HISTORICAL PERSPECTIVES

Fluid optimisation using a peripherally inserted central catheter (PICC) following proximal femoral fracture: Lessons learnt from a feasibility study

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KEYWORDS
Peripherally inserted central catheter (PICC); Hip fracture; Feasibility study; Nursing

Summary  The aim of this study was to test the feasibility of using peripherally inserted central catheters (PICCs) in older people to enable fluid optimisation. Fourteen patients were randomised to three groups: (i) usual care, insertion of short peripheral intravenous cannulae and normal fluid prescription; (ii) PICC insertion and normal fluid prescription; (iii) PICC insertion and guided fluid prescription based on measurements of central venous pressure (CVP). A range of outcome measures were undertaken, plus two focus groups with ward staff and an interview with the research nurse to ascertain views concerning the implementation of the study. Descriptive findings identified that PICC use in this group of patients was extremely difficult. The practical issues affecting the feasibility of this study were: (i) the physical and psychological frailty of the patients, proxy consent, difficulties measuring outcomes, unsuccessful PICC placement due to aged veins, intolerance to lines; (ii) staff concerns relating to patient vulnerability, competent use of new technology, limited resources and work capacity. Most aspects of the trial were made more difficult due to the frailty of the patient group.
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Please cite this article in press as: Tutton, E., Gray, B., Fluid optimisation using a peripherally inserted central catheter (PICC) following proximal femoral fracture: Lessons learnt from a feasibility study ..., Journal of Orthopaedic Nursing
**Background**

Fluid depletion in older adults living with proximal femoral fracture is common. They are often dehydrated on arrival, frail and have poor venous access. Dehydration may be compounded by poor fluid management and inadequate monitoring of fluid balance (Cullum et al., 1999). Fluid optimisation for frail older people living with proximal femoral fracture is an under researched area. A systematic review identified that in perioperative studies of fluid optimisation this group of patients required significantly increased fluid volumes (Price et al., 2004). This suggests that patients may be fluid depleted during their hospital stay which in turn may impact on their recovery and general well being. Using a peripherally inserted central catheter (PICC) would provide a means of fluid provision and enable the monitoring of central venous pressure (CVP), which provides a clinical indication of patients’ fluid requirements. Studies in other patient groups such as paediatrics (Janes et al., 2000) suggest that PICCs may be a useful way of ensuring fluid optimisation with the added benefit of reducing venflon use. This study therefore aimed to increase our knowledge of fluid optimisation for frail older people by assessing: (i) the feasibility of using PICCs and CVP measurements; (ii) the practicalities of using a randomised controlled trial.

**Methods**

**Aim**

The aim of this randomised controlled trial was to test the feasibility of using PICCs in older people living with a proximal femoral fracture to enable fluid optimisation.

**Design**

The study design was a randomised controlled trial with three groups; one control and two intervention groups. The three groups were: (i) usual care, insertion of short peripheral intravenous cannulae and normal fluid prescription; (ii) PICC insertion by a vascular access specialist nurse and normal fluid prescription; (iii) PICC insertion by a vascular access specialist nurse and guided fluid prescription based on measurements of CVP. The PICC was placed by an experienced vascular access specialist nurse using ultrasound to identify the vasculature of the arm. A patient history was obtained to ensure placement was not contraindicated. The guided fluid protocol was based on CVP readings and designed by the Chief Investigator (JP) (Fig. 1).

A range of outcome measures were used, including: volume of fluid administered; missed intravenous drug doses; a measurement of degree of phlebitis; mini-mental state exam (MMSE); assessment of delirium; assessment of pain; lying and standing blood pressure (BP); a standing balance measure and blood results. All data were collected daily except the MMSE which was completed on admission and on day 3; the lying and standing blood pressure and standing balance measure were also performed on day 3.

Fluid volume and drug doses were obtained from the departmental fluid chart and drug chart. Phlebitis was measured using the 5 point visual infusion phlebitis score (VIPS), (adapted from A. Jackson 1997, Nurse Specialist, Rotherham General Hospital NHS Trust). The MMSE is a recognised tool for measuring the cognitive state of patients and claims to be valid and reliable (Folstein et al., 1975). Assessment of delirium was made using the confusion assessment method (CAM) (Inouye et al., 1990). Pain was assessed using the hospital 4 point score from no pain to severe pain. Lying and standing blood pressure were performed following normal hospital procedure. The standing measure balance was a recognised tool used by physiotherapists for measuring balance (Guralnik et al., 1989).

