ORIGINAL RESEARCH PAPER
Volume - 12 | Issue - 01 | January - 2023 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

A PROSPECTIVE STUDY ON PERIPHERAL INTRAVENOUS CATHETER-RELATED PHLEBITIS AND ITS RISK FACTORS

General Medicine

Mrinal Kumar Acharya — Neurologist, The Mission Hospital, Durgapur, West Bengal.

Sudipta Saha — Assistant Professor, Department of General medicine, Raiganj Government Medical College

Suranjan Pal* — Assistant Professor, Department of Microbiology, Raiganj Government Medical College
*Corresponding Author

ABSTRACT

Background: Peripheral venous catheterisation is a common bedside procedure in hospital-admitted patients. It is associated with several complications like peripheral venous phlebitis, septicaemia etc. **Aim:** the present study from eastern India aims to detect the incidence and prevalence of phlebitis, the causes behind its occurrence, and the association of infection with phlebitis. **Study design:** this is a prospective observational cohort study which was conducted in a tertiary medical college in eastern India with 119 patients and 560 catheters throughout 1yr. The patients were included in the study group by using a consecutive sampling technique. **Statistical analysis:** the associations between different variables were analysed using the chi-square test, Kaplan-Meier Survival analysis, Cox proportional hazard regression analysis and other statistical methods using SPSS software version 20.0. **Result:** In the present study, the incidence of phlebitis was 81.5% with more in males than females. Phlebitis was lower in the elderly (>60yrs) and had no relationship with diabetes mellitus. But was more in a patient with the duration of the catheter in situ for more than 3 days, larger bore catheter, lower extremity catheterisation and use of certain infusates like antibiotics, chemotherapeutics, potassium chloride, acyclovir, and macrolides. The bacteriological culture of the catheter tip showed the growth of non-pathogenic strains commonly present as a skin commensal. **Conclusion:** proper knowledge of the site of peripheral venous catheter placement, duration, and size, is essential for all healthcare workers to reduce catheter-associated phlebitis.

KEYWORDS

Peripheral venous catheter, Phlebitis.

BACKGROUND:

Placing a peripheral intravenous catheter (PIVC) is the most commonly performed procedure in healthcare settings. Roughly half of the rehabilitated cases bear at least a single peripheral vein insertion. PIVC are required for the administration of intravenous medicines, infusate results, blood products and parenteral feeding and also for vascular access [1 – 3]. Despite PIVC benefits, several implicit complications are associated with it [3- 8]. Peripheral vein phlebitis passed in 13 – 56% of rehabilitated cases[7- 10]. Phlebitis commonly presents with pain, erythema, swelling, palpable venous cord, and purulent discharge at the catheter point [6,7,10,11]. Cannula- related bloodstream infection (CRBSI) is a dreaded complication of phlebitis. Adverse issues of Phlebitis affect in patient discomfort, longer hospital stay and increased healthcare cost [5, 10- 12]. Factors responsible for phlebitis include mechanical, chemical, natural, patient, and health practice- related factors[8- 13]. Mechanical factors correspond of size, point and type of catheter; duration of the catheter in situ. The type of medicines (irritant, vesicant) and result characteristics (PH, osmolality) are factors of chemical factors. Biological factors include bacterial colonization, biofilm conformation and infection. Case-related factors are age, gender, nutritive status, immunosuppression and co-morbidities. Those with malnutrition, immunosuppression, co-morbidities, and elderly (age> 65 years) are prone to phlebitis. Health practice- related factors include aseptic preventives and the skill of catheter securing. The present study from eastern India was accepted to describe the prevalence and frequency of phlebitis, the causes behind its circumstance, and the association of infection with phlebitis [14]

METHOD:

