

The related factors of phlebitis among low birth weight infants in perinatology ward

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Abstract

Peripheral intravenous line placement might lead to some risks and complications in low birth weight (LBW) infants including phlebitis, which shows varying percentages. This study aimed to analyze the causative factors of phlebitis among LBW infants in a perinatology ward. A total of 106 LBW infants who selected using a consecutive sampling technique were analyzed with cross-sectional method. Data were collected when LBW infants started receiving infusions until the infusion was stopped under certain conditions, using the Infusion Nurses Society (INS) phlebitis scale and the Neonatal Infant Pain Scale (NIPS) as the instrument. The variables related to phlebitis under bivariate analysis included the clinical experience of intravenous insertion, infusion pumps, site of insertion, neonatal birth weight, and the administration of total parenteral nutrition. The most significant risk factor of phlebitis was the nurses' clinical experience of intravenous insertion (< 2 years). Therefore, the results of this study can be considered to improve the quality of nursing care in perinatology ward.

Introduction

Peripheral intravenous line placement is a common procedure performed on neonates that could pose some risks and serious complications because the fragile skin might be susceptible to infectious organisms. One of these risks is the condition known as phlebitis.^{1,2} Peripheral intravenous line placement in premature infants has been proven to be an appropriate procedure during postnatal care.³ Nurses are required to have sufficient knowledge and understanding related to the type of access devices, the appropriateness of the selected devices for the administered therapy, the maintenance of the devices, and the potential complica-

tion related to the devices and infusion fluids.² Prolonged insertion of peripheral intravenous in neonates could be expensive, time-consuming, and significantly related to neonatal morbidity and increased incidences of phlebitis.^{4,5}

The complications caused by intravenous infusion are more common compared to those of central infusion with varied numbers of infiltration/extravasation (2.9%-69.89%), phlebitis (16.7%-25.4%), and obstruction (12.27%) incidences.⁶⁻¹⁰ The causative factors of phlebitis are the effects of total parenteral nutrition (TPN), antibiotics, infection, weight, blood transfusion, and the devices used.^{7,8,11-13} Nurses play an important role in performing intravenous insertion in neonates to prevent phlebitis. There is a significant correlation between nurses' knowledge of intravenous therapy and the incidences of phlebitis, and there is also a significant correlation between nurses' knowledge of intravenous therapy and patient comfort.¹⁴ Therefore, paying attention to the risk factors for phlebitis is crucial to prevent phlebitis incidence in LBW infants.

Data from Hospital X in 2017 showed that the number of births was 3720 and 81.7% of them were high risks infants, for example LBW, premature and asphyxia, needing postnatal treatment in the hospital. Such numbers were in line with the numbers of intravenous therapy during hospitalization. Therefore, the researcher was interested in discovering the related factors of phlebitis in LBW infants.

Materials and Methods

This study employed a cross-sectional analytical design. The total sample size was 106 LBW aged less than 37 weeks. They were hospitalized in Hospital X and received peripheral infusions. The samples were selected using a consecutive sampling technique from March 2019 to May 2019 in the perinatology ward. The LBW infants were included under the criteria: i) weight < 2500 grams; ii) gestational age < 37 weeks; and iii) received a peripheral infusion. Infants with decreased consciousness were excluded from the study. The dependent variable was the incidence of phlebitis and the independent variables were weight, gestational age, medications, infusion fluids, the use of infusion pumps, the use of sterile infusion set in one pouch, the amount of clinical experience of the nurses in charge, the administration of TPN, and the infusion site selection.

Two instruments were used in this

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Key words: Peripheral intravenous; low birth weight infants; phlebitis.

Acknowledgments: The writer would like to express his gratitude to all the infants who participated in this study and their mothers.

Funding: This study was supported by Hibah PITTA B 2019, funded by DRPM Universitas Indonesia (No. NKB-0505/UN2.R3.1/HKP.05.00/2019).

Contributions: RY substantial contributions to the conception of the work; acquisition, analysis, or interpretation of data for the work. YR and DE supervised the findings of this work; final approval of the version to be published. All authors discussed the results and contributed to the final manuscript.

Ethical approval: The practice received ethical approval from the Research Ethics Committee of the Faculty of Nursing, Universitas Indonesia (No.26/UN2.F12.D/HKP.02.04/2019).

Conflict of interest: There is no conflict of interest in this study.

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Pediatric Reports 2020; 12(s1):8691
doi:10.4081/pr.2020.8691

study: the Infusion Nurses Society (INS) phlebitis scale and the Neonatal Infant Pain Scale. Other tools used in the study include the respondent characteristic forms, an observation checklist of phlebitis incidences, and the data of suspected factors. A hundred and six respondents were observed once after the infusions were removed to find out whether phlebitis occurs or not. The observations were conducted, and the forms were filled based on the data from medical records or the infant's daily observation sheets to determine the onset of phlebitis. The respondents who did not have any complications during intravenous insertion until the end of peripheral administration were not considered as having phlebitis. The data were analyzed using univariate, bivariate, and multivariate statistical analyses. Chi-square and Mann-

Whitney U tests were used for the bivariate test (based on data characteristics), while logistic regression was used for the multivariate test.