The feasibility of the research process was ascertained through the collection of staff views concerning the implementation of the study. Two focus groups with ward staff, one at the beginning and one towards the end of the study and an interview with the research nurse were undertaken. The focus groups and interviews had one key question "What are your views about the PICC study? Further prompts were asked such as: Tell me more about that? How did that affect you? What would have helped in that situation?"
The sample was drawn from patients over 65 years admitted to hospital with a proximal femoral fracture and no further injuries. Patients were not included if they: had a central line in already; were not going to have surgery; were not admitted to the trauma unit; more than 18 h had passed since their admittance to accident and emergency; did not speak English or fell as an inpatient. The 18 h limit was removed after 10 patients had been randomised to the trial due to the practical difficulties of access to patients within this time frame.

Data collection

Data collection took place between September 2005 and March 2006. A research nurse visited the patients whilst they were in the accident and emergency department to establish their eligibility for the study and their place of admission. If they were suitable they had a central line in already; were not going to have surgery; were not admitted to the trauma unit; more than 18 h had passed since their admittance to accident and emergency; did not speak English or fell as an inpatient. The 18 h limit was removed after 10 patients had been randomised to the trial due to the practical difficulties of access to patients within this time frame.

Data analysis

Descriptive analysis of the quantitative data was planned, as the study was not sufficiently powered to provide statistically significant data. However the study was finished early due to the practical challenges and hence minimal evidence was available. The qualitative component of this study was small and there was insufficient data to saturate the categories. However, a breadth of experiences was gained and a range of staff views were repre-

<table>
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<th>GUIDED FLUID ADMINISTRATION (CVP GROUP)</th>
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<td>A. Pre- and post-operative periods (trauma wards)</td>
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<tr>
<td>CVP</td>
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<td>≤ 2 mmHg</td>
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<td>3-7 mmHg</td>
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The volume of guided fluid administered on the trauma wards in any 24 hour period will be limited to a maximum of two litres. Reaching this limit will mandate clinical and technical review by a senior doctor (KW or JP). Therefore the range of volume of additional fluid administered daily will be 0-2 litres.

B. Immediate perioperative period (anaesthetic room, theatre and theatre recovery)

Mandatory measurement of CVP; frequency determined by anaesthetic team on an individual patient basis. Fluid administration determined by anaesthetic team, according to CVP measurements, non-invasive observations and clinical judgment alone.

Definitions
1. Pre-operative: from insertion of central line until arrival in anaesthetic room
2. Immediate perioperative period: from arrival in anaesthetic room until departure from theatre/anaesthetic room
3. Post-operative: from departure from theatre recovery until 24 hours following induction of anaesthesia or clinical stability, whichever is the later. Clinical stability assessed as sitting out and drinking normally.

Fig. 1 Guided fluid administration.

Sample

The sample was drawn from patients over 65 years admitted to hospital with a proximal femoral fracture and no further injuries. Patients were not included if they: had a central line in already; were not going to have surgery; were not admitted to the trauma unit; more than 18 h had passed since their admittance to accident and emergency; did not speak English or fell as an inpatient. The 18 h limit was removed after 10 patients had been randomised to the trial due to the practical difficulties of access to patients within this time frame.

Ethics

Ethical issues were considered and a favourable ethical approval was obtained from the Oxfordshire Research Ethics Committee. The two main ethical concerns were firstly the speed at which consent was required, less than the usual 24 h due to the need to maximise any benefits from fluid optimisation prior to surgery. All patients were provided with an information sheet and signed a consent form; they could take up to four hours to make their decision. Secondly the decision to include patients who were not competent to consent was taken as they constitute a large proportion of the sample population. In this group relative assent was obtained, often this was verbal assent over the telephone followed by further discussion and written assent when they visited their family member.

