Sapporo Medical Journal
Volume 56, Issue 11, November 2022

Incidence of Phlebitis After Povidone-Iodine Use and Alcohol Isopropyl Scrubbing as Antiseptics in Peripheral Intravenous Cannulation in Intensive Care Unit, Sulaimaniyah, Iraq

Karzan M. Faud[1,2], Amir M. Boujan[2*], Delan Jamal Qader[3]

1 Intensive Care Unit, Shorsh General Hospital, Directorate of Health, Sulaimaniyah, Iraq
2 Department of Surgery, College of Medicine, University of Sulaimani, Sulaimaniyah, Iraq
3 Department of Adult Nursing, College of Nursing, University of Sulaimani, Sulaimaniyah, Iraq

Abstract— Phlebitis is one of the common complications after peripheral intravenous (PIVC) cannulation, especially in admitted patients. Objective: This study aimed to determine the incidence of phlebitis after povidone-iodine (PVP-I) versus alcohol isopropyl scrubbings as antiseptics in PIVC in patients admitted to the intensive care unit (ICU). A randomized prospective study was conducted in Shar Teaching Hospital, Sulaimaniyah, Iraq, on 201 patients admitted to the ICU from January 2022 to September 2022. Patients were allotted into two groups. Group I (n=99) used povidone-iodine-10% scrub, and group II (n=102) used alcohol isopropyl-70% scrub for sterilizing the skin before PIVC. The study variables included age, gender, site of insertion, place of insertion, cannula size, past medical history, and reason for admission. Phlebitis stages were estimated using a visual infusion phlebitis score (VIPS). The phlebitis incidence in studied patients was 90.5% (87.9% in group I and 93.1% in group II). Most phlebitis cases were developed in patients aged >65 years that had hypertension and were associated with non-significant sex distribution, small catheter size (20 gauge), and insertion on a dorsal metacarpal vein on the right site after 72 hours of IV drug/fluid administration. There was no significant association (P>0.05) between the study groups' variables and their phlebitis stages concerning using different antiseptics. The phlebitis rate was much higher than the global standard rate, and there was no difference between povidone-iodine-10% and alcohol isopropyl-70% scrubbing antiseptics concerning the patient's variables and stages of phlebitis.

Keywords: Povidone-iodine, alcohol isopropyl, phlebitis, intravenous catheter, ICU

1. Introduction

The patient's vein irritation during catheterization is referred to as phlebitis, which results in pain, erythema, edema, irritation, line formation, and/or a palpable cord [1]. Phlebitis can lead to more severe consequences such as restricted vascular access, purulent thrombophlebitis, sepsis, and thrombus development, all of which lengthen hospital stays, necessitate the use of antibiotics, and sometimes even require surgical intervention [2].

Phlebitis can worsen for various reasons, including administering vesicant IV fluids or drugs, harm from the catheter to the vein's inner lining, and infection. Therefore, it's crucial to put preventative measures in place, keep a close eye out for signs of phlebitis at the IV site, and remove the cannula when pain and erythema appear [3]. There are four main phlebitis types, mechanical, chemical, infectious, and thrombophlebitis. In addition, it was found that 3 - 30% of patients with PIVC have various degrees of phlebitis [4].

Peripheral vein phlebitis (PVP) is the commonest obstacle to IV catheterization and occurs in 20% of admitted patients. Mostly, it is a physicochemical phenomenon that needs the cannula to be removed and inserted a new one in another site that might require local treatment and pain reliever [5, 6]. In addition, PIVC progressively results in Staphylococcus aureus bacteremia in 12 - 50% of catheter-associated

episodes. Generally, bacterial phlebitis is not common, but 50% of PIVC-related bacteremia results in PVP [7].

Centers for Disease Control (CDC) and Healthcare Infection Control Practices Advisory Committee (HICPAC) guidelines recommend catheter replacement every 72 hours. However, a European multicenter research surveillance project detected an increased rate of PVP from the insertion day up to 5 days [8]. Alternatively, the ultrasound-guided PIV access program was allied with decreases in central venous catheter placement, especially in less severe cases [9].