Results

The results based on the respondent characteristics and the correlation between independent variables and phlebitis incidences can be seen in Table 1. Bivariate analysis showed that the independent variables indicating a significant correlation with phlebitis were the clinical experience of intravenous insertion (< 2 years), did not use infusion pumps, site of insertion, neona-

tal birth weight, and the administration of total parenteral nutrition. The variables that did not indicate a significant correlation with phlebitis were gestational age, the type of infusion fluids, the type of medication, the use of infusion pumps, and the use of sterile set in one pouch during insertion. The percentage of phlebitis incidence observed in this study was 27%.

The multivariate analysis was performed by entering the variable of $P > 0.25$ in the model. The results are presented in Table 2.

The factors related to phlebitis in LBW infants were the nurses' clinical experience of intravenous insertion (< 2 years), the

administration of TPN for < 72 hours and between 72 hours and 120 hours, the insertion site on the distal lower extremity, birth weight of 1000–1500 grams, and the use of infusion pumps. Meanwhile, the most dominant factor related to the incidences of phlebitis was the level of nurses' clinical experience.

Discussion

Phlebitis incidences

The result showed that 27% of the respondents suffered from phlebitis. Infusion Nurses Society suggests that the

Table 1. Distribution of respondents based on variables correlation with phlebitis incidences (n=106).

Gestational age	Phlebitis incidences				Total		P-value
	Not phlebitis n	%	Phlebitis n	%	n	%	
Gestational age (1)							
< 28 weeks	3	42.9	4	57.1	7	100	0.001
28-31 weeks	23	60.5	15	39.5	38	100	
32-36 weeks	47	77.0	14	23.0	61	100	
> 37 weeks	19	95.0	1	5.0	20	100	
Birth weight (2)							
1500-2499 grams	1	25	3	75	4	100	0.004
1000-1500 grams	15	53.6	13	46.4	28	100	
< 1000 grams	57	77	17	23	74	100	
Type of medication (3)							
No drug	0	0	2	100	2	100	0.004
Line I	57	65.5	30	34.5	87	100	
Line II	11	100	0	0	11	100	
Line III	55	83.3	1	16.7	6	100	
Type of infusion fluids (4)							
Without infusion fluids	3	100	0	0	3	100	0.272
Hypotonic	5	41.7	7	58.3	12	100	
Isotonic	1	100	0	0	1	100	
Hypertonic	64	71.1	26	28.9	90	100	
The administration of TPN (5)							
Without TPNT	39	88.6	5	11.4	44	100	0.001
PN 0-72 hours	29	58	21	42.5	50	100	
TPN 72-120 hours	4	44.4	5	5.6	9	100	
TPN > 120 hours	1	33.3	2	66.7	3	100	
The use of infusion pumps (6)							
Using infusion pumps	44	62.9	26	37.1	70	100	0.078
Not using infusion pumps	29	80.6	7	19.4	36	100	
The use of sterile set in one pouch during insertion (7)							
With a specific set	14	93.3	1	6.7	15	100	0.034
Without a specific set	59	64.8	32	35.2	1	100	
Insertion site (8)							
Distal upper extremity	30	75	10	25	40	100	0.125
Proximal upper extremity	35	70	15	30	50	100	
Distal lower extremity	7	46.7	8	53.3	15	100	
Proximal lower extremity	1	100	0	0	1	100	
Clinical experience of intravenous insertion (9)							
> 10 years	13	86.7	2	13.3	15	100	0.044
6-10 years	36	69.2	16	30.8	52	100	
3-5 years	23	69.7	10	30.3	33	100	
< 2 years	1	16.7	5	83.3	6	100	

(1, 2, 3, 4, 5, 8, and 9) Mann-Whitney U Test; (6 and 7) Chi Square Test; TPN, total parenteral nutrition.

rate of phlebitis should be equal to or less than 5%.¹⁴ Among the complications resulting from infusion insertion, 17.84%-77.5% were phlebitis.^{7,15} Similar studies on pediatrics showed that phlebitis incidences ranged from 9%-71.25%.^{16,17} The difference between these phlebitis incidences needs further analysis, especially those related to the phlebitis scale used. Until recently, there was no adequate and specific phlebitis scale for neonates. Identification of 71 phlebitis scales, three of which had been analyzed psychometrically, yet none of them has been strictly examined, and these might explain the significant difference among phlebitis scales and could be the cause of the difference in the reported phlebitis incidences.¹⁸ The hospital, where this study was conducted, might need to further explain the incidence discovery system and reporting. This study provides new insight related to the phlebitis incidences not only in neonates in general but also in more specific areas such as the LBW and preterm infants.

