The Art and Science of Infusion Nursing

Factors Contributing to Phlebitis Among Adult Patients Admitted in the Medical-Surgical Units of a Central Hospital in Harare, Zimbabwe

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ABSTRACT

This descriptive survey identified factors contributing to phlebitis among 46 adult inpatients using a systematic random sample. The visual infusion phlebitis score was used for assessment. All participants had phlebitis, with stage 4 being most frequent. Factors identified were gender (males—91.7%); immunosuppression (human immunodeficiency virus—63.0%; diabetes—100%; immunosuppressive drugs—100%; absolute leucocyte count <1000 μL—100%); number of catheters inserted (>1—90.9%); site of catheterization (dorsum of wrist—100%); catheter dwell time (2-4 days—100%); catheter gauge (18-gauge—75%); catheter securement (unsecured/contaminated dressing—90%); regularity of catheter flushing (catheter never flushed—72.7%); and continuous infusion (94.2%).

Key words: catheter, infusion, intravenous fluids, intravenous infusion, parenteral line, phlebitis, short peripheral catheter

INTRODUCTION

Short peripheral catheter (SPC) insertion for intravenous (IV) therapy is one of the most commonly performed procedures in medical institutions across the world.[1] Administration of parenteral therapy forms an integral part of nursing practice.[2] SPCs are used in various health care settings such as long-term care facilities and nursing homes; common indications include administration of medication, nutrients, and fluids.[3] Proper maintenance and care to avoid complications such as phlebitis, infiltration, occlusion, local infection, and bloodstream infection are required.[3]

Indications for infusion therapy include hemodynamic monitoring, fluid replacement, drug therapy, blood administration, parenteral nutrition, radiological imaging using IV contrast, or any other procedure requiring venous access.[1]

The frequent use of catheters exposes patients to a series of potential risks and complications such as phlebitis that lead to patient discomfort, permanent damage of affected veins, significant morbidity or mortality, missed medication doses, and a subsequent longer duration of hospital stay with increased treatment costs.[4]

Phlebitis is inflammation of the tunica intima of the vein, which can result from catheterization of the vein.[1] Factors contributing to phlebitis are patient-, infusion-, and catheter-related characteristics.[5] Type of catheter, the site of insertion, the skin preparation method used, the dressing selected to cover the site, the securement method, the catheter dwell time, the frequency of replacement, and the patient population studied also influence complications from catheterization.[3] Clinical manifestations of phlebitis include

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pain, swelling, erythema, and palpable thrombosis of the catheterized vein.[6] The purpose of this study was to assess the factors contributing to phlebitis following SPC insertion among adult patients admitted to the medical-surgical units of a central hospital in Harare, Zimbabwe.

Methods

This was a descriptive survey conducted at a central hospital in Harare, Zimbabwe, with a systematic random sample of 46 inpatients. Ethical approval was granted by the Joint Research Ethics Committee of the University of Zimbabwe and Parirenyatwa Group of Hospitals, the respective consultants of the medical-surgical wards, as well as the ward managers. All patients gave informed consent. Interviews were conducted in private, and code numbers were used to identify patients. Included in the study were patients on infusion therapy, having a catheter in situ whether in use or not in use, or one that had been removed within the preceding 48 hours. Participants had to be fluent in English, Shona, or both languages to ensure accurate interpretation during establishment of informed consent. Excluded from the study were unconscious and unstable patients. Data were collected using the visual infusion phlebitis score (VIPS), which measures the presence, location, and severity of phlebitis. A score of 0 implies no signs of phlebitis; 1, possible first signs of phlebitis; and 2, early stage of phlebitis; while scales of 3, 4, and 5 indicated medium stage of phlebitis, advanced stage of phlebitis/start of thrombophlebitis, and advanced stage of thrombophlebitis, respectively. A clinical audit form identified in the literature was used to determine factors contributing to phlebitis.[1] The clinical audit form was divided into 3 sections, each measuring the research variables. Data were entered and analyzed using Microsoft Excel (Microsoft Corporation, Redmond, WA), and descriptive statistics were used to analyze the data. Data were then presented in the form of tables and graphs.

