Drawing blood from a peripheral intravenous cannula and its effect on cannula dwell time, phlebitis, and blood stream infection: A randomised controlled study

Introduction

Peripheral intravenous cannulas (PIVCs) are the most common intravenous devices inserted for vascular access. It is estimated that worldwide approximately 80% of individuals requiring hospitalisation will require a PIVC with more than 1 billion inserted annually (Alexandrou et al., 2015). The rationale for their use is mainly for administration of fluids and delivery of medications. In some situations, PIVCs are used to sample blood on insertion and provide existing access if venepuncture proves difficult or repeated blood sampling is required. Health policy guidelines recommended by State and Territory governments in Australia are either silent on the practice or provide evidence against the practice that is of poor quality or is contradictory to evidence in support of the practice (A. Jacob, Coventry, Davies, & Jacob, 2020). Opponents of the practice express concern regarding the accuracy of values when blood is sampled through a PIVC and the risk of infection by repeated handling of the cannula bung leading to premature removal of the cannula. This investigation proposes to conduct a randomised controlled study on cannula dwell time, the reporting of phlebitis and the incidence of blood stream infection in patients admitted to the emergency department when blood is sampled through a PIVC.

Background

Blood sampling is a diagnostic tool regularly undertaken by health professionals and is a common feature of most patient experiences on admission to hospital. The preferred option for collecting a blood sample is by venepuncture (Infusion Nurses Society, 2016). It involves inserting a needle into a vein and drawing blood through a syringe. The invasive procedure is not without its draw backs when access is difficult to obtain and painful, increasing patient anxiety if multiple stabs or serial blood sampling is required (Buowari, 2013). It is also associated with a number of complications such as the formation of a hematoma at the insertion site caused when blood from the damaged blood vessel leaks in the surrounding tissue.

Often at the same time blood sampling is required the patient requires the insertion of a PIVC causing the patient to experience a second venepuncture. The device allows intravenous fluids and medications to be administered but provides an alternative pathway to access blood for sampling. Practice recommendations across Australia on when and how blood should be sampled from a PIVC if in fact it should be undertaken at all differ across States and Territories, but most agree sampling of blood straight after insertion or in emergency situations when vascular access is difficult can be undertaken (A. Jacob et al., 2020).

The practice of blood sampling from a PIVC is not uncommon in Australia (Davies, Coventry, Jacob, Stoneman, & Jacob, 2019) and is the subject of debate among nurses (E. Jacob, Jacob, Davies, Stoneman, & Coventry, 2021). The debate has been based on evidence that is mixed in support of the practice for most routine laboratory tests (Jeong et al., 2019; Lesser, Lanham, & Davis, 2020) whilst recommendations have been suggested for more robust studies to be undertaken (Coventry et al., 2019). The other area of concern is the possible risk of PIVC-related phlebitis and blood stream infections caused when there is handling of the cannula for the purpose of sampling blood.

The incidence of PIVC-related complications leading to cannula failure continues to cause concern when it results in premature removal (Helm, Klausner, Klemperer, Flint, & Huang, 2015). It

has been reported that up to 44% of PIVC-related complications leading to cannula failure have been the result of phlebitis (Simin, Milutinovic, Turkulov, & Brkic, 2019). A number of factors can influence the development of phlebitis including when excessive movement of the cannula inside the vein causes friction and inflammation (Urbanetto, Peixoto, & May, 2016). If hygiene practices are not followed the cannula hub attached to the PIVC can become a source of microbial migration. Unless measures are taken to reduce the risk of PIVC associated infection the prospect of developing a serious bloodstream infection increases (Zhang et al., 2016). It is standard practice in Western Australia that after three days (72 hours) all PIVCs are removed and re-sited if there is a continuing need for PIVC access (Government of Western Australia Department of Health, 2017).

Continuation of the practice of sampling blood from a PIVC relies on evidence of its safety and effectiveness. This study will observe the practice of PIVC blood sampling in the emergency department and report on the incidence of phlebitis and blood stream infections affecting cannula dwell time and patient outcomes. Evidence on the safety of sampling blood through a PIVC in terms of posing an infection risk for patients will inform policies and procedures that may or may not support continuation of the practice.

