

BRIEF REPORT: INTERNATIONAL PREVALENCE OF THE USE OF PERIPHERAL INTRAVENOUS CATHETERS

RUNNING TITLE: OMG PILOT STUDY

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Conflict of Interest

Evan Alexandrou has provided education services for Carefusion, Teleflex, Cook Medical and 3M. Peter Carr is undertaking a PhD which is part funded by BD. He has received payment for educational lectures from Carefusion. Claire Rickard's department (Griffith University) has received investigator initiated, unrestricted research/educational grants from suppliers of vascular access device products including: 3M, BD, Carefusion, and Centurion. Claire Rickard has undertaken contract research or educational lectures for Bard, BBraun, BD, Carefusion and Teleflex. Sheila Inwood is an employee of Carefusion. Leonard Mermel has received research funding from Theravance, Astellas Pharma, Marvao Medical, and CareFusion and he has been a consultant for 3M, CareFusion, Catheter Connections, Fresenius Medical, Marvao Medical, Bard Access, and ICU Medical.

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Authors' contributions

All authors have made substantial contributions to the study conception and design, acquisition of data and analysis and interpretation of data. Each author has contributed to drafting and editing the manuscript and approves the final version for publishing as per the ICMJE convention.

Abstract

Over a billion peripheral intravenous catheters (PIVCs) are inserted each year in hospitalised patients worldwide. Yet, international data on prevalence and management of these devices is lacking. The study assessed the prevalence of PIVCs and their management practices across different regions of the world.

This global audit involved 14 hospitals across 13 countries, with 479 patients screened for the presence of a PIVC. We found 59% of patients had at least one PIVC in place and 16% had other types of vascular devices. We also found that overall; 25% of patients had no vascular device in place.

The majority of PIVCs were inserted by nursing staff or a specialist team. The prevalence of idle PIVCs in place with no fluid or medication orders was 16% and, 12% of PIVCs had at least one symptoms of phlebitis.

Key words: Catheter, Peripheral Venous Catheter, Prevalence, Phlebitis

INTRODUCTION

Peripheral intravenous catheters (PIVCs) are ubiquitous devices which can have serious complications including bloodstream infection¹. The annual use of peripheral intravenous cannulas (PIVCs) in North America has been reported to be in excess of 330 million. The estimated number of PIVCs used across greater Europe or other regions of the world is largely unknown, although estimates from global device sales have been reported to be approximately 1.2 billion^{1,2}.

Robust data on the prevalence of PIVCs and their associated management and infection prevention practices remains poor in western countries; even more concerning is that PIVC data in developing nations remains relatively unknown³. Healthcare-associated infection (HAI) rates are significantly higher in developing nations where the lack of resources and staff training can contribute to poor PIVC insertion and management^{4,5}.

There is currently scant data on PIVC management practices across different regions of the world. Localised complication rates such as phlebitis and infiltration are an under reported problem yet are known to be a contributing factor for PIVC failure that leads to premature cessation of IV therapy, device removal and the requirement for re-siting of a new PIVC. Such failure can lead to delays in IV therapy, increased length of hospital stay and cost⁶. Importantly it can also lead to patient reported anxiety and pain. This lack of information has made it difficult to identify contributing factors for PIVC failure that may include inserter characteristics, patient related factors and anatomical placement as well as health care facility adherence to international best practice and infection prevention guidelines^{6,7}.

The aim of this study was to undertake a multi-centre, international study to assess the prevalence of PIVCs across different countries, to review population and PIVC characteristics from different regions of the world, and ascertain whether a larger study would provide beneficial data. The data of interest for this study included: 1) prevalence of PIVC use, 2) patient and PIVC characteristics, 3) prevalence of localised symptoms such as phlebitis, and, 4) PIVC securement and dressing practices.

MATERIALS AND METHODS

Study Design and Participants

Participant hospitals were sourced through the authors' international networks and specialist organisations in vascular access (such as The Association for Vascular Access - USA and The World Congress in Vascular Access - Europe). A convenience sampling method was used for this point prevalence study. Participating sites were instructed to choose inpatient wards with medical or surgical patients and were asked to collect data on as many patients as possible with a PIVC in place on a given day. This method of patient recruitment was used due to the nature of the collaboration with participating sites; workload constraints dictated final sample numbers as no funding was available. Sampling of general medical or surgical patients was expected to yield the greatest number of PIVCs compared to higher acuity areas.

The study was approved by the Human Research Ethics Committee of Griffith University (Queensland, Australia), with each participating organisation required to comply with local ethical and regulatory requirements prior to participation. For the purpose of the study, only adult patients were screened, and all were required to give verbal or written informed consent prior to assessment of the PIVC.

A Site Questionnaire (SQ) identified organisational characteristics regarding resource allocation and clinician training for insertion and management of PIVCs. The patient Case Report Form (CRF) elicited information on patient demographics, characteristics of the PIVC, site assessment, and dressing and securement assessment. The CRF provided standardised assessment criteria. The ‘Strengthening the Reporting of Observational studies in Epidemiology’ (STROBE) Guidelines for Cross-Sectional studies were followed, and results are presented following these recommendations.

Statistical analysis

Statistical software (SAS version 9.1) was used with results stratified into individual countries and regions. Proportions were used (with total number of PIVCs as the denominator) to present the data on PIVC characteristics. Data describing the prevalence of PIVC by country used individual country totals for derivation of a denominator.

