A nurse-led service for tunnelled central venous catheter insertion

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The procedure of inserting tunnelled central venous catheters was once carried out by surgeons or radiologists at Glasgow NHS Trust. However, increased workloads meant that these healthcare professionals were left with less time to devote to these procedures, which resulted in unacceptable waiting times for those requiring them. After visiting several centres in England where nurses were already successfully inserting tunnelled central venous catheters with impressive audit results, we decided to set up a similar service. Following a successful bid for funding we now have a nurse-led service for the insertion of tunnelled central venous catheters with minimal waiting times and low complication rates.

A tunnelled central venous catheter (often known as a Hickman line) is a long, fine, hollow silicone tube with an opening at each end. The tip of the tube is inserted into the superior vena cava. A cuff made of Dacron is located at the exit site and anchors itself under the skin, providing stability and also helping to prevent infection.

There are many indications for central venous access:

- Poor venous access – this may have a variety of causes, including drug abuse and obesity;
- Irritating agents – many drugs are caustic and can irritate veins, which may lead to clotting and inflammation. Infusates with an osmolarity greater than 280–300 mOsm require dilution within a central vein;
- Prolonged intravenous therapy, such as chemotherapy and antibiotics;
- Dialysis, either for acute renal failure or while awaiting permanent access;
- Plasmapheresis;
- Multiple punctures, such as daily blood withdrawals in patients with coagulopathy;
- Total parental nutrition.

Background to service development

Many nurses are now extending their roles and taking on tasks that were traditionally undertaken by medical staff. This development has evolved for a number of reasons, including the European Working Time Directive and the requirement to reduce junior doctors’ working hours. Because of a reduction in the number of medical personnel, there is a need to rebalance the workforce.

This need is being addressed through this expansion of nursing roles and the establishment of nurse-led services (Richardson and Cunliffe, 2003).

In turn, nurses have discovered that by setting up new services, they are able to have a direct effect on the standard of care that patients receive.

Waiting times and insertion delays

The procedure for the insertion of tunnelled central venous catheters varied greatly between the four large hospitals within Glasgow NHS Trust.

On one site radiologists inserted lines via the jugular vein using ultrasound and X-ray screening. These radiologists were also responsible for placing catheters for the oncology centre, which is situated on a different site. Oncology patients were therefore obliged to travel to another hospital for this procedure, which added approximately four hours to the process, as they often had to depend on hospital transport to take them to and from the department.

At the remaining sites, surgeons used a subclavian approach, without the use of ultrasound or X-ray screening, to place the catheters.

In the radiology department at Gartnavel General Hospital, it was becoming extremely difficult to accommodate the needs of venous access patients due to an increase in workload within this department caused by changes in technique and technological advances in interventional radiology.

In theatre, the service depended on the availability of skilled specialist registrars and theatre time, which was at a premium. Patients requiring venous access were not given priority, which caused cancellations and unacceptable waiting times.

Delays in placing tunnelled central venous catheters often resulted in the commencement of curative treatment being postponed and patients having to stay in hospital for longer periods – both of which can compromise patient outcomes.

Evidence to support the requirement for service development

Having worked in radiology departments for 16 years, I was aware of the pressures facing the radiologists and also the disappointment of patients who have had their catheter placements postponed because of emergencies or lists running over time.

I was also aware that many nurses in England were inserting tunnelled venous catheters with good outcomes, and I decided that this approach could be a long-term solution to the problems facing the trust.

Together with two senior nurses, I visited three sites
where nurses had been inserting catheters for a number of years. These were the John Radcliffe Hospital, Oxford, the Christie Hospital, Manchester and the Royal Preston Hospital. These visits enabled me to collect evidence of how services were working elsewhere, to show senior and medical staff.

I also obtained audit results, which revealed a decrease in waiting times and lower infection and complication rates (Fitzsimmons et al, 1997; Hamilton, 1995). Each site worked slightly differently and I aimed to take the best practice from each site to develop a good service.

After many multidisciplinary meetings with nursing and medical staff from all high-user areas and service providers, recommendations were made to improve the service. The preferred option was to develop a nurse-led service for the insertion of tunnelled central venous catheters throughout the trust.

If the service was to succeed, it would have to be fully funded and have the support of senior staff across the trust. It was also important that the service involved more than simply possessing the skills to insert the catheters. The nurses would have to gain the respect and confidence of the referring physicians, which would mean having a good knowledge of catheters, patient care, follow-up and medical conditions, such as myloma (Asch, 2001).

Support and funding application

As it was important to gain the full support of both the nursing and medical staff for this service, a proposal was presented at the nursing practice development forum, as well as to the director of nursing and the medical director at the trust. The funding application was developed by senior nursing staff and included:

- Background to the service;
- A description of the new service;
- Salary costs for the nurses required to run the service;
- Equipment costs, including ultrasound machine and patient monitoring equipment;
- Training and development requirements.

Financial support was available from the Cancer Plan funds so the bid was submitted to the trust executive team, and was accepted. This process took about seven months.