One of the physical signs of grade 1 phlebitis is pain or erythema close to the IV site. In contrast, grade 2 phlebitis (early stage of phlebitis) presents with some physical signs, including site pain, erythema, or edema [4]. On the other hand, in grade 3 phlebitis, pain along the erythema and induration are noticed, and in grade 4 phlebitis with a cannula (early or advanced stages of phlebitis) presents with thrombophlebitis, extensive erythema, and pain along cannula's course [10]. Finally, grade 5 phlebitis is characterized by a palpable venous cord, induration, advanced thrombophlebitis along the cannula's length, palpable erythema and secretory discharge at the IV site, and a venous cord [11].

2. Patients and Methods

2.1. Materials

Before starting the study, both antiseptic agents (povidone iodine-10% solution from Aqua company and alcohol isopropyl-70% solution from Verkan company) were cultured on MaCconkey and blood agar media using sterile techniques in the Microbiology Laboratory at Shorsh Teaching Hospital, Sulaimaniyah, Iraq for 48 hours. The culture results on both media were negative for microorganisms.

2.2. Study setting and design

This prospective randomized study was conducted at Shar Teaching Hospital, Sulaimaniyah, Iraq, from January 2022 to September 2022 on 201 patients admitted to the ICU. Patients were allocated into two groups randomly. Before the insertion of a peripheral catheter, group I (99 patients) was assigned to use povidone-iodine-10%, and group II (102 patients) was given to use alcohol isopropyl-70% as scrubbing antiseptics for skin sterilization.

2.3. Inclusion criteria

Patients aged >18 years that admitted to the ICU regardless of gender were enrolled in this study.

2.4. Exclusion criteria

Patients with preexisting skin diseases, uncontrolled diabetics, and those on chemotherapy or immune suppressant medications who had a central venous catheter or were allergic to study materials were excluded from this study.

2.5. Ethical consideration

Ethical approval was taken from the Scientific and Ethical Committees, College of Medicine, University of Sulaimani, Sulaimaniyah, Iraq, with approval number 233-COM-UoS on 19-12-2021. At the same time, IRB was obtained from the Directorate of Health, Sulaimaniyah Governorate.

2.6. Patient consent

The informed consent was taken verbally, directly from the patient or the patient’s guardian. Patient confidentiality was considered, and patients were free to leave the study without any reason or declaration.

2.7. Questionnaire

A well-constructed self-generated questionnaire was used to collect patient data, including age, gender, cannula insertion site, place of cannula insertion, cannula size, cannula insertion time and date, past medical history, the reason for admission, and admission diagnosis.

Upon insertion of a cannula, the visual infusion phlebitis score (VIPS) based on Maddox et al. phlebitis

grading scale with minor modifications was used to detect the developed signs and symptoms of phlebitis after 72 hours from the insertion time (Table 1) [12].

Table1. Criteria for judging phlebitis in admitted patients at ICU [12].

Site observation	**Score**	**Sign**
IV site appears healthy	0	No sign of phlebitis Observe cannula
One of the following signs is evident - Slight pain near the IV site - Slight redness near the IV site	1	The possible first sign of phlebitis Observe cannula
Two of the following are evident - Pain at the IV site - Redness	2	The early stage of phlebitis Resite cannula
All of the following are evident - Pain a long path of cannula - Redness around the site - Swelling	3	Medium stage of phlebitis Resite cannula Consider treatment
All of the followings are evident and extensive - Pain along the path of cannula - Redness around the site - Swelling - Palpable venous cord	4	Advanced stage of phlebitis or start of thrombophlebitis Resite cannula Consider treatment
All of the followings are evident and extensive - Pain along the path of cannula - Redness around the site - Swelling - Palpable venous cord - Pyrexia	5	Advanced stage or the start of thrombophlebitis Initiate treatment Resite cannula

2.8. Study procedure

Before PIVC, all materials were prepared aseptically, including proper cannula size, tourniquet, antiseptics (povidone-iodine10% and alcohol isopropyl-70% solutions), IV dressing, syringe (5.0 mL), sodium chloride (NaCl; 0.9%) for flushing the cannula, and pen for labeling.