To the best of our knowledge the incidence of phlebitis and blood stream infections associated with the practice of blood sampling from PIVCs is under reported. The prospect of providing a meaningful reduction in patient discomfort and anxiety by 'needle-free' blood sampling would lose its benefit if the practice was associated with an increase in PIVC dislodgement due to repeated handling of the PIVC bung affecting dwell time and incidence of phlebitis and microbial migration. This study follows on from a previous study on the effect of blood sampling method on haemolysis, funded by the Wester Australian Nurses Memorial Charitable Trust (WANMCT).

Project Aim

The aim of this study is to assess the effect of PIVC blood sampling on cannula dwell time, phlebitis and blood stream infection.

Study Design

The investigation is a randomised controlled study design.

Sample and Setting

Adult patients ($\geq$ 18 years) who present to the emergency department at Joondalup Health Campus who are expected to be admitted and whose health complaint requires a blood sample to be drawn and the insertion of a PIVC will be recruited for the study. Only patients who are conscious, able to give informed consent in writing, and medical management not affected by their participation will be recruited. At the proposed study site a total of 323 PIVCs were observed to have been drawn from a freshly inserted cannula when weekly observations of clinical practice totalled 12 to 16 hours spread over a ten week period (E. Jacob, Jacob, Davies, Jenkins, et al., 2021). The study site sees approximately 300 patients per day equating to roughly 100,000 patients seen annually and a higher incidence of the practice under investigation is likely given that observations over that period were only undertaken on designated days and times.

Process

A member of the research team will approach eligible patients to participate in the study. Recruitment will be influenced by the availability of a phlebotomist. On gaining consent patients will be randomised to either have blood sampled by venepuncture or from a freshly inserted PIVC. The control group (Group A) will receive standard practice of sampling blood by venepuncture with no blood sampled from the PIVC. For patients randomised into the interventional group (Group B) blood

will be sampled from the PIVC with no blood sampled by venepuncture. Randomisation will be achieved using a computer-generated random sequence of numbers from 1 to 2 to determine group allocation for each patient (1 = Group A, 2 = Group B). The random sequence of computer-generated numbers will be replicated by a series of sealed envelopes located in the emergency department that will contain a card and group allocation. A follow-up visit by the research team will occur on day three for all patients who agreed to participate in the study. A check will be made on the PIVC that was inserted in the emergency department and data collected from the patient's medical history on the incidence of cannula failure and reasons for its premature removal. If discharged before the follow-up period, the patient's medical records will be recalled and PIVC documentation reviewed. Recruitment of participants will be undertaken in four-hour sessions at different days of the week over a period of 10 weeks. A flow diagram showing the pathway patients will follow after randomisation is shown in Figure 1.

