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THE EFFECT OF TOPICAL APPLICATION OF MUPIROCIN IN INTRAVENOUS CATHETER SITE IN THE INCIDENCE OF SUPERFICIAL PHLEBITIS

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ABSTRACT

Background: Superficial phlebitis is a common complication of venoclysis although its incidence especially in pediatric hospital setting is not often known and evaluated. A standard aseptic technique in IV line insertion is observed to decrease its incidence but the use of topical antibiotic is rarely used.

Study objectives: Our objective was to determine if topical application of antibiotic mupirocin will affect the incidence of superficial phlebitis as compared to using alcohol alone in the preparation of the IV insertion site.

Setting: Pediatric department wards and emergency room of the University of the Philippines-Philippine General Hospital.

Methodology: In a randomized control study, 69 pediatric patients for intravenous catheter insertion were evaluated. Thirty-six patients were assigned in the control group whose IV insertion site were prepared with alcohol alone while 33 patients in the case group received topical mupirocin after application of alcohol in the IV insertion site. The IV insertion site were than evaluated daily by the investigator for the development of superficial phlebitis until the IV cannula were removed.

Results: Eight out of the 36 patients (22%) in the control group while 4 out of the 33 patients (12%) in the case group developed phlebitis.

Conclusion: The use of topical mupirocin in the IV insertion site prior to cannulation can decrease the incidence of superficial phlebitis.

Background

Phlebitis in insertion site is not an uncommon complication of peripheral intravenous catheterization with cases reported to range from a low 2.3% to as high as 31%.[1,2,3,4] It can manifest as an inflammation in the insertion site to cellulitis and suppuration in the contiguous areas to a more severe catheter related sepsis.

In UP-PGH pediatric wards and emergency room, a proper and successful IV catheter insertion is one of the most basic skill that interns and residents should learn. This can be made difficult by the fact that peripheral veins of pediatric patients are small and often difficult to locate visually and by palpation. Formal IV therapy training for hospital personnel has been shown to decrease leakage, phlebitis and infiltration complications of IV cannulation.[5] In PGH, however, most medical interns learn the technique by practice while serving their rotation in the pediatrics department.

A proper and effective way of doing IV catheterization entails an aseptic technique that every health personnel performing the procedure should observe. However, the incidence of phlebitis may still occur in the insertion site requiring the removal of the IV cannula and reinsertion of new cannula in another site.

Several factors may predispose to the development of superficial phlebitis in IV cannulation site foremost of which is the length of time the cannula is in place or the dwell time. The Center for Disease Control guidelines recommends replacement of IV catheter every 48 to 72 hours for adults but no such recommendation for pediatric patients exists.[6] Studies however has shown that there is no significant differences between phlebitis rate of cannula with dwell time of 72 hour and 96 hour.[7,1] Thus, considering the difficulty of successful cannulation, the limited number of skin sites, and the cost of the devise, the cannula may be left in place for longer than 48 hours.[9] Among neonates, catheter life is on the average lasts for only 30 hours. Extravasation, erythema, accidental displacement, and worse, phlebitis may require the removal and reinsertion into another site of the cannula. Without these complications however, catheter can be safely maintained with adequate monitoring for up to 144 hours.[3]

It is advisable that IV cannula should be used only once per attempt but this is not always the case in PGH where the same cannula can be used several times

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in an attempt at successful cannulation. A transparent polyurethane cannula (Insyte) is the most commonly type of used which compared to butterfly steel cannula is said to decrease the risk of phlebitis.[10, 11, 12]

A significant factor in the development of phlebitis is the infusate or the type and frequency of medication or fluid infused and pushed. Drug irritation is the most reliable predictor of phlebitis.[13] Total parenteral nutrition, blood products, potassium and sodium bicarbonate drips are just some of the infusate commonly implicated in phlebitis.

There are commercially available IV cannula dressings available in the market such as transparent dressing and sterile gauze but these are more expensive and thus has not been popularly used. The use of gauze versus transparent dressing shows no relationship with IV complications such as bacterial colonization and phlebitis although a study has shown less evidence of phlebitis with adhesive bandage compared with gauze.[14,3] Bacterial colonization or the presence of positive culture in the cannula tip is widely believed to be not correlated with the development of phlebitis.[15] There has been no reported study comparing these commercially available dressing with adhesive tape (Leukoplast) which is generally what is being used in PGH.