A hospital-based prospective, observational study was conducted between February 1, 2014, and August 31, 2015. All admitted patients above 14 years in the General medicine ward, both from the emergency and outpatients department, with all the peripheral intravenous cannula inserted into these patients, were included in the study. Patients with a history of allergy to the intravenous cannula, having a central venous line or those unable to give consent were excluded from the study. The sample size was calculated using the single population proportion formula with the assumption of a 95% confidence level, a 5% margin of error, and taking 50% estimated proportion of phlebitis. A consecutive sampling method was used to recruit 119 study subjects. Study variables: Peripheral intravenous catheter (PIVC) phlebitis. Independent variables: (1) Socio-demographic characteristics include age, and gender, (2) Clinical characteristics include admission diagnosis, duration of hospital stay, anatomic site of catheter insertion, no. of catheters, catheter size (gauge), catheter dwell time, catheterisation instructions, securement device, intravenous drugs use, infusate use, blood products use, performance level, and co-existing co-morbidities. Data were collected through an investigator-administered pre-designed pre-validated questionnaire. Relevant medical history and laboratory parameters were obtained. Insertion of a catheter was performed by clinical nurses. A hygienic hand rub with 70% alcohol was done after hand washing. The patient's skin was disinfected using a 1% iodine solution and 70% alcohol. Using clean gloves, a catheter was inserted into a peripheral vein of a patient. The catheter was fixed to the patient's skin with a protective dressing and plaster. Patients on indwelling catheters were followed daily by investigators from insertion to developing phlebitis or catheter removal. Those who developed phlebitis were graded based on Jackson's Visual Infusion Phlebitis (VIP) Scoring System [13] and were taken care of as per the recommendations of the Infusion Therapy Standard of Practice [2]. Catheter-tip culture reports for a bacteriological profile after removal of the catheter (cultured on blood agar by the semi-quantitative method described by Maki et al) were obtained. Bacterial identification and antimicrobial sensitivity testing were done by VITEK™.[5] Data were entered into MS office excel and transported to SPSS version 20 for analysis by appropriate statistical tests. Ethical considerations The research protocol complied with the Declaration of Helsinki and was approved by the local ethics committee (Memo no.:Inst/IEC/215 date 12.02.2013). Study subjects were recruited only after informed written consent was obtained. All data obtained were treated confidentially.

RESULT ANALYSIS:

A total of 119 patients were enrolled on the study after considering the inclusion and exclusion criteria. Of 119 patients, 70 were male and 49 were female. The catheter was inserted for reasons such as the administration of fluids, intravenous drugs and blood products. Observations during a follow-up period of peripheral intravenous cannula revealed that out of 597 peripheral intravenous cannulas observed during insertion, only 560 peripheral intravenous cannula were observed prospectively for various cannula and nurse-related activities, of the total 597 catheters observed 37 study subjects were not studied due to different reasons like death, Left against medical Advice (LAMA), faulty documentation and accidental removal during bathing and changing cloths, as the follow-up of these could not be done. Ten cannulas could not be followed because the patients either

died or LAMA, eighteen cannulas were accidentally removed during bathing and changing clothes and follow-up of these could not be done, and lastly, there were nine cannulas with faulty or no documentation. Finally, 560 catheters were studied. Among them, 455 (81%) developed phlebitis. The mean age of the 119 patients enrolled in the study was 44.7 years + 15.6 with the range between 18-75 years. Around 35% of the patients taken up for the study have one or more than one co-morbidities such as coronary artery disease, diabetes mellitus, hypertension, tuberculosis etc. The present study revealed the distribution of after-effects and related incidents at peripheral intravenous cannula as per the characteristics of the person such as age, sex, disease condition, and presence of co-morbidities and the consciousness level of the patient. It was reported that the age (age<60 yrs, P<0.001) and gender (male, P=0.031) of the patient were significantly associated with the development of phlebitis while the presence of co-morbidities like diabetes mellitus did not show any significant association with the development of phlebitis. As per the patient-related factors, the incidence of phlebitis was more in the male subjects (84%) (Table 1).