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sented. Focus groups and the interview were taped and transcribed verbatim. Transcripts were available for participants to make changes if they wished and the analysis of each focus group was shared and discussed with the staff. The data was analysed line by line to identify codes or units of meaning within the data, similar codes were grouped together to create categories, and themes were derived from the patterns found across the data. This form of thematic analysis was drawn from Miles and Huberman (1994) and Lecompte and Schensul (1999).

Findings

During the 6 month period, 264 patients were screened, and 226 of these were eligible for entry into the study. Most were unable to enter the trial due to: unavailability of out of hour’s vascular access, or research nurse; over the 18 h time limit from admission; swift transfer to surgery; and lack of beds on the trauma unit. 14 patients were entered into the trial. Randomisation was stopped after 10 patients and a further 4 patients were allocated PICC and guided fluids to test the feasibility of the intervention prior to early closure of the study. The numbers of patients in each group were: usual care (1); PICC plus usual fluids (5); and PICC plus protocol fluids (8). The patient’s age range was from 67–100 years with an average age of 83 years, 12 were female and 2 were male. Patient consent was obtained for 8 patients and relative as-sent for 6 patients. 15 patients who were approached declined to take part in the study. Most were unable to enter the trial. Teaching sessions were held on a regular basis but it was difficult to ensure all staff had attended the first had 9 participants and the second 8 participants, and an interview with the researcher.

Technical skills

Technical skills encompassed two categories, practical know how and practical use of PICCs. Practical know how identified the concerns staff had learning a new skill within a hectic environment, with little time to spare for coping with new technologies. Teaching sessions were held on a regular basis but it was difficult to ensure all staff had attended and the time lag between teaching and the first PICC patient was considerable. Clear simple instructions were provided with the monitor, and the research nurse provided support but these did not help with the general feeling that it was all too much to cope with on a busy shift.

You haven’t got time to read through the book, you haven’t got time; you have got to get on and do things (Focus group 1).

Staff found the visual look of the monitor and several bags of fluid was unhelpful.

So it looks like spaghetti junction before you start which I don’t think helps (Focus group 1).

There was also often an assumption that the patient was seriously ill as they were attached to a monitor.

Staff 1 And something I found…. Physiotherapists, would not tend to go near her, looking at her (they thought), oh she must be unwell.
Staff 1. And everyday it was, ‘no there’s nothing to stop you getting her out’, but it was a battle (Focus group 2).

There was a sense that it took a while to develop familiarity with the equipment and it was used so infrequently that opportunities for developing experience and confidence were limited. However once staff had used it for a while it was felt to be easy.

Because she’s my primary patient, I’ve got her everyday, so it’s easy now (Focus group 1).

Practical use of PICCs initially caused staff concern because of the inability to place the first 3 PICCs. Staff worried about potential harm to patients, consenting patients if PICC placement was not going to be successful, and what was a reasonable number of attempts, to ensure the patient’s continued comfort. The experienced vascular access nurses were also concerned and felt a degree of relief when they were successful.

The last time we were successful, and she said, ‘phew, you see I can do it sometimes!’ Because actually all of the ones that I helped her with have been unsuccessful and I think it’s very hard for anyone (Interview).

In order to prevent further discomfort to the patient it was intended that the PICC was used for all intravenous fluids except insulin, morphine and blood. It was also used for taking blood samples; however ensuring that this happened was not possible.

With anaesthetists that not only haven’t used the PICC, despite (me) having run around to find out that it was in the right place and was usable, but they’ve put in additional venflons in theatre (Interview).

Learning to use new technology with limited resources (one monitor) was problematic for staff who required experience and confidence before they felt familiar with the equipment. Placing PICCs in this frail older population and ensuring their maximal use to ensure patient comfort was also difficult.

Patient frailty

Patient frailty identified the categories of; obtaining a sample and consent. Obtaining a sample was problematic mainly from the researchers’ viewpoint. Despite the large number of patients screened most were eliminated for practical reasons identified earlier. The staff were frustrated by the lack of weekend cover, uncertain surgery times and long waits in the clinical decision unit (CDU) that took patients over the 18 h from admission.

They were often on CDU weren’t they, for a long time and we didn’t know if they were going to get a bed, and then it was difficult to get the consent quickly, within the 18 h (Interview).