The most practical way of preventing phlebitis is the employment of aseptic technique in the performance of the peripheral IV cannulation procedure. The usual practice in this institution is to topically clean the area in the skin with alcohol and the secure the site with leukoplast. Application of a topical antibiotic prophylactically in the insertion site such as mupirocin ointment is not usually done except although occasionally, povidone iodine, a topical antiseptic is used. Some studies, however has shown that the use of antimicrobial ointment has resulted in higher proportion of phlebitis.[16]

Mupirocin, a topical antibiotic available in ointment form has been used in the treatment of secondarily infected wounds. It is likewise often used in the care of indwelling central lines to prophylactically prevent phlebitis or even treat secondarily infected central line site. It is effective against gram positive and gram negative organisms including methicillin resistant *Staphylococcus aureus*. As to date, there is no local study investigating the efficacy of the application of mupirocin in the prevention of the development of superficial phlebitis in peripheral cannulation site.

OBJECTIVES

The primary objective is to assess whether single topical application of mupirocin ointment in the peripheral IV cannulation site administered prior to IV cannulation compared to applying alcohol alone decreases the incidence of phlebitis.

Secondary objectives include:

1. to determine and assess the factors that predisposes to the development of superficial phlebitis namely:

a. the length of time the IV cannula is in place
b. the type of IV medications infused
c. the number of attempts before the cannula has been inserted
d. the type of personnel (i.e. intern, resident) who performed the cannulation

Type of Study

A randomized controlled trial in which mupirocin ointment topically applied prior to IV cannulation is compared with using alcohol alone.

Participants

Patients in the pediatric wards and emergency room requiring indwelling peripheral IV cannulation for more than 24 hours.

Exclusion Criteria

Patients whom IV cannula was removed within 24 hours from insertion.

Outcome Measures

The presence of signs of phlebitis in the area where IV cannulation has been placed as assessed by the investigator.

METHODOLOGY

All patients in the emergency room and wards for intravenous catheter insertion that was referred for inclusion in the study was randomly assigned to case group or control group. For every patient enrolled in the study a card was drawn from a set of cards randomly marked with “B” and unmarked cards. Those assigned with unmarked cards was put in the control group while those with marked “B” was placed in the case group

The choice of IV site for each patient was at the discretion of the physician and or intern as is the choice of the IV catheter to be used. The insertion technique was done percutaneously without prior skin incision. The skin was prepared with alcohol. All patients in the case group will have topical mupirocin applied to the area covering at least 0.25 cm prior to IV insertion. The insertion site would then covered with an adhesive tape.

The catheters were subsequently handled according to the normal practice of the attending medical and nursing staff. Each patient was seen daily by the investigator and the patient was questioned about pain in the insertion site, or/and the IV site was inspected and palpated. The presence of phlebitis was defined as the presence of a palpable cord or the presence of at least 2 of the following physical changes along the course of the vein: warmth, erythema, tenderness and induration.

RESULTS

Of the 92 patients enrolled in the study, only 36 in the control group and 33 in the case group were included in the evaluation. Twelve patients in the control group out of 48 (25%) and 11 out of the 44 (25%) patients in the case group were excluded because their IV cannula were removed in less than 24 hours or the patients were discharged before the investigator was able to assess the IV site. Subject characteristics for both groups were similar with respect to sex although there in terms of age, there were more subjects in the 1 to 12 months age group among the control. For both control and case group, the locations of the IV insertions had almost similar distribution and most were done in the hand. Final result had shown that 8 out of the 36 (22%) subjects in the control group developed phlebitis as compared to the case group in whom 4 out of the 33 (12%) subjects had phlebitis.

Subject Characteristics:

Control		*Mupirocin*	
I. **Sex:**		I. **Sex:**	
Male	19	Male	20
Female	12	Female	13
II. **Age Group**		II. **Age Group**	
0-<1mo	3	0-<1mo	3
1-12mos	19	1-12mos	11
1-5yrs	6	1-5yrs	11
6-12yrs	7	6-12yrs	6
13-18yrs	1	13-18yrs	2
III. **IV Cannulation Site**		III. **IV Cannulation Site**	
Hand:		Hand:	
Right	15	Right	13
Left	8	Left	9
Forearm:		Forearm:	
Right	0	Right	0
Left	3	Left	4
Foot:		Foot:	
Right	5	Right	4
Left	4	Left	2
Leg:		Leg:	
Right	0	Right	0
Left	1	Left	0
Scalp:	0	Scalp:	1

A. Dwell time

The average dwell time for subjects in the control group is 62.9 hours (SD 30.3 hours) as compared to the case group with average dwell time of 62.8 hours (SD 30.4). If subjects whom IV cannula were electively removed or those whom cannulation where removed because they were no longer need for were excluded, the average dwell time became 62.7 hours (SD 29.9) for the control and 65 hours (SD 27.6) for the case group. Of the total of 12 patients who had phlebitis, 5 had their cannula in place for 24-48 hours, 3 of them for 49-72 hours, 2 for 73-96 hours while 2 had their cannula in place for 145-168 hours.