RESULTS

Demographic Characteristics

Table 1 describes the demographic data. Of 46 participants, 24 (52.2%) were male, while 22 (47.8%) were female. The mean age was 46.15 years (standard deviation [SD] = 14.09; min = 23; max = 80).

Visual Infusion Phlebitis Score

Table 2 presents phlebitis score. All 46 patients (100%) of the study sample had phlebitis (mean = 3.96; SD = 0.94; min = 1; max = 5; mode = 4). The majority 23 (50.0%) of participants had Grade 4 phlebitis.

Factors Contributing to Phlebitis

Factors contributing to phlebitis in this section were described according to patient-related characteristics, catheter-related characteristics, and infusion-related characteristics.

TABLE 1

Demographic Data

	n	%	Frequency of 4th/5th-Grade Phlebitis in Subcategory	% of Subcategory With 4th/5th Grade Phlebitis
Age				
20-29	5	10.87	4	80.00
30-39	13	28.26	9	69.23
40-49	12	26.09	9	75.00
50-59	5	10.87	4	80.00
60-69	9	19.57	8	88.88
70+	2	4.35	1	50.00
Total	46	100.00		
Gender				
Male	24	52.20	22	91.67
Female	22	47.80	15	68.18
Total	46	100.00		

Patient-related characteristics

Table 3 highlights patient-related characteristics contributing to phlebitis. Twenty-nine (63.0%) participants had infection (pneumonia, pulmonary tuberculosis, cryptococcal meningitis, human immunodeficiency virus [HIV], encephalopathy, gastroenteritis, Kaposi sarcoma). Thirteen (76.5%) participants of those without infection had advanced stages of phlebitis, while 16 (55.2%) of those infections had advanced stages of phlebitis. Five (10.9%) participants did not have any comorbidities, while 41 (89.1%) participants had 1 or more comorbidities. All 5 participants without comorbidities had advanced stages of phlebitis, while 31 (75.6%) of those with 1 or more comorbidities had advanced stages of phlebitis.

Regarding serostatus, 27 (58.7%) participants were HIV positive, and 19 (41.3%) did not know their HIV status. All participants with unknown HIV status developed advanced stages of phlebitis; 17 (63.0%) of those who were HIV positive

TABLE 2

Frequency Distribution of Phlebitis (N = 46)

VIPS	Frequency	Percentage	Cumulative Frequency
1	1	2.17	2.17
2	3	6.52	8.70
3	6	13.04	21.74
4	23	50.00	71.74
5	13	28.26	100.00
Total	46	100.00	

Abbreviation: VIPS, visual infusion phlebitis score.

TABLE 3

Factors Contributing to Phlebitis: Patient-related Characteristics (N = 46)

	n	%	Frequency of 4th/5th-Grade Phlebitis in Subcategory	% of Subcategory With 4th/5th-Grade Phlebitis
Level of consciousness				
(Glasgow Coma Scale)				
14-15	39	84.78	31	79.44
12-13	7	15.22	5	71.43
Total	46	100.00		
Ongoing infections				
Absent	17	36.96	13	76.47
Present	29	63.04	16	55.17
Total	46	100.00		
Number of comorbidities				
None	5	10.87	5	100.00
1 or more	41	89.13	31	75.61
Total	46	100.00		
HIV status				
HIV negative (-)	0	0.00	0	0.00
HIV status unknown	19	41.30	19	100.00
HIV positive (+)	27	58.70	17	63.00
Total	46	100.00		
Other immunosuppression				
None	10	21.74	10	100.00
Diabetes mellitus	6	13.04	6	100.00
Use of immunosuppressive drugs	2	4.35	2	100.00
Absolute leucocyte count (<1000 μL)	28	60.87	18	64.29

Abbreviation: HIV, human immunodeficiency virus.

had advanced stages of phlebitis. The 10 (21.7%) participants who had HIV as the sole infection, the 6 (13.0%) who had diabetes mellitus, the 2 (4.4%) who were on immunosuppressive medications, and 28 (60.9%) of those with an absolute leucocyte count less than 1000 μL had advanced phlebitis.