The PIVC process was divided into five steps. In step one, hand washing was carried out for 30 seconds before the antiseptics were applied to patients and after the procedure between the patients, as the World Health Organization (WHO) recommended to prevent infections related to health care providers [13]. In step two, one of the prominent upper limbs' veins was selected for IV cannula insertion, and cannula size was identified according to eligible vein access and the patient's condition. In contrast, the tourniquet was applied 10 cm above the IV site in step three. In step four, povidone iodine-10% scrub was used for group 1 (n=99) patients and alcohol isopropyl-70% scrub for group II (n=102) patients. Povidone iodine-10% was applied to the IV site as a circle with a diameter of 5.0 cm to reduce skin staining and irritation. After 3-5 minutes and upon skin dryness, the IV cannula was inserted, and the skin was observed to assess any

allergic reaction/irritation. While alcohol isopropyl-70% was used in the same manner as povidone-iodine, the IV cannula was inserted after 20 seconds.

In the fifth step, IV dressing was applied, then the time, date, nurse's initial name, and signature were documented on the questionnaire paper. Seventy-two hours later, the cannula insertion site was assessed and evaluated for the incidence of phlebitis according to the VIPS measure outcome. Thus, if the cannula was not outed or there was no infection, it was kept to maintain infusion therapy for 96 hours (4 days) according to WHO protocol [14].

2.9. Statistical analysis

The data were analyzed by Statistical Package for Social Science (SPSS, Chicago, USA, Version 22.0). Descriptive data were presented as mean±standard deviation (SD) and frequencies as percentages. The Chi-square test was used for categorical variables, and the independent T-test was used to compare between means. P-values of <0.05 were considered significant.

3. Results

The patient's mean±SD age was 58.1±20.9 years for group I and 59.6±18.5 years for group II without significant correlation (p=0.58), and most patients in both groups were aged >65 years. Regarding the patient's gender, most patients in group I was males, while group II included more females. The patients were admitted for various causes, and most had hypertension. We used a cannula gauge 20 on the dorsal metacarpal vein on the right site for IV cannula insertion in most patients in both groups. No significant association between both groups regarding age (p=0.24), gender (p=0.06), reasons for admission to ICU (p=0.051), past medical history, cannula size (p=0.47), upper limbs insertion site (p=0.54), dorsal aspect of the upper peripheral vein (p=0.27) and inner aspect vein (p=0.76) were found (Table 2).

Table 2. The association between both antiseptics concerning different patient variables.

Variable	**Antiseptic**		**P-value**
	Alcohol ispropyl-70%	**Povidone-iodine-10%**	
Age (Year)			
18 - 35	20	11	0.24
36 - 50	14	21	
51 - 65	26	23	
> 65	42	44	
Gender			
Female	45	57	0.06
Male	57	42	
Reason of admission			
Fall from height	5	0	0.51
Road traffic accident	11	4	
Multiple fractures	1	2	
Cardio Vascular Accident (CVA)	25	34	
Renal failure	4	11	
Heart failure	21	18	

Liver failure	5	3	
Others (neurology, respiratory failure, and so on)	29	27	
Past medical history			
Hypertension	42	38	0.47
Heart disease	6	8	
Anemia	1	0	
Neurological disorder	3	0	
Other	27	29	
Concomitant (multiple) diseases	23	24	
IV Size			
Gauge 18	11	8	0.47
Gauge 20	55	48	
Gauge 22	36	43	
Limb site			
Right	62	56	0.54
Left	40	43	
Dorsal aspect			
Dorsal metacarpal vein	33	35	0.27
Dorsal digital vein	2	4	
Dorsal venous network	1	5	
Cephalic vein	22	18	
Basilic vein	1	4	
Inner aspect			
Cephalic vein	21	19	0.76
Accessory cephalic vein	7	4	
Median cubital vein	9	6	
Median vein of the forearm	6	4	
Basilic vein	0	1	
Total	**102**	**99**	**201**