Dwell Time	Control		Mupirocin	
	# of Subjects	+ Phlebitis	# of Subjects	+ Phlebitis
24-48 hrs	16	5	14	0
49-72 hrs	10	2	10	1
73-96 hrs	4	1	5	1
97-120 hrs	4	0	1	0
121-144 hrs	1	0	2	2
145-168 hrs	1	0	1	0

B. Type of Infusate

Of the 12 patients in the control group who developed phlebitis, 8 were given IV fluids while 4 had heparin lock. Eight were given IV antibiotics while 3 were given blood products.

Table 2. Subjects in the control group who developed phlebitis and the type of infusate given

Control Group

Subjects with phlebitis	**Type of infusate**		
	IV fluids	Antibiotic	Others IV meds
1	D5 0.3 NaCl		Mannitol, Dexamethasone
2	D5 IMB	Ampicillin, Metronidazole	Famotidine
3	D5 IMB	Penicillin G, Amikacin	Vitamin K, Paracetamol
4		Meropenem	
5		Piperacillin-Tazobactam	Midazolam
6	pNSS		pRBC
7	D5IMB + K2 + Ca200	Meropenem	Famotidine
8	D5IMB	Ampicillin, Amikacin	Vitamin K

Table 2. Subjects in theMupirocin group who developed phlebitis and the type of infusate given

Mupirocin

Subjects with phlebitis	Type of infusate		
	IV fluids	Antibiotic	Others IV meds
1	D5 0.3 Nacl		Furosemide
2		Penicillin G	
		Choramphenicol	
3	pNSS	Cefepime	
		Metronidazole	plt conc
4	D5 0.3 Nacl		plt conc

C. Number of times the IV cannula were used

There could be several attempts in IV insertion in a subject and a cannula could be used several times by the intern or the residents before a successful cannulation. Majority of IV insertion fortunately was successful on first attempt. Seven out of 51 of those who developed phlebitis had the IV cannula used only once in an attempt. There were 2 subjects whose cannula was used 4 times but did not developed phlebitis.

Table 4. No of times the cannulla has been used and the incidence of phlebitis

No. of Times the IV Cathwas used	Mupirocin		Control	
	# of Subjects	+ Phlebitis	# of Subjects	+ Phlebitis
1	30	5	21	2
2	3	1	10	2
3	1	1	2	0
4	2	1	0	0

D. Type of Personnel Performing the cannulation.

In PGH pediatric wards and emergency room, the interns were the first in line who should perform the IV insertion, thus 70% (36/53) of the IV insertion were performed by the interns while the rest were done by the residents. Seven out of the 36 insertions done by the interns developed phlebitis while 4 out of the 18 insertions done by the residents had phlebitis.

Table 5. The type of personnel performing the IV cannulation and the incidence of phlebitis

Type of Personnel	Control		Mupirocin	
	# of Subjects	+ Phlebitis	# of Subjects	+ Phlebitis
Interns	24	4	20	3
Residents	13	4	13	1

DISCUSSION

Phlebitis is the most common complication of IV therapy and several factors has been implicated in its pathogenesis. Chemical factors such as irritant drugs and physical factors such as duration of cannulation are just few of the identified risk factors for the development of phlebitis.

Among the 69 subjects both in the control and mupirocin group evaluated in this study, 12 developed phlebitis thereby giving an incidence rate of 17%. This is within range of the incidence of phlebitis reported in other studies which is from a low of 2.3% to a high 31%.[1,2,3,4] For those in the control group, 22% (8/36) developed phlebitis, a rate that is higher than in the case group with 12% (4/33). With using topical topical mupirocin the absolute risk reduction is 10% and the relative risk reduction of 46%. The results therefore suggests that applying topical mupirocin (Bactroban) in the IV insertion site may the decrease the risk of phlebitis. However, using the statistical analysis Fisher's exact test this finding is not statistically significant with a 2-tail p value of 0.34781

The rationale for the use of topical antimicrobial in the preparation of the skin for IV insertion can decrease the bacterial load of the skin thus decreasing the colonization in the point of entry. Topical antimicrobial is often employed in the care of central venous catheter but its use in percutaneous IV cannulation is not by standards observed. Some studies even discourage the use of antimicrobial ointment because it can result in higher incidence of phlebitis.