Catheter-related characteristics

Tables 4 and 5 outline catheter-related characteristics contributing to phlebitis. A total of 57 SPCs were assessed (mean = 1.24; SD = 0.43; min = 1; max = 2). Thirty-five (76.0%) participants had 1 catheter, and 11 (23.9%) had 2. Of the 25 participants with 1 catheter, 71.4% had advanced phlebitis, while 10 (90.9%) of those that had 2 catheters had advanced phlebitis.

Regarding anatomic site of catheterization, 14 (30.4%) participants were catheterized in the left cubital fossa, 6 (13.0%) in the left forearm, 20 (43.5%) in the dorsal aspect of the left wrist, and 4 (8.7%) in the right cubital fossa, while 1 each was in the right forearm, and 1 on the dorsal aspect of the right wrist, respectively. Advanced phlebitis was observed in 8 (57.1%) participants of those catheterized in the left cubital fossa, 6 (100%) in the left forearm, 18 (90%) in the dorsal aspect of the left wrist, 3 (75.0%) in the right cubital fossa, and in the patient catheterized on the dorsal aspect of the right wrist.

Eight (17.4%) participants had an 18-gauge SPC inserted, 36 (78.3%) had a 20-gauge SPC, and 2 (4.4%) had a 22-gauge SPC. Advanced phlebitis was observed in 6 (75%) participants with an 18-gauge SPC, in 16 (44.4%) with a 20-gauge SPC, and in both patients with a 22-gauge SPC.

Six participants (13.0%) had their catheter in situ for 2 to 4 days, and 40 (87.0%) for more than 4 days. Advanced phlebitis was observed in all 6 participants that had their catheter in situ for 2 to 4 days and in 30 (75%) of those that had their catheter in situ for more than 4 days. Twenty-six (56.5%) participants had their SPCs secured with adhesive tape, and 20 participants (43.5%) had either an unsecured catheter or a catheter secured with a contaminated

TABLE 4

Factors Contributing to Phlebitis: Catheter-related Characteristics (1) (N = 46)

	n	%	Frequency of 4th/5th-Grade Phlebitis in Subcategory	% of Subcategory With 4th/5th-Grade Phlebitis
Number of SPCs				
1	35	76.09	25	71.43
2	11	23.91	10	90.91
Total	46	100.00		
Anatomic sites of catheter(s)				
Left cubital fossa	14	30.43	8	57.14
Left forearm	6	13.04	6	100.00
Left wrist (dorsal aspect)	20	43.48	18	90.00
Left wrist (palmar aspect)	0	0.00	0	0.00
Right cubital fossa	4	8.70	3	75.00
Right forearm	1	2.17	0	0.00
Right wrist (dorsal aspect)	1	2.17	1	100.00
Right wrist (palmar aspect)	0	0.00	0	0.00
Left lower limb	0	0.00	0	0.00
Right lower limb	0	0.00	0	0.00
Total	46	100.00	0	0.00
Catheter dwell time				
<1 day	0	0.00	0	0.00
2-4 days	6	13.04	6	100.00
>4 days	40	86.96	30	75.00
Total	46	100.00		

Abbreviation: SPC, short peripheral catheter.

dressing. Advanced phlebitis was observed in 18 (69.2%) participants who had SPCs secured with adhesive tape and in 28 (90.0%) who had an unsecured SPC or was secured with a contaminated dressing.

Eighteen (39.1%) participants had the catheter in situ and in use, 6 (13.0%) had the catheter not in use but in situ with irregular flushing, and 22 (47.8%) had catheters that were in situ, not in use, and never flushed. Advanced phlebitis was observed in 3 (50%) of those that had catheters that were irregularly flushed and in 16 (72.7%) of those with catheters that were never flushed (Tables 4 and 5).