The correlation between the level of clinical experience in intravenous insertion and phlebitis incidences

The level of clinical experience of the nurses (< 2 years) was significantly associated with the phlebitis incidences in LBW. The clinical conclusion is that the probability of phlebitis in LBW treated by < 2 year-experience nurses was four times greater than those who were treated by > 10 year-experience nurses. In a study done among nurses, intravenous insertion training was found to increase their knowledge and skill (31% and 24%, respectively).¹⁹ In another study, the clinical experience of infusion insertion significantly affected the duration of peripheral intravenous cannulation therapy.²⁰ Studies have also demonstrated that there is a significant correlation between nurses' knowledge about infusion therapy and phlebitis incidences.¹⁴ In contrast, a study on neonates in New Zealand stated that the discipline of the

inserter might not be the factor causing the peripheral intravenous complication.²¹ It is necessary to consider the clinical experience of the nurses in resolving the peripheral infusion cases in LBW.

The correlation between neonatal birth weight and phlebitis incidences

This research shows that the probability of suffering from phlebitis among LBW weighing 1000-1500 grams were five times greater than among LBW weighing 1500-2499 grams. Studies have shown that neonatal birth weight is associated with the infiltration/complication of extravasation and increases the risk of complication due to the small, fragile and less visible vein, and also the higher percentage of the adipose tissue.²² Findings from a case study of 590 grams neonates who suffered from phlebitis and exhibited malformation also support this claim.²³ A study conducted in 2006 did not find any significant causes of extravasation associated with neonatal age and weight.²⁴

The correlation between total parenteral nutrition administration and phlebitis incidences

The duration for TPN was correlated with the incidences of phlebitis. The longer the insertion, the higher the risk of phlebitis. TPN is the nutrient administered through the blood vessel and contained an amino acid, glucose (10-20%), and lipid emulsions (10-20%). The fluid should preferably be administered through the central blood vessels. However, it could also be administered through the peripheral veins, if the osmolality allows ranged from 800 to 1200 mOsm/L.^{11,25} The small and fragile neonatal veins make cannulation difficult, exhibit low tolerance to pH change and osmolality, which could trigger thrombophlebitis in neonates who received hypertonic solution.⁴ Phlebitis has been reported as the most common complication during TPN through peripheral access in neonates (3%-31%).²⁵ This emphasizes the fact that high

osmolality fluids could increase the risk of phlebitis incidences because of the size and fragility of the veins of LBW. The process of TPN liquid compounding was performed in the nursing room before it was administered to the respondents. Some studies have revealed that the TPN compounding should be conducted all in one by central pharmacy under a closed system.²⁶ The findings of this study suggest that the administration of TPN should be given through central venous, and the nutrient fluid compounding should be conducted by pharmacy staff in a closed system.

The correlation between infusion pumps and phlebitis incidences

The findings of this study showed an inverse relationship between the use of infusion pumps and phlebitis incidences, *i.e.*, if the infusion pump is used, the risk of phlebitis increases. Infusion pumps could help to control the consistency of fluid volume entering the patient's body during the administration of peripheral intravenous. In general, the infusion pump alarm will give a signal when the fluid is altered due to occlusion, but it cannot detect the early infiltration. The pressure caused by the infiltration cannot trigger the alarm because it is lower than the pressure caused by occlusion.²⁷ When the gravity method is applied to administer the infusion or medication in pediatrics, the duration of peripheral infusion becomes longer (72.56 ± 35.85 hours) compared to when electronic pump or puncture is applied (60.03 ± 33.88 hours).²⁸ Research has demonstrated that 72% to 99% of clinical alarms are false. The high number of false alarms has led to alarm fatigue, which can result in the desensitization of alarms and missed alarms.²⁹ The findings of this study suggest that the incidences of phlebitis related to the use of infusion pumps is affected by other factors.

The correlation of insertion site and phlebitis incidences

The selection of peripheral intravenous insertion site in the distal lower extremity was significantly associated with the incidences of phlebitis in LBW infants ($P = 0.019$). A study found that the insertion site in the arm area affected the length of insertion without complication.^{20,30} Found a different result reported that the insertion site of peripheral intravenous in neonates did not correlate with the infusion complication. Further research related to the site selection in neonates is required because the infusion insertion in LBW infants is quite risky, and the blood vessels of the babies are small, fragile, and can be easily damaged by pressure.

Table 2. Multivariate analysis with backward method between selected independent variables and phlebitis incidences (n = 106).

Variable	B	Sig.	Exp (B)
Clinical experience (< 2 years)	4.350	0.015	77.516
TPN 72-120 hours	3.260	0.006	26.054
TPN 0-72 hours	2.743	0.002	15.538
Distal Lower Extremity	2.884	0.014	17.887
Weight 1000-1500 grams	1.660	0.037	5.257
Not using infusion pumps	-2.051	0.032	0.112
Constanta	-3.920		

TPN, total parenteral nutrition.

Conclusions

The factors that have been proven to be significantly correlated with the incidences of phlebitis in LBW were the clinical experience of intravenous insertion (< 2 years), did not use infusion pumps, site of insertion, neonatal birth weight, and the administration of total parenteral nutrition. Gestational age, the type of infusion fluids, the type of medication, the use of infusion pumps, and the use of sterile set in one pouch during insertion did not correlate with the incidences of phlebitis in LBW in perinatology ward. Multivariate analysis revealed that the most significant factor is the level of clinical experience of the nurses in charge.

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