The length of time that the IV cannula is in place is traditionally believed to be directly correlated with the incidence of phlebitis. Two subjects however whose dwell time exceeds 144 hours did not developed phlebitis although 2 subjects with dwell time of 121-144 hours did. Five subjects in the control group with dwell time less than 48 hours had phlebitis. The per day risk of phlebitis is not evident in this study and this supports the no longer acceptable practice of replacing IV cannula every three days.

In this study, the IV insertion performed by interns showed 16% (7/44) rate of phlebitis as compared with residents who had 19% (5/26). In PGH, it is usually the interns who were first in line to do the IV insertion and the procedure would be referred to the residents in cases of difficult insertion. The higher rate of phlebitis among those done by residents can be probably explained by their more difficult tasks of IV insertion especially among chronic patients.

Since IV cannula is sometimes used several times in an insertion, the number of times the cannula has been used before a successful cannulation has been recorded and analyzed as a risk factor of phlebitis. Although majority of the insertion has been successful on 1st attempt, 14% (7/51) has developed phlebitis while 23%, (3/13), 50% (1/2) and 50%(1/2) has developed phlebitis when the cannula has been reinserted twice, thrice and four times respectively. It is therefore recommended that the IV cannula be used only once and be discarded if attempt is unsuccessful. The cost of IV cannula will however make this suggestion impractical.

These results lead to the question of whether there is a direct relationship between difficulty of insertion as evaluated subjectively by those performing the IV cannulation and by the number of attempts before a successful cannulation has been made. A similar study with such an objective is therefore recommended.

The type of infusate such as irritant IV medication is a significant factor in the development of phlebitis. Among subjects who developed phlebitis, some of the drugs that has been infused and recognized to be often implicated in the development of phlebitis has been IV fluids with KCl and Ca gluconate incorporation and blood products packe RBC and platelet concentrate. There is however particular classification of infusate as to their abiltity and degree to irritate the veins and cause phlebitis. The application of topical mupirocin may not decrease the incidence of chemical phlebitis or those caused by irritant infusate in contrast to those with infectious etiology although both factors may co-exist in the development of phlebitis.

The potential of topical mupirocin in decreasing the incidence of phlebitis therefore needs further confirmation. The amount of ointment used per cannulation is so small that it will not greatly increase the cost of IV therapy. The only problem however is the more tedious way of inserting the cannula since the skin site can have more glare from the shiny ointment once applied as reported by the residents and interns who participated in the study. However, if proven by further studies and by evidenced based medicine, the decreased cost of reinsertion and decreased pain for the patient can be beneficial.