The study reported that the size of the cannula used for insertion and whether the dominant or non-dominant side of the patient was involved in insertion, did not found to have any impact on the development of phlebitis while the use of the wrist as the site of insertion of cannula (P<0.001), joint involvement (P<0.001) and use of elbow joint (P=0.018) are significantly associated with the development of infiltration and phlebitis. Around 40% of cannulas secured using dynaplast and 60% of cannulas secured using leucoplast developed phlebitis, the relationship is significantly associated. The insertion of PIVC in the upper limb of the patient was significantly associated with a lower risk of phlebitis as compared to lower limb insertion(P<0.001). As per the catheter insertion site-related risk factors it was observed that phlebitis was more in the patients when the catheter was inserted in the vein of the wrist (95.7%) and elbow joint (95.2) as compared to veins of the forearm (63.4%) The patients with peripheral IV cannula were studied prospectively for the fluids and medications administered through the cannula. Out of the total 455 subjects who developed phlebitis, 96.2% and 88.7% of the study subjects had phlebitis where antibiotics and electrolytes were used respectively and were found to be highly significant (p<0.001).1/3rd of the study subjects had developed phlebitis where three or more other drugs were used like analgesics, antipyretics, diuretics, H2 receptor antagonists, etc. 87.6% of the subjects who received crystalloids developed phlebitis (P>0.05), but it was not statistically significant. It is revealed that the administration of crystalloids such as normal saline, ringer lactate, dextrose solutions and antibiotics increase the incidence of phlebitis (P<0.001) while catheters with blood transfusion (P<0.001) also developed phlebitis more frequently (Table 2). Table 3 showed the descriptive statistics associated with the dwell time by the phlebitis status. It showed that patients without phlebitis were on a mean dwell time of 79.2 hours whereas patients with phlebitis were on a mean dwell time of 84.31 hours. It also revealed that these two groups are statistically different. This result; however, does not show the exact cut-off dwell time associated with the risk of having phlebitis infection. Actuarial life table analysis further reported that the hazard rate for phlebitis increased from day one of insertion from 0.00 to 0.07 on the 4th day with a maximum increase from the 3rd day of insertion (0.03) to the 4th day of insertion (0.07).To compare the effect of different risk factors on the catheter survival duration (taking phlebitis as the endpoint), Kaplan-Meier survival plot analysis shows that among the variables, only sex of the patient, upper limb or lower limb insertion, site of insertion, fluid infusion & the type of infusate, antibiotic administration and blood transfusion have a significant effect on the duration to develop phlebitis (Table 4). The variables are then analysed using the Cox-Proportional regression Model, to assess which variable could independently predict the occurrence of Phlebitis. Cox Proportional Hazard Regression shows that the sex of the patient, upper limb or lower limb insertion, fluid infusion and blood transfusion could independently predict the occurrence of phlebitis. The frequency distribution table clearly shows that *Staphylococcus epidermidis* is the most common isolated organism, followed by *Staphylococcus aureus and Acinetobacter* spp. (Table 5). Among the isolates 20% Staphyloccus spp. were methicillin resistant.

DISCUSSION:

The placement of PIVC is the most common invasive procedures performed in hospitals. Despite the many benefits these intravascular devices are associated with a large numbers of complications ranging from phlebitis to sepsis to death leading to longer hospitalization and increased cost. It is now well established that the etiology of phlebitis is multi-factorial. The present study was undertaken to investigate various risk factors responsible for the occurrence of phlebitis and to develop a protocol for their prevention. The major finding of this study is that the risk factors of phlebitis can be easily assessed. In the present study, the incidence of phlebitis was 81.5% which was in the higher range of the incidence rates reported at other centers around the world. However, it is well above the 5% established by the INS.[15] Because we used two criteria for the diagnosis of phlebitis, we can conclude that the problem is significant.

