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Phlebitis Rates in Trauma Patients: Peripheral Intravenous Catheters Started In or Outside the Emergency Department

Ligia J. Zarate
Brigham Young University - Provo

PHLEBITIS RATES IN TRAUMA PATIENTS: PERIPHERAL INTRAVENOUS CATHETERS STARTED IN OR OUTSIDE THE EMERGENCY DEPARTMENT

by

Ligia J. Zarate

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of a thesis submitted by

Ligia J. Zarate

This thesis has been read by each member of the following graduate committee and by majority vote has been has been found to be satisfactory.

Date	Barbara Mandleco, PhD, RN, Chair
Date	Patricia Ravert, PhD, RN
Date	Russell Wilshaw, MS, RN

BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee I have read the thesis of Ligia J. Zarate in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and college style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

Date

Barbara Mandleco, PhD, RN
Chair, Graduate Committee

Accepted for the College

Mary Williams, PhD, RN
Associate Dean of Graduate Affairs
Research and Scholarship

Mary Williams, PhD, RN

Interim Dean and Associate Professor,
College of Nursing

ABSTRACT

PHLEBITIS RATES IN TRAUMA PATIENTS: PERIPHERAL INTRAVENOUS CATHETERS STARTED IN OR OUTSIDE THE EMERGENCY DEPARTMENT

Ligia J. Zarate

College of Nursing

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Peripheral catheter-related phlebitis is the inflammation of a superficial vein that can lead to infection or thrombus formation if untreated. About 150 million peripheral intravenous catheters (PIVC) are inserted in the United States each year with phlebitis rates reported between 5% and 70%. Many PIVCs are started on trauma patients, but the rate of phlebitis in trauma patients whether the PIVC is started outside the emergency department (ED) or inside the ED is unknown. Therefore, the purpose of this pilot study was to determine phlebitis rates in trauma patients when PIVC's are started inside or outside the emergency department. Variables investigated, which may influence phlebitis rates were duration of time the catheter was in place, the anatomical placement site of the PIVC, the catheter gauge, where the PIVC initially was placed (inside or outside the ED), and the injury severity score (ISS). This was a prospective descriptive design. Results indicated 432 catheters were placed inside or outside the ED in trauma patients that met the inclusion criteria.

The overall phlebitis rate was 5.79 %. The rate of phlebitis when the PIVC was started inside the ED was 2.92%. The rate of phlebitis when the PIVC was started outside the ED was 6.94%. If the PIVC was started outside the ED by EMTs the rate was 6.09%. When the PIVC was started outside the ED by paramedics the rate was 7.78%. There was no significant difference in rates of phlebitis according to where the PIVC was started when a Chi Square analysis was performed. No variables predicted phlebitis no matter where the PIVC was started when regression analyses were conducted.

The rate of phlebitis in PIVCs started in the ED, or by EMTs or Paramedics outside the ED in this study was similar to and low according to the literature. The Center for Disease Control and Prevention (CDC) suggests removal of the PIVC within 48 hours if placed under emergency situations. However in this study, phlebitis rates of trauma patients meet the benchmark of best practice and perhaps removal of the PIVC within 48 hours should be reconsidered. Complete documentation of medical records was 87.4%. However, best practice of recording information and patient response to treatment should be higher.

Keywords: Phlebitis, Peripheral, Intravenous, Trauma, Injury Severity Score (ISS).

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INTRODUCTION

Intravenous (IV) therapy can have beneficial effects for patients by providing hydration and stabilizing hemodynamics in various clinical conditions. Peripheral intravenous catheters (PIVCs) are the most widely used devices for vascular access (Center for Disease Control [CDC], 2002). In fact, there are about 150 million peripheral intravenous catheters inserted in the United States annually (Gallant & Schultz, 2006). Furthermore, infusion therapy is known to account for one third of all nosocomial infections (Soifer, Borzak, Edlin, & Weinstein, 1998). However one negative effect of prolonged catheter use is phlebitis.