Moreover, the majority of phlebitis patients were in stage 2 (early stage of phlebitis) (49.0% for alcohol isopropyl-70% and 36.4% for povidone-iodine10%), followed by stage one (the possible first sign of phlebitis) (27.5% for alcohol isopropyl-70% and 42.4% for povidone iodine-10%), then stage 3 (medium stage of phlebitis) (13.7% for alcohol isopropyl-70% and 7.1% for povidone iodine-10%). While stage 4 (advanced stage of phlebitis) in patients was 2.0% for alcohol isopropyl-70% and 1.0% for povidone-iodine10%, however; stage 5 (advanced stage of thrombophlebitis) phlebitis were the least that accounts only 1.0% for each antiseptic. On the other hand, stage 0 (no phlebitis signs) was 6.9% and 12.1% after applying alcohol isopropyl-70% and povidone-iodine-10% scrubbing, respectively. No significant correlations ($p>0.05$) between various stages of phlebitis and using different scrubbing materials in PIVC in patients were observed (Table 3). Thus, the incidence of phlebitis (stage 1-5) for group 1 was 87.9% (87 patients), and for group, II was 93.1% (95 patients), which means the phlebitis incidence total in this study was 90.5% (182 patients in both groups).

Table 3. Illustrates stages of phlebitis according to visual infusion phlebitis scores (VIPS).

VIPS	No./Frequency (%)		P-value
	Alcohol isopropyl- 70%	Povidone iodine-10%	
Stage 0 (no phlebitis signs)	7.0 (6.86)	12 (12.12)	0.11
Stage 1 (Possible first sign of phlebitis)	28 (27.45)	42 (42.42)	0.8
Stage 2 (Early stage of phlebitis)	50 (49.01)	36 (36.36)	0.09
Stage 3 (medium stage of phlebitis)	14 (13.72)	7.0 (7.01)	0.06
Stage 4 (advanced stage of phlebitis)	2.0 (1.96)	1.0 (1.01)	0.33
Stage 5 (advanced stage of thrombophlebitis)	1.0 (0.98)	1.0 (1.01)	0.72
Total	(102)100	(99)100	

4. Discussion

PIVC complications such as phlebitis can result in various issues [15]. The chemical elements of drugs and technical and mechanical factors have a more significant part in the development of phlebitis [6]. In the current study, the phlebitis incidence was 90.5%; most cases were developed in patients aged >65 years with hypertension and were correlated with non-significant sex distribution, small catheter size (20 gauge) insertion on a dorsal metacarpal vein on the right site after 72 hours of IV drug administration. In this regard, Singh et al., 2008 reported that phlebitis was developed in 59.1% of admitted patients. However, that was very mild in most cases and related to the male sex, small catheter size (20 gauge), insertion site at the forearm, IV medication, and blood transfusions after 36 hours of catheterization [16]. Additionally, Mandal and Raghu, 2019 observed the phlebitis incidence to be 31.4%, with more incidence rate in females aged <60 years, lower limb insertion, large catheter size, catheters inserted in emergencies, and IV medication [17].

On the other hand, our phlebitis rate (90.5%) was more than the standard acceptable phlebitis rate (≤5.0%) [18]. Additionally, our phlebitis incidence was much more than other studies that showed a phlebitis rate of 7.5% [4], 7.6% [19], 8% [15], and 9.1% [6]. The highest phlebitis rate in this study might be due to resources from which catheters were made, catheter size/length, insertion site, frequency of catheterization in the same place, time to remove catheters, the osmolality of IV fluids/drugs, infusion rates, asepsis, types of dressings used to fix catheters, time to the renewal of infusion sets, approaches for opening open, and nursing skill in catheterization [20]. Phlebitis may lead to increased hospitalization duration, patient stress level, and financial burden with increasing staff workload. Progressive practice nurses must be aware of the reasons that raise the possibility of phlebitis and take suitable actions to avoid it [21].

Regarding using antiseptic-related phlebitis, we found the incidence to be 93.1% in group I and 90.5% in group II without significant differences. Zamanzadeh et al., 2009 in Iran showed the incidence of phlebitis in the ethylic alcohol group to be 53.3% and in the povidone-iodine group to be 46.7% without significant differences between them [22]. Moreover, Mimoz et al., 2015 found that alcohol isopropyl-70% and povidone idodine-10% scrubbings were not correlated to catheter colonization (p=0.38) [23].