Infusion-related characteristics

Table 6 describes factors contributing to phlebitis (infusion-related characteristics). Twenty-four participants (52.2%) had a prescribed infusion, and 22 (47.8%) had a catheter in situ with no current prescribed infusion. Of the 24 participants with the prescribed infusion, 17 (37%) were receiving an isotonic infusion, 7 (15.2%) a hypertonic solution, 6 (13%) antibiotic therapy, 1 (2.17%) potassium chloride (KCl), 16 (34.8%) crystalloid solution and 1 (2.17%) blood. Advanced phlebitis was observed in 15 (88.2%) participants of those receiving an isotonic solution and in 4 (57.1%) of those receiving a hypertonic infusion.

Seven (29.2%) participants were receiving intermittent infusions, and 17 (37.0%) were receiving continuous infusion. Advanced phlebitis was observed in 4 (57.1%) of those receiving intermittent infusions and in 16 (94.1%) of those receiving continuous infusion.

DISCUSSION

Demographics

Of the 46 patients, 52.2% were male and 47.8% were female. Mean age was 46.5 years, and the model age group was the 30 to 39 years age group.

Visual Infusion Phlebitis Scores

Advanced phlebitis (grades 4 and 5) was observed in 78.5% of the participants, with 50% requiring immediate replacement of the SPC and possible treatment and 28.3% requiring immediate catheter replacement and initiation of treatment. Other studies, however, have reported lower

TABLE 5

Factors Contributing to Phlebitis: Catheter-related Characteristics (2) (N = 46)

	n	%	Frequency of 4th/5th-Grade Phlebitis in Subcategory	% of Subcategory With 4th/5th-Grade Phlebitis
Catheter gauge				
14-gauge	0	0.00	0	0.00
16-gauge	0	0.00	0	0.00
18-gauge	8	17.39	6	75.00
20-gauge	36	78.26	16	44.44
22-gauge	2	4.35	2	100.00
Total	46	100.00		
Catheter securement				
Gauze dressing	0	0.00	0	0.00
Transparent dressing	0	0.00	0	0.00
Tape	26	56.52	18	69.23
Catheter unsecured/contaminated dressing	20	43.48	18	90.00
Total	46	100.00		
Regular catheter flushing				
Catheter in situ and in current use	18	39.13	16	88.88
Catheter in situ with regular flushing	0	0.00	0	0.00
Catheter in situ with irregular flushing	6	13.04	3	50.00
Catheter in situ and never flushed	22	47.83	16	72.72
Total	46	100.00		

incidences of 11.09%[7] and 3.7% to 67.24%.[5] The most common grades of phlebitis were grade 1 and 2 (37.0% and 53.6%), respectively.[7] Uslusoy and Mete also found grade 1 phlebitis to be the most frequent (44.5%).[8] Though the sample size used was too small compared with other studies, the high incidence of phlebitis in this study could indicate a lack of vigilance in the management of SPCs. It could also be explained by the subjectivity that is ingrained in the VIPS.

Patient-related characteristics

Medical Condition. Phlebitis was observed in all participants despite all patients being sufficiently conscious to be able to report tenderness at the site of catheter insertion. Phlebitis could have been due to other factors, as 63.0% had ongoing infections. Advanced phlebitis was also observed in 75.6% of those with comorbidities and in 80% of those receiving amphotericin B. Infection is assumed to predispose a patient to phlebitis in the spread of microorganisms through septic emboli from the focus of the infection to the catheter tip.[1] Immunosuppression leaves patients more prone to infections and reduces the body's ability to respond to infection, thus contributing to phlebitis. In addition, use of amphotericin B in patients with cryptococcal meningitis has been reported to irritate the vein, leading to chemical phlebitis.[9]