RESULTS

Prevalence of PIVC use

Fourteen sites in 13 countries contributed to this study (including 2 sites in the USA). The regions of Oceania, North and South America, Europe, and Asia were all represented. A total of 479 patients across all sites were screened for the presence of a PIVC. On the day of the study, the PIVC prevalence was 59% ($n = 281$) with a range of 24-100%; only one patient across the entire cohort had more than 1 PIVC in place on the day of the study. The prevalence of patients with a vascular access device (VAD) other than a PIVC (e.g., centrally or peripherally inserted central venous catheters) was 16% ($n = 76$) and one quarter ($n = 122$, 25%) of patients screened had no VAD in place (Table 1).

The study sites in Spain and Argentina were among the countries that screened the largest number of patients and had a similar prevalence of PIVC use (83% and 79% respectively, Table 1). The study site in China, which screened the highest number of patients overall ($n = 93$), had the lowest PIVC prevalence at only 24%; this site also had the highest proportion of patients with no device at all (50%).

PIVC Characteristics

Overall, PIVC gauge preference was between 18g and 22g, this comprised 95% of all PIVCs in place across the regions. The forearm was the preferential choice for the regions of North America and Asia, with approximately half of PIVCs placed in this area. Notably, most PIVCs were inserted by nurses or specialty vascular access teams (Table 2), with medical practitioner insertions reported in only two regions (Western Europe and Oceania). Overall, most PIVCs were inserted in the general wards (91%). No PIVCs were found to have been inserted in the emergency room on the day of the study (although they could be represented in the unknown category).

There were disparate results across the regions for whether patients had a documented intravenous (IV) fluid order or IV medication order. The Asian region had the highest proportion of documented IV fluid and medication orders (85% and 95% respectively) for patients with a PIVC. The lowest proportions of documented IV fluid and medication orders were from Oceania (38% and 43% respectively). This region also had the highest number of PIVCs with neither IV nor medication order (43%). The overall study incidence of redundant PIVCs with no IV orders was 16%.

Most PIVC sites assessed had no symptoms of phlebitis; although every region had some patients with at least one sign (range 3% - 12%). PIVC dressings were primarily clean and

intact ($n = 226$, 80%); however, the Oceania region had the highest proportion of dressings that were loose or lifting (24%). Dressing selection was homogenous in North America, Latin America and Asia where study sites exclusively used borderless transparent polyurethane dressings. A small proportion (9%) of patients in Western Europe had gauze and tape dressings.

Five of the 14 sites (36%) had a dedicated IV team and most hospitals had dedicated PIVC insertion training for nursing staff ($n = 10$, 71%). In contrast, only 43% ($n = 6$) of sites provided PIVC insertion training for medical staff. Some facilities also used specially trained technicians to undertake cannulation ($n = 6$, 43%). Most sites had policies for care and maintenance of PIVCs ($n = 12$, 86%) and predominantly prescribed routine replacement of PIVCs every 72–96 hours ($n = 11$, 83%). No sites exclusively prescribed leaving PIVCs in place until clinically indicated for removal, although some provided this as an option for certain patients.

DISCUSSION

This study has shown variation in the prevalence, characteristics and management practices of PIVCs across sites from different regions of the world. Estimates for global PIVC prevalence in hospitalised patients vary widely from 30% to 80%⁸⁻¹⁰. The overall prevalence of PIVCs in this pilot study at 59% lay in the mid-range of those reported in recent literature¹¹, yet we found disproportionate PIVC prevalence between sites and regions. This heterogeneity could be explained by a number of factors including cohort acuity, clinician preference, and hospital guidelines. The generalizability of results from participating hospitals to their country is limited because in most countries only a single institution participated.

Insertion of PIVCs was mainly by nurses, except in the Oceania region where specialist teams and medical staff were the primary inserters. Of concern was the disparity in training provided by sites, with medical staff being less likely to receive instruction in how to prevent infection during this important procedure. A larger study would be needed to understand the effect on patient and infection outcomes of different inserter models and training provided.

A small proportion of patients from a site in Western Europe were observed to have gauze and tape as the PIVC dressing. The preference for gauze and tape is not common in developed nations, although recommended in clinical practice guidelines as an acceptable option¹². There is currently no strong evidence to suggest that any one dressing or securement device to secure PIVCs is more effective than any other¹³. Nearly a quarter of PIVC were loose or lifting from the Oceania region, this is of concern as interrupted dressings have been shown to increase the risk of catheter failure and catheter-related blood stream infection¹⁴.

We found that 17% of PIVCs overall had no IV order for fluids or medication. This proportion of 'redundant' catheters increases the burden of preventable intravascular infection¹⁵. The prevalence of unnecessary PIVCs was lowest in Asia and greatest in the Oceania region where 43% had no documented IV orders.

We reported PIVC prevalence from only a small number of non-representative international sites for the purpose of considering a larger prevalence study. Observed differences in PIVC care and management cannot be generalised to entire regions. We asked sites to focus on medical-surgical wards, and as such some PIVCs in higher acuity areas were likely not included. A larger study will help to assess PIVC outcomes and contributing factors for any differences and improve external validity.

Operational challenges also may have affected sample selection and size. This was an unfunded study undertaken by hospital investigators with competing workload demands. Poor or slow internet connection at the bedside was reported by every participating site, and may have contributed to the small numbers of patients screened at some sites.

CONCLUSION

More than half of hospitalised patients screened internationally had a PIVC, and 1 in 4 patients had no VAD with wide variability from country to country both in prevalence and practice. The data gained has provided valuable initial insights into the global variation in PIVC use and care, and confirms that a larger international study with multiple sites is warranted. In particular, it remains important to understand variations in PIVC use and whether country or regional trends increase the risk of infection.

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