The incidence of phlebitis in the present study was more in males as compared to females which is consistent with the studies of Lanbeck et al (2002); Lundgren et al (1993).[16,17] This may be due to more number of males in the study. In contrast to other studies, the incidence of phlebitis in elderly patients ≥ 60years old was lower. Because the inflammatory response in the elderly is often impaired, signs and symptoms of phlebitis may be subtle. Also, the elderly population is lower in our study. One of the most striking findings of our study was that there was no relationship between diabetes mellitus and phlebitis, consistent with Monreal et al's study, where diabetes mellitus was not a risk factor.[18] The duration of aPIVC significantly influence the incidence of thrombophlebitis. Patients who have a catheter for more than 3 days are more likely to have an increased risk of developing thrombophlebitis. Similar findings have previously been reported by Uslusoy et et al and Barker et al.[19,20] The duration of PIVC is the only modifiable risk factor identified . The results of many studies have shown that the risk of thrombophlebitis increases with an increased duration of catheterization. It is recommended that prophylactic re-sitting of the catheter should be practiced in all patients. The catheter should be replaced or removed in another site after 72 hours of insertion, even when there is no sign of thrombophlebitis. A randomised clinical trial in Scarborough, UK has found that there was a significant reduction of thrombophlebitis incidence when the catheter was electively replaced.[21] This practice did not result in increased catheterization of the patients as compared to re-sitting only when thrombophlebitis develops. The location of catheter placement has been found by previous studies to influence the incidence of peripheral venous catheter thrombophlebitis. When upper-extremity veins were catheterised, patients had less chance of developing phlebitis, in comparison with the lower limbs. However, statistically significant differences were observed between the specific anatomical site used (hand, forearm, wrist) and phlebitis, which is congruent with studies by Lanbeck et al (2002); Maki and Ringer (1991) The choice of catheter size inserted is influenced by the rate of infusion required in the management of the patient.[16,21] Patients anticipated requiring a rapid infusion of fluids or blood products will have larger catheters inserted. Large bore catheters usually cause more phlebitis due to greater mechanical irritation. Our study results were consistent with the findings of Uslusoy and Mete 2008; Abbas et al 2007; Ferreira et al 2007; Regueiro Pose et al 2005; which showed that catheter bore size is not a risk factor for phlebitis.[19,23,24] No significant differences were found between the number of simultaneous catheters and phlebitis in the majority of the cases. The material used to secure the catheter was adhesive tape; other studies compared the use of sterile gauze with a transparent film and concluded there were no statistically significant differences between both types of dressings and the early detection of phlebitis. We attempted to observe an increased incidence of thrombophlebitis when infusate is used in patients. Statistically significant differences were found between the administration of fluids and antibiotics, particularly macrolides,b lactams, aminoglycosides and acyclovir. Fluid infusion increased the probability of phlebitis by 21.7 times and antibiotics led to an increase of 6.3times, which was 2.3 times higher with macrolides and 2.5 times higher with acyclovir. Antibiotics also increased the risk of phlebitis significantly when compared to other drugs (Lanbeck et al 2002; Regueiro Pose et al 2005; Maki and Ringer 1991).[16,21,24] However, there was no significant difference between the type of infusate and the development of thrombophlebitis among the sample population in this study. This may be due to the inadequate size of the study sample and the fact that most of the patients received different infusates through the same peripheral catheter. A further study using only one infusate per catheter may help confirm the risk of different infusates on the development of thrombophlebitis. No significant differences were found between the administration of a serum infusion and phlebitis. As for the number of IV drugs, no significant differences were found.

There was bacterial etiology could be established in only 44% of the PIVC removed because of phlebitis. No significant difference was found in bacterial growth between the index and control groups, and the majority of isolated organisms were nonpathogenic strains commonly colonizing the skin, suggesting that the majority of cases of clinically diagnosed phlebitis may have been due to local inflammation rather than infection. This inflammatory response may be determined by individual host factors. The most frequently isolated organisms in our study were coagulase-negative staphylococci. Interestingly, the typical nosocomial pathogens such as Staphylococcus aureus, Acinetobacter spp., Pseudomonas spp., and Enterococcus spp. were isolated infrequently. Coagulase-negative Staphylococcus, and in particular Staphylococcus epidermidis, is the predominant organism isolated from medical devices. The adherence of these bacteria to surfaces, the secretion of an extracellular polysaccharide, and the formation of biofilm protect these bacteria from the effects of antimicrobials and the host immune system.[25] It may be impossible to reduce the rate of phlebitis to zero because of the increasing age of hospitalized patients and the presence of underlying diseases. Moreover, as this study has suggested, the majority of instances diagnosed as clinical phlebitis may have resulted from an inflammatory reaction. Inflammation may start as a non-infectious process, precipitated by IVC, infused drugs, and/or other factors. Subsequently, the inflammatory debris may serve as culture media for the growth of microorganisms colonizing the puncture site. Phlebitis is the initial and possibly necessary step for IVC-associated infections. It is, therefore, relevant and important to diagnose early IVC-associated phlebitis to prevent subsequent clinical infection, local and systemic. During the study period, we did not observe any bacteraemia, and these results are in agreement with other studies136 reporting it as inexistent or as a very uncommon event (0–0.3%), except for the few diagnosed cases of septicaemia, where the organism isolated from the blood were different from that of the catheter-tip culture. It can be speculated why PVC-BSI has escaped our radar. There may be no associated problem at all, or the necessary studies have not been performed because their conduct outside intensive care units is complicated, labour-intensive and difficult to accomplish. PVC-BSI should be addressed more specifically by designing studies to address the important questions such as the burden of PVC-BSI, device- and environment-associated risk factors and, if PVC-BSI is found to be a serious problem in the hospital, successful intervention measures have to be taken. Selection bias couldn't be avoided as a consecutive sampling method was used to recruit study subjects. The incidence of phlebitis was considerably high. Catheter dwell time> 96 h was found to be a risk factor for the increased incidence of phlebitis. The cannula must be reviewed on daily basis, and it should be removed if it stayed later than 96 h.