Their frailty also affected whether staff felt they should be entered into the trial.

One is a 100 and she’s fairly with it and I just went to say hello to her and she just looked so tired and so... and I just thought I can’t... And the other one that came in today is so skinny that I don’t think they’d easily be able to put a PICC in (Focus group 2).

Obtaining informed consent was felt to be a struggle for both staff and patients due to their advanced age and frailty.

They are really old. They’re much older than I think any of us really anticipated and so they’re very frail physically and quite frail intellectually, I suppose, because people in their late 80’s, their memory isn’t so good and their concentration isn’t so good and so their ability to process information is deteriorating (Interview).

Pitching the information at the right level required a judgement about patients capacity to cope with the decision, 15 patients felt they did not have the energy to cope with any more decisions or procedures. The relatives approached n = 6 had no problem including their family member in the study but the researcher felt uncomfortable when the only patients in the study had assent provided by their relatives. Consent due to patient frailty was therefore a stressful process for the researcher.

And I do find it quite stressful, every time I’ve approached anybody; I always come back and off-load (Interview).

Staff also felt uncomfortable about relative assent in case the patients clearly indicated in their behaviour that they did not want the PICC and the researcher was not available. They also felt that this group of patients may consent because they liked the extra company, were happy to conform and did not really understand what the study entailed.

Or they say ‘’you make the decision, I’ll do whatever you like’’ (Focus group 2).

Patient frailty was therefore an issue in relation to the struggle to obtain a sample despite organisational limitations and concerns around patients having the energy to make a decision at this early stage of their treatment. Staff concerns about confused patients’ rights to stop the treatment were also identified.
Discussion

Despite the rationale that these patients were likely to be under perfused and stand to gain most from having an adequate level of hydration there remains many barriers to the use of PICCs for fluid optimisation with frail older people. A significant aspect of this is the degree of frailty in this group of patients. Frailty is a complex concept encompassing many different facets but helps to identify health and life changes that differ from those expected from normal aging (Levers et al., 2006). Most of the patients were in their 80’s or 90’s with an average age of 83 years. Vascular access was problematic, despite the use of ultrasound and experienced vascular access nurses. This was partly due to under perfusion but mainly related to an aged vasculature. Physical frailty was also evident in the lack of ability to stand independently on day 3 post operatively. This combined with the increased mental fragility that led to moments of delirium in which 4 PICCs were pulled out by the patients suggests that PICCs may have limited practical use in this age group.

Initially an RCT design was utilised as it was felt important to compare the use of PICCs with usual practice. However the choice of design proved difficult for patients; their understanding and ability to process information around trial design was compromised by the emergency nature of their admission and some felt this was one decision they could do without. Patients with intravenous fluids via a venflon in situ generally felt this was an adequate level of care and did not wish for further interventions. Once settled on the trauma unit rather than in accident and emergency the decision making process for patients appeared easier. Patients also found it easier to decide whether to have a PICC or not once the randomisation process was one time exacerbated this process suggesting that randomisation was a problematic concept for this group of patients.

The consenting process itself was difficult for the researcher who felt that real skill was required in judging how to present the study in ways that enabled patients to understand. Taking time, pacing the interaction, repeating, picking up cues, ringing family, undertaking comfort tasks, returning after a period of time were all necessary to enable the patient to make an informed decision. Hancock et al. (2003) in interviewing older patients in ward settings found that the consenting process took a considerable amount of time and researchers were concerned about increasing the burden on vulnerable older patients. In our study hearing, memory and concentration were often impaired and the boundary between patients that could consent for themselves and those that required relative assent often required an element of clinical judgement. Some patients who seemed confused on arrival appeared improved once settled on the ward. Harris and Dyson (2001) suggest that researchers have to make their own decision about whether the patient has understood and are able to give consent based on the cues they pick up during the interaction. The researcher in this study also noted their own reticence to approach very frail older people knowing that the process would be difficult for them and were concerned about the impact of the decision making process on the patients’ well being. Early on in the study ward staff were concerned about their role where relative assent was obtained if patients showed signs that they did not want the PICC. This situation did not occur but suggests that tensions exist for staff around the use of relative assent in trials. McCormack (2002) suggests that for patients with dementia a one off consenting process acts as an exertion of power over a person and consent should be seen within the narrative of an individual’s life. The relatives’ narrative should be considered alongside this narrative but recognising the relatives own emotions, views, values and beliefs about the intervention.