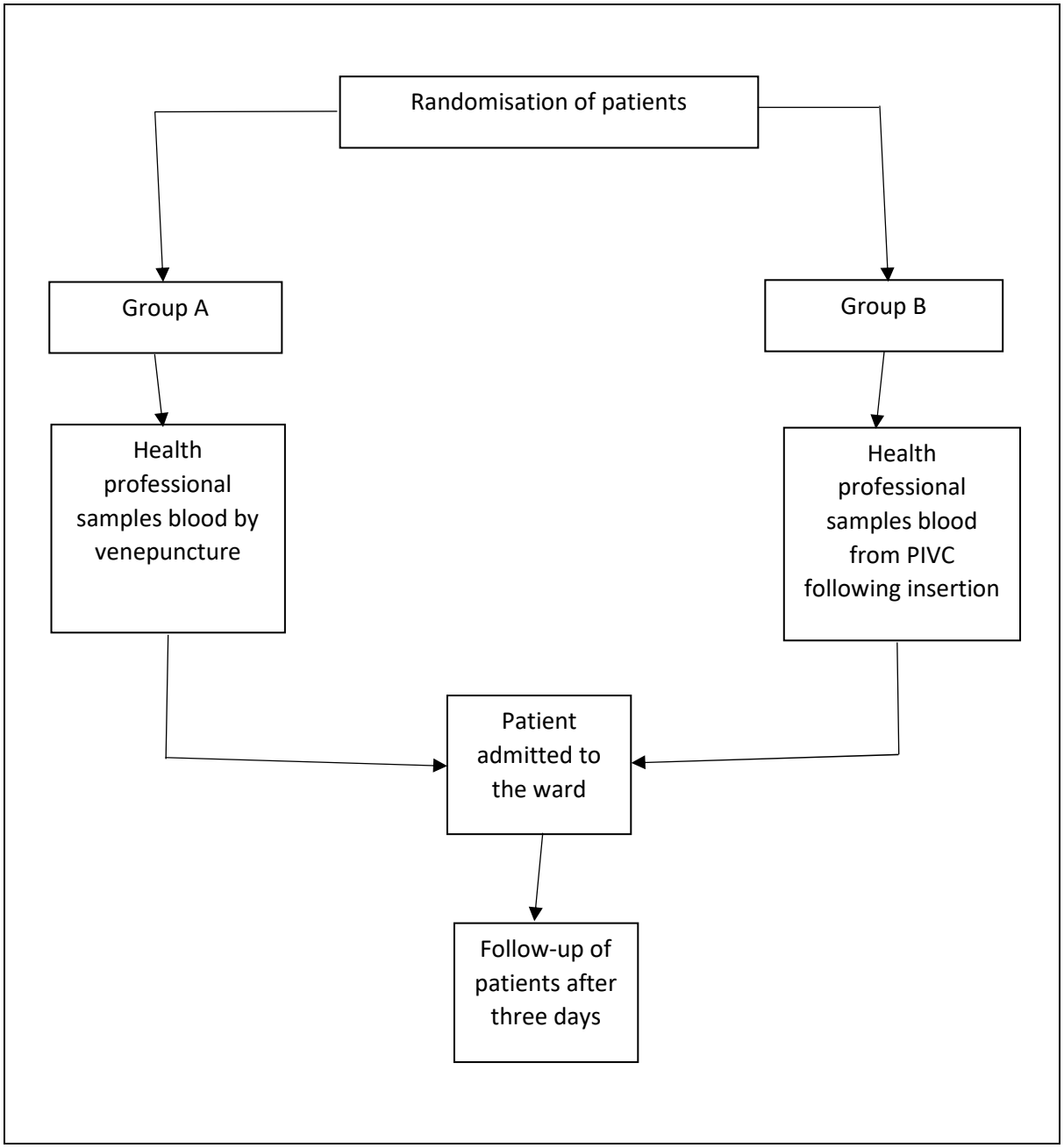

Figure 1: Flow diagram showing the pathway patients will follow between the control and interventional groups after randomisation.

Variables of Interest

The primary outcome measures between the control and interventional groupings will be cannula dwell time, occurrence of phlebitis and cannula-related blood stream infections. A data collection tool will be used following insertion of PIVC to record device-related complications after three days (See Appendix 1).

Data Analysis

Continuous variables will be summarised using means and standard deviations, medians and interquartile ranges. A summary of categorical variables will be by frequencies and percentages. Comparisons between Group A (control group) and Group B (interventional group) will be undertaken using student's t-test for normally distributed data and Mann Whitney U test for data not normally distributed. Statistical significance will be set at 0.05.

Ethics

Approval to conduct the study will be sought from the ethics committees of Edith Cowan University and Joondalup Health Campus. An information sheet will be given to patients describing the study and a written consent obtained from the patient before blood is sampled through the PIVC. All study data will be located in a secure environment away from unauthorised access with electronic data stored on a password protected computer. Information about study participants will be reported as aggregate data and in ways that maintain confidentiality ensuring individual participants will not able to be identified.

Budget

A research assistant (HEW4.300) will be appointed and will be responsible for data collection and compilation of research findings for report writing. A total of 180 hours over a period of 10 weeks (18 hours per week) will be allocated to the project at a cost of $9,585 ($53.25 per hour x 18 hours per week x 10 weeks). Total cost of research project $9,585. A summary of the request for funding is shown in Table 1.

Table 1: Summary of Funding

Detailed budget items	$ amount
Research Assistant for 180 hours at $53.25 per hour (HEW4.300)	$9,585
Total cost of research proposal	$9,585

Milestones of Research Project

An outline of the milestones of the research project showing the process that will be followed for the investigation is shown in Figure 2.