CONCLUSION:

Phlebitis protective measures and catheter management strategy should be improved. Both the cost and discomfort of the patients must be taken into account when establishing a policy of catheter replacement. The definitive answer to the question of whether routine catheter exchange is better than replacement on a clinical basis can only be obtained from a carefully designed, well-conducted randomized clinical trial comparing both strategies, particularly in high-risk catheters.

Table 1 Incidence rates of Phlebitis by different background variables

FACTORS	NUMBER	PHLEBITIS	INCIDENCE RATE	RELATIVE RISK
SEX				1.0952
Male	350	294	84	
Female	210	161	76.7	
AGE				1.2577
<60 Yrs	287	259	90.3	
>60 Yrs	273	196	71.8	
DIABETIC STATUS				1.0530
Yes	294	245	83.3	
No	266	210	79.1	
SIDE				1.2577
Dominant	287	259	90.3	
Non-Dominant	273	196	71.8	
LIMBS				1.4641
Upper	511	427	83.6	
Lower	49	28	57.1	
SITE				
Wrist	161	154	95.7	
Forearm	210	133	63.4	
Elbow	147	140	95.2	
SIZE				1.1253
20G	175	154	88	
18G	385	301	78.2	
FLUID INFUSION				1.7684
Yes	364	350	96.2	
No	196	105	54.4	
FLUID TYPE				
0.9% NaCl	253	215	84.9	
3% NaCl	31	28	90.3	
Dextrose solution	87	77	88.5	
BLD TRANSFUSION		.		1.0983
Yes	42	38	90.5	
No	518	417	82.4	
ANTIBIOTICS				1.5982
Yes	434	385	88.7	
No	126	70	55.5	

Table 2: Distribution of after effects and related incidents of peripheral intravenous cannulae as per different related variables