Catheter-related characteristics

Number of Simultaneous Catheters. The average number of catheters in this study was 1.24 (SD = 0.43; median = 1; min = 1; max = 2). There was a greater percentage of advanced stages of phlebitis (90.9%) among patients who had 2 simultaneous catheters in situ compared with those who had 1 catheter (71.4%). This is similar to the findings of Osei-Tutu et al,[1] who reported significantly higher odds of developing phlebitis with more than 1 simultaneous SPC. Incidence of phlebitis and level of severity have been reported to increase with the number of catheters inserted.[10] Incidence also increases when catheters are repeatedly inserted in the same arm.[8]

Anatomic Site of Catheter Insertion. The most frequent sites for catheterization were the dorsal aspect of the wrist (43.5%) and the cubital fossa (30.4%). The cubital fossa and the wrist are considered less preferable sites for catheter insertion because the flow of infusion can be impeded by flexion and extension movements at the joints, increasing the risk of mechanical phlebitis.[1] As was observed in this study, catheters placed at joint sites had a higher percentage of 4th- and 5th-grade phlebitis scores (90% of the dorsal aspect of the left wrist; 75% of the right cubital fossa; 57.1% of the left cubital fossa). Other studies show the risk

TABLE 6

Factors Contributing to Phlebitis: Infusion-related Characteristics (N = 46)

	n	%	Frequency of 4th/5th-Grade Phlebitis in Subcategory	% of Subcategory With 4th/5th-Grade Phlebitis
Infusion tonicity				
Isotonic	17	37.00	15	88.24
Hypertonic	7	15.17	4	57.14
Hypotonic	0	0.00	0	0.00
No infusion	22	47.82	18	81.81
Type of infusion				
Antibiotic	6	13.00	3	50.00
Potassium chloride	1	2.17	1	100.00
Crystalloid solution	16	34.76	15	93.75
Blood/blood products	1	2.17	1	100.00
No infusion	22	47.82	18	81.81
Infusion rate				
Intermittent	7	29.17	4	57.14
Continuous	17	36.96	16	94.12
No infusion	22	47.82	18	81.81
Use of an infusion pump				
Yes	0	0.00	0	0
No	46	100.00	46	100.00

is lower when SPCs are inserted in the hand or wrist rather than in the forearm.[11] Nevertheless, catheter insertion on the dorsal side of the hands poses a high risk for thrombophlebitis.[12] Thus, it seems that catheter insertion in areas of flexion or high mobility contribute to the development of traumatic phlebitis.[8,13]

Catheter Gauge. The most frequent SPCs used were 18-gauge and 20-gauge, at frequency rates of 17.3% and 78.3%, respectively. Many studies have documented the use of small-size catheters as being advantageous in the prevention of phlebitis.[13] This is described as being due to smaller catheters permitting greater blood flow in the adjacent tissue, preventing venous damage.[14] In this study, 75% of patients with an 18-gauge catheter recorded advanced stages of phlebitis as compared with the 44.4% with a 20-gauge catheter that developed advanced stages of phlebitis. Through this, catheter gauge is noted as contributing to the severity of phlebitis as recorded in the findings.[13] Guidelines, as such, recommend the use of smaller-sized catheter gauges for the prevention of phlebitis.[15] Many authors have highlighted the advantages of using smaller-gauge catheters.[12,13] Smaller catheters allow blood to flow in the adjacent tissue, preventing vein damage.[14,15]

Catheter Dwell Time. In this study, 87.0% of patients had an IV catheter in situ for more than 4 days, and 13.0% of patients had a catheter dwell time of 2 to 4 days. In an analysis of phlebitis rates between these 2 groups, all patients with a catheter in situ for 2 to 4 days displayed advanced stages of phlebitis (grade 4 and higher), with 75% of patients catheterized for more than 4 days displaying advanced stages of phlebitis. This trend is similar to that described by Osei-Tutu et al, of phlebitis rates increasing from day 1, then displaying a slight decrease on day 4 before a steep rise of incidence to day 8 and beyond.[1] Removal of an SPC is not based solely on dwell time and is replaced when clinically indicated.[16] Infusion Nurses Society (INS) recommends skin antisepsis using a chlorhexidine solution. Following SPC insertion, a sterile dressing should be applied and maintained, and changed when soiled or no longer intact.[16] INS specifies that site care frequency should be based on type of dressing: transparent semipermeable dressings should be changed every 5 to 7 days, and gauze dressings should be changed every 2 days.[16]