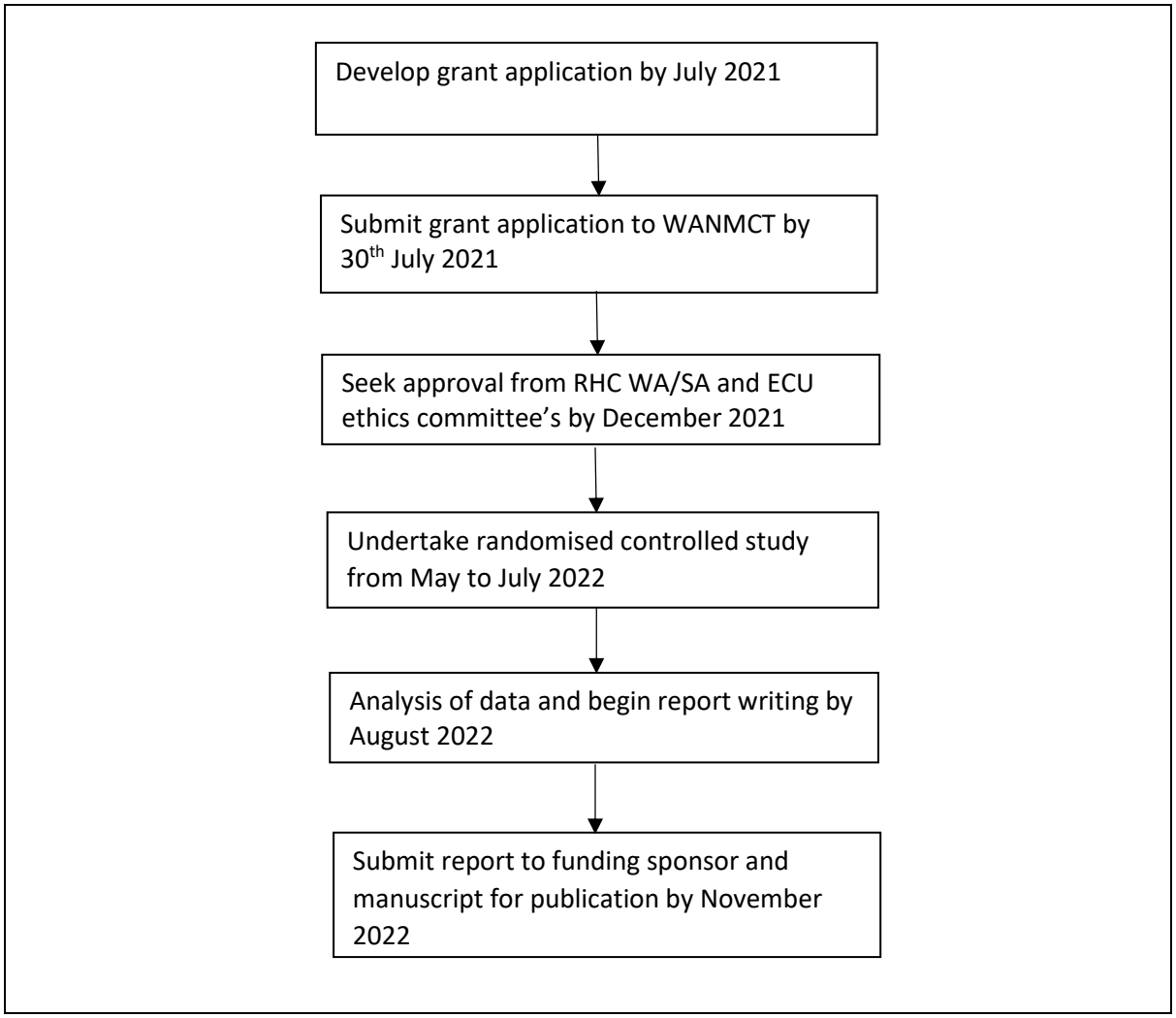

Figure 2: Flow diagram showing the proposed timeline for the research project.

Translation of Findings into Clinical Practice

This study has the potential to improve clinical practice and achieve better health outcomes for patients when vascular access for blood sampling is required. Observations to assess the impact of PIVC blood sampling on cannula dwell time, phlebitis and blood stream infection will assist in gaining knowledge on the practice that has important practice implications. Information from the study has the potential to provide a pathway to achieve behavioural change that is evidence-based in the practice of sampling blood from PIVCs.

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