REFERENCES

1. Lai. Safety of prolonging peripheral cannula and i.v. tubing use from 72 hours to 96 hours. Am J Infect Control 1998 Feb; 26 (1): 66-70
2. Shimandle, Johnson, Baker, Stotland, Karrison, Arnow. Safety of peripheral intravenous catheters in children. Infect Control Hosp Epidemiol 1999 Nov; 20(11): 736-40
3. Stephen, Loewenthal, Wong, Benn. Complications of intravenous therapy. Med J Aust 1976 Oct 9; 2(15): 557-9
4. Tager, Ginsberg, Ellis, Walsh, Dupont, Simchen, Faich. An epidemiologic study of the risks associated with peripheral intravenous catheters. Am J Epidemiol 1983 Dec;118 (6): 839-51
5. Palefski, Stoddard. The infusion nurse and patient complication rates of peripheral-short catheters. A prospective evaluation. J Intraven Nurs 2001 Mar-Apr; 24(2): 113-23
6. Oishi. The necessity of routinely replacing peripheral intravenous catheters in hospitalized children. A review of literature. J Intraven Nurs 2001 May-Jun; 24 (3); 174-9
7. Homer, Holmes. Risks associated with 72- and 96-hour peripheral intravenous catheter dwell times. J Intraven Nurs 1998 Sep-Oct; 21(5): 301-5
8. Tobin. The Teflon intravenous catheter: incidence of phlebitis and duration of catheter life in the neonatal patient. J Obstet Gynecol Neonatal Nurs 1988 Jan-Feb; 17 (1): 35-42
9. Garland, Dunne, Havens, Hintermeyer, Bozzette, Wincek, Bromberger, Seavers. Peripheral intravenous catheter complications in critically ill children: A prospective study Pediatrics 1992 Jun; 89 (6 Pt 2): 1145-50
10. McKee, Shell, Warren, Campbell. Complications of intravenous therapy: a randomized prospective study – Vialon vs. Teflon. J Intraven Nurs 1989 Sep-Oct; 12(5): 288-95
11. Karadag, Gorgulu. Effect of two different short peripheral materials on phlebitis development.J Intraven Nurs. 1998 Sep-Oct; 1 (5):301-5
12. Maki, Ringer. Risk factors for infusion-related phlebitis with small peripheral venous catheters. Ann Inter Med 1991 May 15; 114 (10): 845-54
13. Catney, Hillis, Wakefield, Simpson, Domino, Keller, Connely, White, Price, Wagner. Relationship between peripheral intravenous catheter Dwell time and development of phlebitis and infiltration. J Infus Nurs 2001 Sep-Oct; 24(5): 332-41
14. Pettit, Kraus. The use of gauze versus transparent dressings for peripheral intravenous catheter sites. Nurs Clin North Am 1995 Sep; 30 (3): 495-506
15. Righter, Bischop, Hill. Infection and peripheral venous catheterization. Diagn Microbiol Infect Dis 1983 Jun; 1 (2); 89-93.

16. Vost, Longstaff.. Infection control and related issues in intravascular therapy. Br J Nurs 1997 Aug 14-Sep 10; 6 (15); 846-8, 850, 852 passim
17. Campbell, Carrington. Peripheral i.v. cannula dressings: advantages and disadvantages. Br J Nurs 1999 Nov 25-Dec 8 ; 8(21): 1420-2
18. Garland, Nelson, Cheah, Hennes, Johnson. Infectious complications during peripheral intravenous therapy with Teflon catheters: a prospective study. Pediatr Infect Dis J 1987 Oct; 6 (10): 918-21
19. Harris, Alford, Dan, Savage. Bacteremia related to IV cannulation: variability of underlying venous infection. South Med J 1980 Jun; 73(6):719-22
20. Hershey, Tomford, McLaren, Porter, Cohen. The natural history of intravenous catheter-associated phlebitis. Arch Intern Med 1984 Jul; 144(7): 1373-5
21. Hoffmann, Weber, Samsa, Rutala. Transparent polyurethane film as an intravenous catheter dressing. A meta-analysis of the infection risks. JAMA 1992 Apr 15; 267(15):2072-6
22. Hoffmann, Western, Kaiser, Wenzel, Groschel. Bacterial colonization and phlebitis-associated risk with transparent polyurethane film for peripheral intravenous site dressings. Am J Infect Control 1988 Jun; 16(3): 101-6
23. McKee, Shell, Warren, Campbell. Complications of intravenous therapy: a randomized prospective study – Vialon vs. Teflon. J Intraven Nurs 1989 Sep-Oct; 12(5): 288-95
24. Meylan. Increased risk of bacterial colonization of intravenous catheters covered with transparent adhesive polyurethane bandages, compared to classical gauze bandages. Schweiz Med Wocheenschr 1987 Dec 12; 117
25. Monreal, Quilez, Rey-Joly, Rodriguez, Sopena, Neira, Roca. Infusion phlebitis in patients with acute pneumonia. Chest 1999; 115: 1576-80
26. Nelson, Garland. The natural history of Teflon catheter-associated phlebitis in children. Am J Dis Child 1987 Oct; 141 (10): 1090-2
27. Parras, Ena, Bouza,Guerrero, Moreno, Galvez, Cercenado. Impact of an educational program for the prevention of colonization of intravascular catheters. Infect Control Hosp Epidemiol 1994 Apr; 15 (4 Pt 1): 239-42.
28. Tomford, Hershey, McLaren, Porte, Cohen. Intravenous therapy team and peripheral venous catheterassociate complications. A prospective controlled study. Arch Intern Med 1984 Jun; 1444(6): 1191-4
29. VandenBosch, Cooch, Treston-Aurand. Research utilization: adhesive bandage dressing regimen for peripheral venous catheters.Am J Infect Control 1997 Dec;25(6): 513-9