FACTORS	Catheters with thrombophlebitisN(% of total)	Catheters without thrombophlebitis N(% of total)	TOTAL N(% of total)	Chi Square /df /p	Odds Ratio (95 % confidence interval)
Gender Male female	294(52.5) 161(28.7)	56(10) 49(8.8)	350(62.5) 210(37.5)	4.633 0.031	1.598(1.04 1-2.453)
Age >60yrs <60yrs	259(46.3) 196(35)	28(5) 77(13.8)	287(51.2) 273(48.8)	20.485 <0.001	3.634(2.27 0-5.818)
Diabetic status Yes no	245(43.8) 210(37.5)	49(8.8) 56(10)	294(52.5) 266(47.5)	1.763 0.84	1.333(0.87 1-2.040)
Side Dominant Non-dominant	259(46.3) 196(35)	28(5) 77(13.8)	287(51.2) 273(48.8)	31.259 0.345	3.634 (2.270-5.818)
LIMBS Upper Lower	427 (76.3) 28 (5)	84 (15) 21 (3.8)	511(91.3) 49(8.7)	20.485 1 <0.001	3.813 (2.067 – 7.032)
Joints involvement YES NO	315(56.3) 140 (25)	28 (5) 77 (13.8)	343 (61.2) 217 (38.8)	97.04 1 <0.001	0.862 (0.830 – 0.894)
SIZE of cannula 18 G 20 G	154 (27.5) 238 (42.5)	21 (3.8) 63 (11.3)	175 (31.1) 301 (63.8)	8.327 1 0.116	0.426 (0.216-0.842)
FLUID INFUSION YES NO	350 (62.5) 105 (18.8)	14 (2.5) 91 (196)	364 (65) 196 (35)	151.637 1 <0.001	21.667 (11.850 – 39.616)
FLUID TYPE DEXTROSE NON-DEXTROSE	77 (13.8) 273 (48.8)	7 (1.3) 27 (493)	84 (15) 300 (53.6)	70.457 1 <0.001	6.286 (3.967 – 9.960)
BLOOD RANSFUSION YES NO	38 (6.8) 427 (76.3)	4 (0.8) 91 (16.3)	42 (7.5) 518 (92.5)	6.339 1 0.012	0.426 (0.216 – 0.842)
ANTIBIOTICS YES NO	385 (68.8) 70 (12.5)	49 (8.8) 56 (10)	434(77.5) 126 (22.5)	70.457 1 <0.001	1.763 (0.871 – 2.040)

Table 3: Descriptive Statistics of Dwell Time by Phlebitis Status

PHLEBITIS	MEAN(hrs)	STD. DEV.	SEM	NUMBER	P-VALUE
YES	84.631	17.0333	0.7985	455	
NO	79.2	16.4969	1.7075	105	0.019
TOTAL	84.175	17.1317	0.7239	560	

Table 4 : Kaplan Meier Life Table Analysis For Risk Factors

FACTORS	LOG RANK TEST	P-VALUE
SEX	6.686	0.009
DIABETIC STATUS	0.023	0.88
SIZE	2.957	0.228
SIDE	2.090	0.148
UL/LL	16.574	<0.001
SITE	63.325	<0.001
FLUID INFUSION	67.807	<0.001
FLUID TYPE	60.923	<0.001
ANTIBIOTICS	4.722	0.03
BLOOD INFUSION	20.072	<0.001

Table 5: Frequency and the type of organism isolated from the catheter-tip culture throughout the study population

ORGANISM	PHLEBITIS		TOTAL
	YES	NO	
Staphylocccus epidermidis	10	7	17
Staphylocccus aureus	1	2	3
Escherichia coli	1	0	1
Klebsiella pneumoniae	0	1	1
Propionobacterium spp.	1	0	1
Acinetobacter baumanii complex	2	0	2
Total	15	10	25

REFERENCES:

1. O'Grady NP, Alexander M, Burns LA, Dellinger EP, Garland J, Heard SO, et al. Summary of recommendations: guidelines for the prevention of intravascular catheter-related infections. Clin Inf Dis. 2011;52(9):1087–99.
2. Infusion therapy standard of practice. Official publication of the infusion nurses society. J Inf Nurs. 2016;39:1S.
3. Helm RE, Klausner JD, Klemperer JA, Flint LM, Huang E. Accepted but unacceptable peripheral IV catheter failure. J Infus Nursing. 2015;38:189–203.
4. Miliani K, Taravella R, Thillard D, Chauvin V, Martin E, Edouard S, et al. Peripheral venous catheter-related adverse events: evaluation from a multicentre epidemiological study in France (the CATHEVAL project). PLoS ONE. 2017;12(1):e0168637.
5. Cicolini G, Manzoli L, Simonetti V, Flacco ME, Comparacini D, Capasso L, et al. Phlebitis risk varies by peripheral venous catheter site and increases after 96 hours: a large multi-centre prospective study. J Adv Nurs. 2014; 70(11):2539–49.
6. Mermel La, Farr Bm, Sherertz Rj, Raad Ii, O'grady N, Harris Js, Et Al, Guidelines For The Management Of Intravascular Catheter-Related Infections. Clin Infect Dis. 2001;32:1249–72.
7. Simin D, Milutinovic D, Turkulov V, Brkic S. Incidence, severity and risk factors of peripheral intravenous cannula-induced complications: an observational prospective study. J Clin Nurs. 2019;28:1585–99.
8. Tan F, Wu H, Nie L, Li W, Li L. Risk factors for phlebitis in patients with peripheral intravenous catheters. Global J Health Sci. 2020;12(1):41–5.
9. Atay S, Sen S, Cukurlu D. Phlebitis-related peripheral venous catheterization and the associated risk factors. Niger J Clin Pract. 2018;21:827–31.
10. Abolfotouh MA, Salam M, Beni-Mustafa A, White D, Balkhy HH. Prospective study of incidence and predictors of peripheral intravenous catheterinduced complications. Ther Clin Risk Manag. 2014;10:993–1001.
11. Zhang J, LV L. The incidence and risk of infusion phlebitis with peripheral intravenous catheters: a meta-analysis. J Vasc Access. 2020;21(3):342–9.
12. Singh S, Gupta A, Handa P, Aggarwal N, Gupta S, Kalyani VC, et al. Peripheral venous cannulation associated thrombophlebitis and its management. Eur J Med Health Sci. 2020;2(3):292–5.
13. Jackson A. An update on VIP score monitoring of peripheral IV sites with Andrew Jackson. https://pedagogyeducation.com/Main-Campus/NewsBlogs/Campus-News/News.aspx?news=68. Jackson A. Infection control: a battle in infusion phlebitis. Nursing Times 1998; 94:4:68-71.
14. Lulie, Mulugeta & Tadesse, Abilo & Tsegaye, Tewodros & Yesuf, Tesfaye & Asres, Mezgebu Silamsaw. (2021). Incidence of peripheral intravenous catheter phlebitis and its associated factors among patients admitted to University of Gondar hospital, Northwest Ethiopia: a prospective, observational study. Thrombosis Journal. 19. 10.1186/s12959-021-00301-x.
15. Infusion Nursing Standards Of Practice. J Infus Nurs 2006;29:S1–92.
16. Lanbeck P, Odenholt I, Paulsen O. Antibiotics differ in their tendency to cause infusion phlebitis: a prospective observational study. Scand J Infect Dis. 2002;34:512–9.
17. Lundgren A, Jorfeldt L, Ek Ac. The Care And Handling Of Peripheral Intravenous Cannulae On 60 Surgery And Internal Medicine Patients: An Observation Study. J Adv Nurs 1993;18:963–71.
18. Monreal M, Oller B, Rodriguez N, et al. Infusion phlebitis in postoperative patients: when and why. Haemostasis 1999; 29:247-54.
19. Uslusoy E, Mete S, Predisposing factors to phlebitis intravenous catheters: a descriptive study. J Am Ac Nurse Pract. 2008;20:172-80.
20. Barker P, Anderson AD, MacFie J. Randomized clinical trial of elective re- sitting of intravenous cannulae. Anns R Coll Surg Engl. 2004; 86: 281–83.
21. Maki DG, Ringer M. Risk factors for infusion-related phlebitis with small peripheral venous catheters. A randomized controlled trial. Ann Intern Med. 1991;114(10):845-854
22. Abbas SZ, de Vries TK, Shaw S, Abbas SQ. Use and complications of peripheral vascular catheters: a prospective study. Br J Nurs 2007;16:648,650,652
23. Ferreira L R, Pedreira M L and Diccini S. Phlebitis among neurosurgical patients. Acta Paulista de Enfermagnem. 2007;20:30-6.
24. Regueiro Pose, M., Souto Rodríguez, B., Iglesias Maroño, M., Outón Fernández, I., Cambeiro Nuñez, J., Pértega Díaz, S. and Pita Fernández, S. Peripheral venous catheters: incidence of phlebitis and its determining factors. Revista de Enfermería, 2005;28(10):21-28.
25. Yuehuei HA, Friedman RF. Laboratory methods for studies of bacterial adhesion. J Microbiol Methods 1997;30:141-52.