A review of the literature on phlebitis reveals 5% to 70% of patients receiving intravenous therapy develop phlebitis (Gallant & Schultz, 2006; Campbell, Trojanowski, & Ackroyd-Stolarz, 2005), and phlebitis is the most common intravenous therapy complication patients experience requiring removal of the cannula (Maki & Ringer, 1991; Management of Peripheral Intravascular Devices, 1998). In fact, phlebitis rates increase from 12% to 34% after the first day of IV therapy, followed by an increase of 35% to 65% after 48 hours post catheter placement (Gallant & Schultz). However, the difference in incidence of phlebitis rates in trauma patients specifically is unknown.

Peripheral catheter-related phlebitis is defined as inflammation of a superficial vein caused by irritation to the lining of the vessel (Gabriel, Bravery, Dougherty, Kayley, Maister, & Scales, 2005). Phlebitis refers to the subjective clinical manifestation at an access site with two of the following symptoms: redness, pain, swelling, palpable venous cord, thrombosis or streak formation (Bregenzer, Conen, Sakmann, & Widmer,1998; Maki & Ringer, 1991; Management of peripheral intravascular devices, 1998; Standards for Infusion Therapy, 2005). Phlebitis can lead to infection or thrombus formation and symptoms develop over hours to days and resolve in days to weeks (Fernandez, 2007).

There are 3 types of phlebitis: mechanical, chemical, and infectious (Hamilton, 2006; Josephson, 2004). Mechanical phlebitis occurs when a peripheral intravenous catheter (PIVC) is not secured properly, leading the catheter to change position within the vein. Subsequent irritation causes vessel inflammation, which can result in a clot at the distal end of the catheter, leading to platelet aggregation around the injured vessel. Mechanical phlebitis can also occur if a cannula is too large for the vein and consequently prevents free flow of blood around it (Josephson, 2004). Mechanical phlebitis often leads to removal/replacement of the catheter (Shah, Ng, & Sinha, 2004).

Chemical phlebitis is caused by highly vesicant irritants, such as drugs, which lead to thrombus formation, causing a sterile inflammation of the vein intima (Lanbeck, Odenholt, & Riesbeck, 2004). In fact, drug irritation was indicated as the most significant predictor of phlebitis (Catney, Hillis, Wakefield, Simpson, Domino, & Keller et al., 2001). Other causes of chemical phlebitis are physicochemical properties of solutions, with high or low osmolarities or pH (Bregenzer et al., 1998; Gabriel et al., 2005), as well as antibiotics, blood products, and glucose containing fluids.

Infectious or bacterial phlebitis is caused when an infectious agent is introduced onto the PIVC, this starts an inflammatory response. Infectious phlebitis can be caused by contamination of the catheter tip anytime during IV insertion (Gabriel et al., 2005; Maki & Ringer, 1991). Infectious phlebitis may also occur if a cannula is left in place longer than recommended by the CDC.

Another possible variable related to the occurrence of phlebitis could be the patient's overall physical health. For example, inmunocompromised patients, and critically ill patients susceptible to nosocomial infection or with host infections, are at higher risk for developing phlebitis (Maki & Ringer, 1991).

Within these types of phlebitis are several specific subcategories of causes. Contamination at the insertion site during PIVC insertion and the length of time the PIVC is left in place could be considered subcategories of the infection type. Mechanical subcategories include the anatomical placement site of the PIVC, the gauge or size of the catheter being used. The ISS could be considered a subcategory of the patient's over all physical health.

Infectious Types of Phlebitis: Contamination at the Insertion Site

Strict aseptic technique should be used by all healthcare professionals who initiate IV therapy (Gabriel et al., 2005). Not using aseptic technique when starting a PIVC plays an especially important role in the development of phlebitis, since cannulation itself provides a portal of entry for microbes, consequently causing inflammation/infection (Hindley, 2004). However, when PIVCs are inserted in an emergency situation, when optimal attention to aseptic technique might not be feasible, there could be a higher incidence of phlebitis. In fact, according to Lawrence and Lauro (1988) PIVCs started outside of a hospital setting were 4.65 times more likely to develop phlebitis than those started under aseptic conditions in the emergency department.

