peripheral venous cannula sites. Nursing Times, 108: 12-15.
4. Fakih, M., K. Jones, J. Rey, R. Takla, S. Szpunar, K. Brown, A. Boelstler and L. Saravolatz, 2013. Peripheral venous catheter care in the emergency department: Education and feedback lead to marked improvements. American Journal of Infection Control, 41: 531-536.
5. Robert, E., D. Jeffrey, D. John, M. Lori and E. Huang, 2015. Accepted but Unacceptable: Peripheral IV Catheter Failure. Infusion Nurses Society, 38: 189-203.
6. Qamar, Z., M. Afzal, R. Kousar, A. Waqas and S. Gilaniet, 2016. Assess Nurses Knowledge and Practices towards Care and Maintenance of Peripheral Intravenous Cannulation in Services Hospital Lahore, Pakistan Saudi J. Med. Pharm. Sci., 3: 608-614.
7. Higginson, R. and A. Parry, 2011. Phlebitis: treatment, care and prevention. Nursing Times, 107: 18-21.
8. Ray-Barruel, G., D. Polit, J. Murfield and C. Rickard, 2014. Infusion phlebitis assessment measures: a systematic review. J. Eval. Clin. Pract., 20: 191-202.
9. Gallant, P. and A. Schultz, 2006. Evaluation of a visual infusion phlebitis scale for determining appropriate discontinuation of peripheral intravenous catheters. J. Infus. Nurs., 29: 338-345.
10. Groll, D., B. Davies, J. MacDonald, S. Nelson and T. Virani, 2010. Evaluation of the psychometric properties of the phlebitis and infiltration scales for the assessment of complications of peripheral vascular access devices. J. Infus. Nurs., 33: 385-390.
11. O'Grady, N., M. Alexander, P. Dellinger, J. Gerberding, O. Stephen, G. Dennis, H. Masur, R. McCormick, L. Michele, I. Issam, A. Randolph and R. Weinstein, 2011. CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections. Available at:www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html. Accessed March, 10, 2015.
12. Health Protection Surveillance Centre. Prevention of Intravascular Catheter-related Infection in Ireland. 2014. SARI Prevention of Intravascular Catheter-related Infection Sub-Committee. Pdf, pp: 1-113.
13. Webster, J., S. Clarke, D. Paterson, A. Hutton, S. Van-Dyk, C. Gale and T. Hopkins, 2008. Routine care of peripheral intravenous catheters versus clinically indicated replacement: randomized controlled trial. BMJ, 19: 57-160.
14. Zundert, A., 2012. IV catheter technology: Benefits of closed IV catheter systems. Hospital Pharmacy Europe, Issue, pp: 62.
15. Bausone-Gazda, D., C. Lefaiver and S. Walters, 2010. A randomized controlled trial to compare the complications of 2 peripheral intravenous catheter-stabilization systems. J. Infus. Nurs., 33: 371-384.
16. Hinkle, J. and K. Cheever, 2014. Brunner & Suddarth's Textbook of Medical-Surgical Nursing. 13th ed. Philadelphia: Lippincott Williams & Wilkins, pp: 402-474.
17. Lavery, I., 2011. Intravenous therapy: preparation and administration of IV medicines. British journal of nursing, 20: S28, S30-34.

18. Infusion Nurses Society, 2011. Infusion nursing standards of practice: Phlebitis. J. Infus. Nurs., 34: S1-110.
19. Culverwell, E., 2013. Peripheral Intravenous Cannulation Self Learning Package Handbook. New Zealand: Canterbury District Health Board, pp: 9-22.
20. Royal College of Nursing (RCN), 2010. Standards for Infusion Therapy. 3rded. London: Royal College of Nursing.
21. Dougherty, L. and S. Lister, 2011. The Royal Marsden Hospital Manual of Clinical Nursing Procedures. 8th ed. Oxford: Blackwell Publishing. pp: 575-675.
22. Weinstein, S., 2007. Plumer's Principles and practice of Intravenous therapy 8th ed. London: Lippincott, Williams and Wilkins, pp: 24-54.
23. Alexandrou, E., M. Ramjan, T. Spencer, S. Frost, Y. Salamonson, P. Davidson and K. Hillman, 2011. The use of midline catheters in the adult acute care setting - clinical implications and recommendations for practice, Journal of the Association for Vascular Access, 16: 35-41.
24. McCallum, L. and D. Higgins, 2012. Care of peripheral venous cannula sites. Nursing Times, 108: 12-15.
25. Furtado, R., 2011. Incidence and predisposing factors of phlebitis in a surgerydepartment. Br J Nurs, 20: 30-36.
26. Dychter, S., D. Gold, D. Carson and M. Haller, 2012. Intravenous therapy: a review of complications and economic considerations of peripheral access. J. Infus. Nurs., 35: 84-91.
27. Sabri, A., J. Szalas, K. Holmes, L. Labib and T. Mussivand, 2013. Failed attempts and improvement strategies in peripheral intravenous catheterization. Biomed. Mater. Eng., 23: 93-108.
28. Phillips, S., M. Collins and L. Dougherty, 2011. Venipuncture and cannulation. London: Wiley Blackwell, pp: 131-170.
29. Malach, T., Z. Jerassy, B. Rudensky, B. Rudensky, Y. Schlesinger, E. Broide, O. Olsha, A. Yinnon and D. Raveh, 2006. Prospective surveillance of phlebitis associated with peripheral intravenous catheters. Am. J. Infect. Control., 34: 308-312.
30. Powell, J., K. Tarnow and R. Perucca, 2008. The relationship between peripheral intravenous catheter indwell time and the incidence of phlebitis. J. Infus. Nurs., 31: 39-45.
31. Ho, K. and D. Cheung, 2012. Guidelines on timing in replacing peripheral intravenous catheters. J. Clin. Nurs., 21: 1499-1506.
32. Gillies, D. and E. O'Riordan, 2012. Should intravenous catheters be replaced routinely? Lancet, 380: 1036-1038.
33. Webster, J., S. Osborne, C. Rickard and J. Hall, 2010. Clinically indicated replacement versus routine replacement of peripheral venous catheters. Cochrane Database Syst. Rev., 3: CD007798.
34. Clinical Quality and Patient Safety Unit, 2016. Clinical Practice Procedures: Assessment/Primary and secondary surveys. Queensland Ambulance Service, pp: 360-364.
35. Maki, D., V. Rosenthal, R. Salomao, F. Franzetti and R. Frausto, 2011. Impact of switching from an open to a closed infusion system on rates of central line-associated bloodstream infection: A meta-analysis of time-sequence cohort studies in 4 countries. Infect. Control Hosp. Epidemiol., 32: 50-58.
36. Gonzalez-Lopez, J., A. Vilela, E. Del Palacio, O. Corral, B. Marti and H. Portal, 2014. Indwell times, complications and costs of open vs closed safety peripheral intravenous catheters: A randomized study, Journal of Hospital Infection, 86: 117-126.
37. Graves, N., A. Barnett and V. Rosenthal, 2011. Open versus closed IV infusion systems: A state based model to predict risk of catheter associated blood stream infections. BMJ, 1: e188.