In the current study, the phlebitis was estimated according to its stage from 0-5 were 6.9%, 27.5%, 49.0%, 13.7%, 2.0%, and 1.0%, respectively, after using alcohol isopropyl-70% scrub. Thus, phlebitis in stage II

was the highest rate, and this outcome is not agreed with that found by Abdollahi and Arbabisarjou, 2016 who found the highest rate of phlebitis in stage 1 [24]. Simultaneously, the phlebitis stages were estimated from 0-5 (12.12%, 42%, 36.36%, 7.01%, and 1.01%, respectively) after using povidone idodine-10% scrub, and we reported more phlebitis in stage I. Unfortunately, we could not find recent studies on this subject; thus, we compared our study outcomes to very old ones. In this regard, Thompson et al., 1983 demonstrated that the use of povidone-iodine ointment for prophylaxis did not reduce the incidence of cannula thrombophlebitis [25], as well as Noble et al., 1980 concluded that the use of povidone-iodine dry powder spray for prophylaxis not reduced the incidence of infusion thrombophlebitis [26].

5. Conclusions

The phlebitis rate in patients admitted to ICU was very high (90.5%) and much above the global standard rate using two different antiseptics. However, using the antiseptics in PIVC to decrease the incidence of phlebitis is not significantly associated with various patient variables nor subside the phlebitis stages. Therefore, we recommend the subsequent study be conducted on a larger sample size in multiple hospitals in different areas, search for other causes of phlebitis, and both antiseptics not be compared to find out the incidence of phlebitis.

Acknowledgments

The authors appreciate the healthcare staff from Shar Teaching Hospital and Shorsh General Hospital for their kind help and support of this study. Also, thanks go to the College of Medicine, University of Sulaimani, Sulaimaniyah, Iraq, for providing facilities and services to this study.

References

[1] Ray-Barruel G., Polit D.F., Murfield J.E., & Rickard C.M. (2014). Infusion phlebitis assessment measures: a systematic review. Journal of Evaluation in Clinical Practice. 20(2), 191-202.

[2] Marsh N., Mihaela G., Ray-Barruel G., Webster J., Wallis M.C., & Rickard C.M. (2015). Inter-rater agreement on PIVC-associated phlebitis signs, symptoms and scales. Journal of Evaluation in Clinical Practice. 21(5), 893-9.

[3] Arias-Fernández L., Suérez-Mier B., del Carmen Martínez-Ortega M., & Lana A. (2017). Incidence and risk factors of phlebitis associated with peripheral intravenous catheters. Enfermería Clínica (English Edition). 27(2), 79-86.

[4] Yasuda H., Yamamoto R., Hayashi Y., Kotani Y., Kishihara Y., Kondo N., et al. (2021). Occurrence and incidence rate of peripheral intravascular catheter-related phlebitis and complications in critically ill patients: a prospective cohort study (AMOR-VENUS study). Journal of Intensive Care. 9(1), 1-12.

[5] Atay S., Şen S., & Cukurlu D. (2018). Phlebitis-related peripheral venous catheterization and the associated risk factors. Nigerian Journal of Clinical Practice. 21(7), 827-31.

[6] Yasuda H., Rickard C.M., Marsh N., Yamamoto R., Kotani Y., Kishihara Y., et al. (2022). Risk factors for peripheral intravascular catheter-related phlebitis in critically ill patients: analysis of 3429 catheters from 23 Japanese intensive care units. Annals of Intensive Care. 12(1), 1-13.

[7] Suliman M., Saleh W., Al-Shiekh H., Taan W., & AlBashtawy M. (2020). The incidence of peripheral intravenous catheter phlebitis and risk factors among pediatric patients. Journal of Pediatric Nursing. 50, 89-93.

[8] Lulie M., Tadesse A., Tsegaye T., Yesuf T., & Silamsaw M. (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(1), 1-8.

[9] Shokoohi H., Boniface K., McCarthy M., Al-Time T.K., Sattarian M., Ding R., et al. (2013). Ultrasound-guided peripheral intravenous access program is associated with a marked reduction in central venous catheter use in noncritically ill emergency department patients. Annals of Emergency Medicine. 61(2), 198-203.