Infectious Types of Phlebitis: Duration of Catheter in Place

The amount of time the PIVC is left in place is a second possible cause of phlebitis. The Center for Disease Control and Prevention (CDC) recommends rotating the PIVC every 72-96 hours, to reduce both the risk of infection and patient discomfort associated with phlebitis (2002). In fact, studies indicate the longer the PIVC is in place, the higher the patients risks for developing phlebitis (Grune, Schrappe, Basten, Wenchel, & Stutzer, 2004; Schultz & Gallant, 2005).

Mechanical types of phlebitis: Anatomical Placement of the PIVC

The anatomical site of the PIVC placement is the third possible source of phlebitis. Catheters can be placed in a peripheral arm vein, in the forearm, or hand. IV's started in

the lower extremities are more likely to develop thrombophlebitis, deep vein thrombosis and on rare occasions, pulmonary embolus. Phlebitis can develop within all of these sites, however the antecubital fossa, (the first choice PIVC placement in trauma patients due to ease of access to larger veins), has been associated with an increased risk of phlebitis (Hankins, Waldman, Lonsway, Hedrick & Perdu, 2001).

Mechanical types of phlebitis: PIVC Gauge and Size

The gauge of the IV catheter has also been identified as another cause of phlebitis. The gauge size refers to the external diameter of the catheter lumen (Gabriel et al., 2005) The Standards for IV therapy are to select the smallest gauge for the prescribed therapy (Standards for Infusion Therapy, 2005). For blood infusions or rapid infusion, larger cannulae should be used (14-16 gauges). For crystalloids, smaller size gauges (18-20) are recommended. For intermittent administration of drugs, an even smaller gauge (20-24 gauge) is recommended (Waitt, Waitt, & Pirmohamed, 2004). Despite wider gauge and shorter catheter lengths permit faster infusions, (Gabriel et al., 2005) the larger the catheter, the higher the risk of phlebitis (CDC, 2002). Critical patients require large bore IVs for immediate resuscitation efforts and are therefore at higher risk for developing phlebitis.

Patient's Overall Physical Health: Injury Severity Score (ISS)

A final possible cause of phlebitis may be a patient's ISS. The ISS was developed in 1974 by Baker and O'Neill (1976) and yields a specific probability of survival for patients with multiple injuries. It is the most widely used scale of injury for trauma patients (Offner, 2002). The ISS calculates the Abbreviated Injury Score (AIS) values of injury in six body areas: head and neck (score=1), face (=2), chest (=3), abdomen and pelvic contents (=4), extremities and pelvis (=5), and general and cutaneous (=6). The ISS is obtained by adding the three most severe areas and squaring the sum. Values range from 0 to 75, the higher the score, the more critically ill the patient is.

PURPOSE OF STUDY

Indeed, phlebitis continues to be a complication of PIVC use, and there are a variety of possible situations linked to its occurrence. In addition, phlebitis rates in patients whose PIVC was started outside the hospital are much higher than phlebitis rates of patients whose PIVC was started inside the hospital. There also is no data available on phlebitis rates of trauma patients. Therefore, the purpose of this pilot study was to document the incidence of PIVC phlebitis rates in trauma patients when the PIVC was started inside the emergency room by nurses and when the PIVC was started outside the hospital setting by Emergency Medical Services [EMS] personnel, Paramedics, and Intermediate/Basic Emergency Medical Technicians (EMTs). Variables investigated which may influence phlebitis rates, are the length of time the PIVC was in place, the anatomical insertion site of PIVC, the catheter gauge, whether the PIVC was placed inside or outside the emergency department, the age and gender of the patient, and the injury severity score (ISS).

Questions this project sought to answer were:

1. What is the phlebitis rate in trauma patients?
2. Is there a difference in phlebitis rates in trauma patients according to where the PIVC was started?
3. What variables predict phlebitis in trauma patients whose PIVC was started in the emergency department?
4. What variables predict phlebitis in trauma patients whose PIVC was started outside the emergency department?