The practical issues of introducing technology into a ward environment were immense. The study had use of one cardiac monitor which limited staff exposure to the equipment. Delays between teaching and equipment left many staff concerned about their competence to use the equipment. Competence proved essential when using the equipment on a busy shift with little extra time for additional learning. Frustration levels were often high until mastery was achieved and researcher support at this time was crucial. The slow nature of this study with only one person on the trial at any one time exacerbated this process suggesting that greater numbers were required to provide a critical mass of ward based expertise in the use of PICCs and CVP measurement.

The practical aspects of running this trial within normal routine hospital practice were challenging. Maximising fluid optimisation by having a PICC line in and working within 18 h was impracticable. Researchers, vascular access nurses, X-ray facilities, medical officers for checking the X-ray would have to be available 24 h a day for this to be achievable. Patients were often waiting for beds, for considerable amounts of time, in accident and emergency, the clinical decision unit, or sent to wards other than trauma. Time to surgery varied from immediately on admission to up to two weeks
post admission depending on surgical availability and fitness for surgery. Practically planning PICC insertion, setting up the monitor, getting an X-ray, obtaining a medical officer to check the X-ray and starting the fluids took a considerable amount of time. Reliance on fluid charts for data was also problematic as they were not filled in or added up correctly and daily bloods were not prioritised at weekends unless the researcher was available. The MMSE created discomfort for the researcher when patients were unable to fulfil any aspect of the tool. It was felt patients in this scenario also felt confused and uncomfortable when repeatedly faced with questions they were unable to answer.

**Implications for practice**

The data from this small feasibility study suggests that fluid optimisation for this group of patients' remains a challenge that requires clinical attention from nursing and medical staff. Fluid charts and prescription charts need to run in parallel and closer attention needs to be paid to whether oral intake is sufficient for this group. As a result of this study a new fluid chart was designed to facilitate integration of prescription and charting of fluids (Fig. 2). Non invasive clinical measurements such as specific gravity of urine require consideration as alternatives to CVP measurement in order to gauge patients’ state of hydration.

Fluid optimisation is highlighted in one of the British Orthopaedic Association Standards for Trauma (BOAST, 2007) which identifies the importance of pre-operative blood tests and appropriate hydration. This practice is supported by the British Orthopaedic Association (BOA) and the British Geriatrics Society (BGS) in their 'Blue book'. They recommend immediate fluid resuscitation with intravenous saline for all patients at time of presentation to the emergency department. They also recognise the importance of assessment by an Ortho–Geriatrician and the target of a maximum delay of 48 h from admission to surgery (BOA & BGS, 2007). All these practices should lead to greater opportunities for fluid optimisation. However the value of nursing staff in maintaining a high state of vigilance in relation to fluid optimisation is vital; providing continuity of care through the ability to monitor and assess change in patients over time.

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Conclusions

This study has highlighted, with regard to this group of frail older people, the challenges of using PICCs as a means of fluid optimisation, the difficulty of using a randomised trial approach and the demands of introducing a different technology into a ward area. The feasibility of routinely using PICCs in this population for fluid optimisation is problematic due to their high degree of mental and physical frailty. Consenting older patients for randomised controlled trials in stressful accident and emergency situations is not easy and raises concerns about patient vulnerability, added burden and the efficacy of relative assent. Introducing different technology into practice requires a critical mass of competent users and a great deal of support for the process of change. A heightened awareness of the clinical skills around fluid optimisation in frail older people and the necessity for practice development is this area is required.

Acknowledgements

In addition to the authors, the research team that undertook this study were: Dr. James Price (Consultant Geriatrician and Chief Investigator), Helen Hamilton (Senior Nurse, Vascular Access Services), Professor Sallie Lamb (Kadoorie Professor of Trauma Rehabilitation), Debbie Langstaff (Matron), Professor Keith Willett (Professor of Orthopaedic Trauma Surgery).

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