Catheter Securement Type. Although the type of catheter site dressing has been reported not to influence the rate of phlebitis, dressing types that require frequent changing have been implicated in increased phlebitis rates—presumably due to manipulation of the SPC during dressing changes. In this study, 56.5% of SPCs were secured with the use of adhesive tape. The remaining 43.5% of SPCs were either unsecured or had a contaminated dressing. Ninety percent of those unsecured or with a contaminated dressing displayed a similar severity, while 69.2% of catheters secured with adhesive tape developed advanced stages of phlebitis. Guidelines recommend the use of sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site.[14] The gauze used should be sterile, and the tape should be from a sealed packet. Though gauze may be sterile, it does not provide a waterproof barrier, and over time it can become contaminated and will need to be changed more often.[3] Partially used surgical tape rolls that have been open for undetermined amounts of time have been found to be frequently contaminated with bacteria, including multidrug-resistant organisms.[17] Dressings need to be changed if soiled or damaged, but if still intact, changing a dressing may contribute to introducing contamination.[3]

Catheter Flushing. The findings of this study show that no catheters were flushed on a regular basis, and only 13.0% were flushed irregularly; 72.7% of SPCs that were never flushed developed advanced stages of phlebitis (grades 4 and 5). INS recommends that flushing and locking all vascular access devices be established in organizational policies, procedures, and practice guidelines; however it was noted

that the study site did not have procedural guidelines on catheter care.

Infusion-related characteristics

Type of Infusion. In this study, 70.8% of infusions administered were isotonic, with mostly crystalloids such as 0.9% sodium chloride and Ringer's lactate being used in the maintenance of fluid balance. Administration of hypertonic solutions was noted in 7 participants, with 6 receiving IV antibiotic therapy and 1 receiving IV KCl. In the study by Uslusoy and Mete, KCl was found to increase the probability of phlebitis 1.95-fold, while antibiotics led to a 1.92-fold probability increase attributable to the presence of microparticulates in the antibiotic.[8] Out of the 7 patients that received administration of hypertonic solutions, 57% (3 of those that were receiving antibiotic administration and the patient who was on KCl therapy) were found to develop advanced stages of phlebitis. This indicates that hypertonic solutions can contribute to increased phlebitis severity. Despite this, the study produced similar results to those of Osei-Tutu et al,[1] with patients who were on antibiotic therapy having a lower incidence of advanced stages of phlebitis (50%) compared with patients on nonantibiotic therapy (94.4%). This is presumed to be due to antibiotics assisting in providing prophylaxis to septic phlebitis. In another study, drugs administered 4 or more times a day were 2 times more likely to cause phlebitis than drugs administered 1 to 3 times a day.[8] Furtado also found that drugs administered 7 or more times a day led to a high rate of phlebitis.[13] The reasons presented for this may be linked to the pH of the administered drugs and the need to manipulate the catheter site more often.[8]

Rate of Infusion. Thirty-seven percent of patients in this study were noted to be on continuous IV infusion, while 29.2% were on intermittent infusion. Patients who were on intermittent infusion had lower rates of advanced stage phlebitis (57.1%) compared with those who were on continuous infusion (94.1%). This is similar to a study that highlighted continuous infusion to be a predictor of phlebitis.[13] Other researchers have reported a higher risk of phlebitis in SPCs with intermittent infusions versus those with continuous infusions.[10,18] In contrast, Furtado[13] stated that continuous infusion was a predictor of phlebitis.

CONCLUSION

Advanced phlebitis was common in this study, with an incidence much higher than that reported in the literature. A number of modifiable factors contributing to phlebitis were also identified. It is necessary in our setting to improve care of SPCs to enhance patients' comfort and healing. There is a need to conduct randomized controlled trials with larger samples in our setting to enable evidence-based practice through the use of scientifically based guidelines.

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