Central venous catheter placement: extending the role of the nurse

ABSTRACT – *Objective:* to improve the quality of the percutaneous tunnelled central venous catheter placement service for patients being treated for malignant disease.

Design: a clinical nurse specialist was specially trained to insert percutaneous tunnelled central venous catheters according to predetermined guidelines. Catheters were inserted under local anaesthetic in the outpatient department or the ward. The quality of the service was analysed and compared with the pre-existing service provided by junior medical staff[1].

Subjects: two hundred adult patients with malignant disease seen between January 1995 and January 1996 at the Christie Hospital Trust.

Main Outcome Measures: success of the procedure, insertion-related infection rates and waiting times compared to historical controls.

Results: the rate of failed insertions fell from 20% to 3% with a concomitant reduction in surgical referrals; for 97% of patients waiting time was reduced to less than one working day compared with 80% previously. Line-related infection rates in the first thirty days following insertion fell from 10 episodes per 72 lines inserted to two episodes per 200 lines inserted.

Conclusions: training and using a clinical nurse specialist has improved the quality of service and gives junior doctors more opportunity to become competent in the technique of central venous catheter placement. The introduction of guidelines has encouraged a standard approach that facilitates audit.

Effective cancer treatment protocols often require continuous or repeated infusions of chemotherapy over several days to ambulant patients. Venous access is thus necessary for prolonged support with blood products and antibiotics, parenteral nutrition and the infusion of peripheral blood stem cells or bone marrow. At the Christie Hospital Trust 500 percutaneous tunnelled central venous catheters (CVC) are now inserted in patients each year to facilitate their treatment.

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When we reviewed use of CVC in 1990 in patients with malignant disease attending the departments of medical oncology and haematology, we found that insertion of such lines under local anaesthetic by junior doctors failed in 20% of cases, and it became necessary to refer patients to the surgical team for insertion of CVC under general anaesthesia. This caused a delay of 2–22 days before a successful procedure[1]. Sepsis related to the insertion of the catheter (defined as a fever above 38°C, with blood cultures positive for coagulase negative *staphylococci*, vancomycin-responsive fever or skin tunnel sepsis during the first 30 days after catheter insertion) became a recurrent problem in 14% of cases[1]. No protected medical time was dedicated to training in CVC insertion and there was a rapid turnover of medical staff with varying levels of skills. Most medical staff had been trained entirely at the bedside in different hospitals and there was no standard operating procedure (SOP). Consequently, there was some variation in their approach (eg the minimum acceptable platelet count, the necessity of a coagulation screen in patients without clinical evidence of a coagulopathy, and the requirement for crossmatched blood). This review provided the impetus for change. We have now trained a clinical nurse specialist (CNS) to provide a dedicated service and give junior doctors more training under direct supervision in accordance with the philosophy of the Calman report[2].

Methods

We obtained funding from the New Deal initiative to reduce junior doctors' hours[3] and from the hospital Endowment Fund for the appointment of a CNS, who was trained in placing CVCs and who was to participate in the training of medical staff in these procedures. Before June 1994 the Christie Hospital had no written protocol for insertion of central lines. The CNS required guidelines by which to practise[4] and a protocol was written that incorporated published guidelines[5–7] and set acceptable standards (summarised in Table 1). The aims of the training were to provide a skilled and readily available operator who would deliver a consistent service of high quality with fewer complication rates and shorter waiting times than previously. The CNS was given training in the procedure at the bedside by experienced medical practitioners, along with tutorials on the anatomy of the thorax and neck, the use of local anaesthesia and sedatives, and the use of a standard text as anatomical reference[8]. The CNS was already proficient at

cannulation of veins and initially observed 80 procedures in which the lines were placed in the subclavian or external jugular vein using a Seldinger technique and were then tunnelled under the skin. Following this, the CNS carried out 20 procedures in patients with normal baseline platelet counts and clotting times who had given informed consent, supervised by experienced medical practitioners.

The CNS's competence in performing the procedure was formally assessed with an oral examination testing knowledge of anatomy, potential hazards of the procedure, side effects of drugs used and knowledge of the agreed guidelines. During the practical demonstration the CNS gave a commentary on her actions, with explanations of the reasoning behind her decisions. At the end of the assessment, the CNS and one of the authors (MRR) gave a written undertaking that both were satisfied that the CNS was competent. After this training, the CNS only undertook these procedures in low risk patients and only when experienced medical backup was immediately available until 50 CVCs had been inserted without direct supervision. The CNS keeps a record of all lines inserted and of any complications and the Christie Hospital Trust accepts liability for the procedure, providing that the CNS follows the agreed guidelines.

Results

The CNS could competently insert percutaneous tunnelled CVC after 20 procedures. In the period January 1995–January 1996, the CNS inserted 200 CVCs with a 97% success rate, a fall to 1% in the incidence of sepsis related to catheter insertion (as defined above), a reduction in waiting time to less than one working day for 97% of patients and an improvement in supervision and teaching of medical staff. The CNS now inserts half of the CVCs in the hospital.

Fewer complications meant fewer referrals for surgical insertion of CVC, with a concomitant reduction in the waiting time for such procedures. During the successful procedures 3% of patients had arterial stabs, but none of these had any further complications. Chest radiographs showed that in 5% of cases the intravascular catheter tip was misplaced but could be manipulated into an acceptable position by interventional radiologists within 24 hours. The 3% failure rate was associated with obesity in three cases, and extensive upper mediastinal disease in two patients. All five were referred for surgical placement. Overall, 1% of procedures were complicated by pneumothorax.

The standard operating procedure (SOP) introduced by the CNS for inserting a CVC made some changes to the previous practice. For example, the working surface of the instrument trolley is draped in sterile green cloths rather than simply being cleaned with alcohol before the instrument pack is opened, and the operator wears two pairs of gloves until the patient's skin is cleaned and draped. In addition, the CNS set up a hospital working party to establish a standard hospital dressing policy and, as a result, chlorhexidine in antiseptic spirit and OpSite IV3000 occlusive films were adopted for routine use.

Most junior doctors appointed at the Christie Hospital Trust have had some previous experience of inserting CVC but few have used a subcutaneous tunnelling technique. The CNS is able to teach them this aspect of the procedure and to reinforce the observance of the agreed guidelines and SOP.

Table 1. Guidelines for practice by the CNS (summary).

- Written informed consent by the patient
- Haemoglobin >9 g/dl
- Platelet count >100 x 10^6/l
- A normal prothrombin time and activated partial thromboplastin time immediately prior to the procedure
- Group and save specimen to be taken before procedure
- In the event of arterial puncture two units of blood to be crossmatched
- A chest x-ray to be performed in all cases
- Following failed insertion, 24 hours to elapse before an attempt is made on the other side to reduce risk of bilateral complications

Comments

We believe that operator experience is the most significant factor affecting complications relating to insertion of CVC[9]. Employing a CNS to place CVC reduced the failure rate from 20% to 3%, reduced patient waiting times and sepsis related to catheter insertion, and reduced referrals for surgical help. All of this has led to better service. At the same time, junior doctors in training have more opportunities to learn and become competent in the technique of CVC than they did before the appointment of a dedicated CNS. Additionally, the introduction of guidelines has encouraged a uniform approach and facilitates audit.

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