METHOD

Design

This pilot study used a prospective descriptive design.

Procedure

Institutional Review Board (IRB) approval was obtained from Brigham Young University and Intermountain Healthcare Urban South Region prior to data collection. Data was gathered at a 330-bed full-service tertiary and acute care referral center serving Utah County and Central and Southern Utah. Upon receiving IRB approval, the medical records of all trauma patients who were brought to the emergency department between January 1 and December 31 of 2006 were reviewed. Data was gathered only on patients who met the inclusion criteria. Prior to actual data collection, all patient identifying information was removed.

Inclusion/Exclusion Criteria

The following three inclusion criteria were used: (a) all Trauma One and Trauma-Evaluations (Eval) patients as listed per hospital protocol admitted to the emergency department between January 1 and December 31 2006, (b) placement of PIVC either in the emergency department or in the field prior to admission to the emergency department, (c) admission to a hospital unit for at least 48 hours with intravenous catheters in place for at least 24-48 hours. The criteria at this hospital for Trauma One is defined as unstable vital signs including airway, a Glascow Coma Score (GCS) of less than eight, a penetrating wound such as, a gunshot or stab, to the neck, thorax, or abdomen, and an unstable patient who was transferred from another hospital who were receiving blood. A Trauma One can also be determined by the Emergency Department physician or Emergency Department Team Leader (Garry & Hill, 2005).

Trauma Eval patients include victims of an auto-pedestrian accident, experiencing a fall greater than10-feet, a gunshot or stab wound to the head or areas other than the

neck, thorax, or abdomen, a GCS greater than eight but less than thirteen, and a person caught in a cave-in longer than thirty minutes. Other criteria for Trauma Evals include disparity in vehicle size when involved in an accident, fatalities in the same accident, persons ejected from a vehicle, aircraft accidents, patients suffering from two or more fractures of proximal bones, a flail chest, a fractured pelvis, paralysis, a Burn Surface Area (BSA) greater than 20% associated with major trauma or hemorrhage, a crush injury to the torso or upper thighs, major amputation, or stable patients transferred from another Emergency Department with any of the above injuries (Garry & Hill, 2005).

Three exclusion criteria were: (a) patients under 18 years of age (b) traumas who were transferred from another medical facility with IV therapy already in place, and (c) incomplete or missing data.

COLLECTION OF DATA AND CHART REVIEW

Data gathered included age, gender, where the PIVC was started (inside /outside the ED), PIVC gauge, anatomical location of PIVC, the injury severity score (ISS), and the presence/absence of phlebitis. Phlebitis severity was measured by assigning a numerical score on a phlebitis scale of 0 to 5; (*Phlebitis Criteria for Judging Newborn Pediatric Adult Tool, 2007*) with a lower total score implying less severe phlebitis. All IV therapy requires daily assessment for signs and symptoms of phlebitis, and a rating score of 2 or higher indicates the first sign of phlebitis, (pain and redness). The cannula was usually removed at this hospital when a score of 2 was assigned (Refer to Appendix 1 for phlebitis scores).

DATA ANALYSIS

Data were analyzed using SAS. Descriptive statistics were determined for all variables before calculating a GLM for all variables. The Chi Square (x^2) test-to-test was also run to determine differences in phlebitis rates according to where the PIVC was started (inside or outside the ED). An alpha level of $p < 0.05$ was used.

RESULTS

Out of 634 Trauma One and Trauma Evals admitted to the ED, 494 patients initially met the inclusion criteria. However, not all of these 494 records had complete data, therefore only 432 (244 men and 188 women) patient's records were used in analyses (87.45% complete information). Despite the fact that phlebitis data was recorded only in the narrative and not on the phlebitis assessment tool, the specific phlebitis score could still be determined and was used. The mean patient age was 47.12 years (range, 18-95 years) and the mean number of days before the first phlebitis indication was 3.14 days with a range of 1-6 days and a SD of 1.378 days. (Refer to other descriptive statistics in Table 1)