[10] Urbanetto J.d.S., Peixoto C.G., & May T.A. (2016). Incidence of phlebitis associated with the use of peripheral IV catheter and following catheter removal. Revista Latino-Americana de Enfermagem. 24, e2746.

[11] Urbanetto J.d.S., Muniz F.d.O.M., Silva R.M.d., Freitas A.P.C.d., Oliveira A.P.R.d., & Santos J.d.C.R.d. (2017). Incidence of phlebitis and post-infusion phlebitis in hospitalised adults. Revista Gaúcha de Enfermagem. 38(2), e58793.

[12] Maddox R.R., Rush D.R., Rapp R.P., Foster T.S., Mazella V., & McKean H.E. (1977). Double-blind study to investigate methods to prevent cephalothin-induced phlebitis. American Journal of Health-System Pharmacy. 34(1), 29-34.

[13] Allegranzi B., Conway L., Larson E., & Pittet D. (2014). Status of the implementation of the World Health Organization multimodal hand hygiene strategy in United States of America health care facilities. American Journal of Infection Control. 42(3), 224-30.

[14] Organization W.H. Pocket book of hospital care for children: guidelines for the management of common childhood illnesses: World Health Organization; 2013.

[15] Guihard B., Rouyer F., Serrano D., Sudrial J., & Combes X. (2018). Appropriateness and complications of peripheral venous catheters placed in an emergency department. The Journal of Emergency Medicine. 54(3), 281-6.

[16] Singh R., Bhandari S., & Pun K. (2008). Peripheral intravenous catheter related phlebitis and its contributing factors among adult population at KU Teaching Hospital. Kathmandu University Medical Journal. 6(4), 443-7.

[17] Mandal A., & Raghu K. (2019). Study on incidence of phlebitis following the use of peripheral intravenous catheter. Journal of Family Medicine and Primary Care. 8(9), 2827-31.

[18] Gorski L.A. (2021). A look at 2021 infusion therapy standards of practice. Home Healthcare Now. 39(2), 62-71.

[19] A. R. (2020). Correlations Of Giving Disinfection (Alcohol Swab) When Giving Intravein Injection With Phlebitis. Journal of Vocational Nursing. 1(1), 37-43.

[20] Milutinović D., Simin D., & Zec D. (2015). Risk factor for phlebitis: a questionnaire study of nurses' perception. Revista Latino-Americana de Enfermagem. 23, 677-84.

[21] Uslusoy E., & Mete S. (2008). Predisposing factors to phlebitis in patients with peripheral intravenous catheters: a descriptive study. Journal of the American Academy of Nurse Practitioners. 20(4), 172-80.

[22] Zamanzadeh V., Kolahdoozipour J., Abdollahzadeh F., & Lotfi M. (2009). Comparison of the Effect of Chlorhexidine Gluconate 2%, Ethylic Alcohol 70% and Povidone-Iodine10% in Prevention of Phlebitis. Medical Journal of Tabriz University of Medical Sciences. 30(3), 55-60.

[23] Mimoz O., Lucet J.-C., Kerforne T., Pascal J., Souweine B., Goudet V., et al. (2015). Skin antisepsis with chlorhexidine–alcohol versus povidone iodine–alcohol, with and without skin scrubbing, for prevention of intravascular-catheter-related infection (CLEAN): an open-label, multicentre, randomised, controlled, two-by-two factorial trial. The Lancet. 386(10008), 2069-77.

[24] Abdollahi F., & Arbabisarjou A. (2016). Comparing the Effect of Disinfectant Solution of 2% Chlorhexidine Gluconate and 70% Alcohol on Prevention of Phlebitis. Der Pharmacia Lettre. 8(6), 129-34.

[25] Thompson D., Jones G., & Sutton T. (1983). A trial of povidone-iodine ointment for the prevention of cannula thrombophlebitis. Journal of Hospital Infection. 4(3), 285-9.

[26] Noble C., Morgan-Capner P., Hammer M., Sivyer C., Wagstaff P., & Pattison J. (1980). A trial of povidone-iodine dry powder spray for the prevention of infusion thrombophlebitis. Journal of Hospital Infection. 1(1), 47-51.