The overall phlebitis rate for the 432 trauma patients was 5.79 %. The rate of phlebitis when the PIVC was started in the ED was 2.92%. The rate of phlebitis when the PIVC was started outside the ED was 6.94%. If the PIVC was started outside the ED by EMTs the rate was 6.09%. When the PIVC was started outside the ED by paramedics the rate was 7.78%. There was no statistically significant difference in rates according to where the PIVC was started, (x^2 3.3933; $p < 0.18$). The regression analysis using the anatomical placement site, gender, age, ISS score and IV gauge as predictors for phlebitis in all patients was not significant. Regression analyses using these same variables as predictors for phlebitis in patients where the PIVC was started inside the ED or outside the ED were not significant.

DISCUSSION

This pilot study not only examined phlebitis rates in trauma patients, but also sought to determine if phlebitis rates in these patients varied according to whether the PIVC was started inside the Emergency Department by Registered Nurses, or outside the Emergency Department by EMS Personnel (EMTs/Paramedics). The study also sought to discover predictors of phlebitis in these trauma patients, a discussion of findings according to the research questions follows.

What is the phlebitis rate in trauma patients? The overall phlebitis rate in trauma patients in this study was 5.79%. According to the literature, phlebitis rates in patients range from 5-70% (Gallant & Schultz, 2006), but phlebitis rates are unknown for patients experiencing trauma. These results are certainly within this range and in fact, very close to the lowest range of phlebitis rates reported in the literature. However, further investigation is warranted since the ranges reported in the literature for phlebitis rates are for all patients rather than those experiencing trauma.

Is there a difference in phlebitis rates in trauma patients according to whether the PIVC was started inside or outside the ED? Results indicated the rate of phlebitis for PIVCs started in the ED was 2.92%, and the overall rate of phlebitis when the PIVC was started outside the ED was 6.94%. If the PIVC was started by EMT's outside the ED the phlebitis rate was 6.09%. If the PIVC was started outside the ED by paramedics the rate was 7.78%. According to x^2 analysis there were no differences in these rates. The finding is surprising since the literature suggests the phlebitis rates of PIVCs started outside the hospital (in the field) is 4.65 times higher than PIVC's started in the emergency department (Lawrence & Lauro, 1988). Reasons for this difference are unclear and further investigation is warranted.

What variables predict phlebitis in trauma patients whose PIVC was started in the emergency department? None of the variables examined in this study (age, gender,

catheter duration, PIVC anatomical site placement, PIVC gauge, and the ISS), predicted phlebitis in trauma patients whose PIVC was started inside the ED. The finding was not anticipated since the literature suggests many of these variables can be causes of phlebitis. The findings are surprising and further investigation is warranted. Other variables not examined in this study (type of IV solutions or IV medications) may also predict the development of phlebitis in trauma patients. However means for the investigation of (type of IV solutions or IV medications) were not feasible and should therefore be investigated in future studies.

What variables predict phlebitis in trauma patients whose PIVC was started outside the hospital? None of the variables examined in the study (age, gender, catheter duration, PIVC anatomical site placement, PIVC gauge size, and ISS) predicted phlebitis in patients whose PIVC was started outside the hospital. This finding is also surprising and in fact unanticipated since the literature suggests the phlebitis rate in patients whose PIVC was started outside the hospital is 4.65 times higher than the phlebitis rate of patients whose PIVC was started inside the hospital (Lawrence & Lauro, 1998). Indeed, further investigation of phlebitis rates in patients whose PIVC is started outside the hospital is warranted; additional studies are needed to examine phlebitis rates in trauma patients specifically. This is especially important because the research related to phlebitis rates in IVs started outside the hospital (Lawrence & Lauro, 1988) is almost 20 years old, and evaluation for healthcare personnel starting PIVCs outside the hospital probably has changed in the last 20 years. The specific type of material of which catheters are made of now has also changed. In fact, the CDC recommends using catheters made of Teflon® polyvinyl chloride or polyethylene since they are most resistant to microorganism's adherence. The use of a skin antiseptic of 2% chlorhexidine (CDC, 2002) is also now Standard Care whenever starting a PIVC.

LIMITATIONS

Even though this pilot study provided new and helpful information regarding phlebitis rates in trauma patients, there are at least six limitations to the study. First, neither medication therapy nor how often intravenous tubing was monitored or changed was recorded. In addition, no bacterial catheter tip cultures were performed on those PIVCs that were removed. Four, the presence of underlying medical conditions in these trauma patients (blood dyscrasia or autoimmune disease) which may increase the incidence of phlebitis were not studied. Five, although patients were brought to the ED with multiple IV's, only one IV per patient was used for analyzing the presence or absence of phlebitis. Finally, the study was limited to one geographical location.

IMPLICATIONS AND RECOMMENDATIONS

Although the phlebitis rates in trauma patients examined in this study were very low, and no difference in the phlebitis rate was noted according to where the IV was started, continued monitoring of phlebitis rates is critical. In addition, providing information about the importance of maintaining a sterile or aseptic field when starting a PIVC in the field is important so the rates reported in the study continue to remain low. Finally, even though 87.45% of patient records examined were used in the study, it is still important to reinforce the necessity of accurate and complete documentation. Medical record entries must also be legible, and timely. Phlebitis scores should be documented as a requirement per Joint Commission on Accreditation of Healthcare organizations (JCAHO), as opposed to creating verbose narrative. A complete objective description of the PIVC placement procedure, the site of insertion, the gauge used and the patient's response to treatment can improve charting, and aid future researchers who need complete information about patient conditions they are studying.

CONCLUSION

Evaluation of PIVC's started in the ED versus PIVC started outside the ED did not show significant differences in the incidence of phlebitis in trauma patients. In addition, the phlebitis rates of patients in the study were much lower than previously reported in the literature. Finally, no variables studied (age, gender, length of time the PIVC is in place, the anatomical insertion site of PIVC, the catheter gauge, whether the PIVC was placed inside or outside the emergency department, and ISS) were found to predict phlebitis. Further study is warranted not only in trauma patients but also in all patients since revised and lower incidences of phlebitis may now be the norm, and no information about the phlebitis rates in trauma patients especially currently exists in the literature.

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TABLE

Table 1

Frequency of Gender, where IV Started (inside/outside ED), IV Gauge, Size, Anatomical Placement of PIVC and ISS

	Percent	Frequency	Total
Gender			432
Male	56.48	244	
Female	43.52	188	
IV Started			432
Emergency Room	31.71	137	
Outside Paramedics	41.67	180	
Outside EMT's I, II	26.62	115	
Gauge Size			432
14g	0.7	3	
16g	5.6	24	
18g	55.6	240	
20g	34.7	150	
22g	3.2	14	
24g	0.2	1	
Anatomical Location			432
AC (antecubital)	54.2	234	
FA (Forearm)	17.1	74	
Wrist	7.2	31	
Hand	17.1	74	
Arm	3.7	16	
Other	0.7	3	
Injury Severity Score (ISS)			432
Minimal (0-14)	65.74	284	
Moderate (15-24)	18.29	79	
Severe (25-75)	15.97	69	

APPENDIX A

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Phlebitis Criteria for Judging Newborn Pediatric Adult Tool (2007)

Severity	Adult Criteria
0	No pain at IV site, no erythema, no swelling, no induration, no palpable venous cord
1+	Painful IV site, no erythema, no swelling, no induration, palpable venous cord
2+	Painful IV site with erythema or some degree of swelling, or both, no induration, no palpable venous cord
3+	Painful IV site w/ erythema and swelling and w/ induration or a palpable venous cord less than three inches above IV site
4+	Painful IV site, erythema, swelling, induration and palpable venous cord greater than three inches above IV site
5+	Frank vein thrombosis along w/ all sings of 4+, IV may have stopped running d/t thrombosis. May have pus at site

This guideline is designed for the general use of most patients, but may need to be adapted to meet the special needs of a specific as deter by the patient's health care provider.