Method

Education

At present there is no accredited course for tunnelled central venous catheter line placement, so I returned to the John Radcliffe Hospital in Oxford to spend a few days with a specialist nurse who had been inserting tunnelled central lines for many years. Subsequently, I devised a training programme and competencies to work towards (Box 1). Training to perform the procedure involved using a turkey with Foley catheters tunnelled into it to mimic the vein and to aid in ultrasound guided puncture (Davis and Kew, 2001). I also attended courses in life support and ultrasound guided puncture.

Policies

Protocols and policies had to be devised for the insertion of tunnelled central venous catheters. These included:

- Referral protocol;
- Consent policy;
- Sedation policy;
- Aseptic technique;
- Patient information;
- Patient sedation.

Exclusion criteria were also established (Box 2).

Insertion of a central line

An internal jugular approach is used to gain venous access. Studies have demonstrated that it is technically easier to puncture with fewer complications than by establishing subclavian access (Mallory et al, 1990). This

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REFERENCES


is achieved by using a small portable ultrasound machine. The process is as follows:

- After cleaning and draping the skin, the internal jugular vein is punctured using a 19g needle;
- A fine wire is passed through the needle in order to maintain access;
- A tunnel is then created beneath the skin, which is fashioned back to the point of venous access;
- A peel-away sheath is passed over the wire and into the inferior vena cava;
- The catheter is cut to length and, following removal of the dilator and wire, the catheter is fed through the sheath into the superior vena cava;
- The sheath is peeled away and the catheter tip is left in the lower superior vena cava or the right atrium. There is still debate with regard to the correct position for the tip of a central venous catheter (Vessey, 2003).

Complications

There are many complications associated with the insertion of tunnelled central lines (McGee and Gould, 2003). These include:

- Air embolism;
- Arterial puncture;
- Infection;
- Cardiac arrhythmia;
- Cardiac tamponade;
- Pneumothorax or haemothorax.

All of these complications can be prevented and it is essential that staff undertaking the procedure are aware of preventive measures.

Departments involved in the establishment of the service

Many disciplines within the trust have assisted in setting up the service. These include:

- Microbiology and infection control departments, which looked at ways of reducing infection related to tunnelled central venous catheters;
- Radiologists provided training and support while nursing staff learnt the procedure;
- Pharmacist helped to formulate the patient group directions (PGDs);
- The audit department helped to devise audit forms and correlate pilot results;
- Medical illustrations to print patient information leaflets, consent forms, pre-procedure checklists, procedure and referral forms;
- The bioengineering department looked at materials to make models for practising venous puncture.

The new service

The service team consists of a lead nurse and four clinical nurse specialists. Referrals are received directly from medical staff. Any patients who fall within the exclusion criteria are discussed with medical staff.

This group of patients is then either added to the medical lists or medical staff make themselves available while these procedures are being performed.

Clinical nurse specialists should obtain advice from medical staff before inserting tunnelled central venous catheters in patients who present with any of the following health problems:

- Pleural effusion;
- Pneumothorax;
- Consolodation of lung – these patients may be underventilated and require oxygen and suction. In addition, with the risk of pneumothorax, it is important not to compromise a healthy lung;
- Tracheotomy – the tracheotomy itself would not interfere with tunnelling, but patients may have a poor cough reflex and require frequent suction;
- White cell count lower than one – these patients would be at risk of infection;
- Platelets under 50 – this should be corrected with fresh frozen plasma prior to the procedure;
- Nodes – enlarged neck nodes may disrupt ultrasound visualisation, making it unsafe to proceed with the placement;
- Pacing wires in situ;
- Supraventricular tachycardia – as the procedure involves placing a wire into the superior vena cava it may occasionally find its way into the right atrium. This can cause arrhythmias and compound problems in the two conditions mentioned above);
- Previous thrombosis – thrombosis of a vessel is obvious on ultrasound because the vessel will not be compressible. Under these circumstances another site should be considered.

At present, the average wait is approximately three days. However, if an urgent request is received, the catheter is placed the same day if possible.

Patient consent is obtained and the aftercare of catheters is discussed. Patients receive a detailed information leaflet, containing contact numbers and advice on dealing with any complications.

Catheters are placed within the X-ray department although X-rays are not used. Staff use a full scrub technique and wear gowns, and patients are fully draped to minimise the risk of infection (Raad et al, 1994).

Ultrasound guidance is used to locate and puncture the vein because it has been shown to increase the success of jugular puncture.

A chest X-ray is performed immediately after the placement to confirm the catheter position. A consultant radiologist makes the final decision regarding the position of the tip and if it is confirmed as being correct, the catheter can be used immediately.

All patients are referred back to the service for catheter
removal to ensure safety and reduce complications (Drewitt, 2000). Staff within the service will be trained and required to complete competencies in tunnelled central line removal.

**Audit of pilot procedures**

Overall, 20 procedures were audited and the results were as follows:
- Waiting times – the average wait was three days from referral to catheter placement;
- There were no complications in 89 per cent of catheter placements. One patient had a very short muscular neck and eventually had his catheter placed with the help of two consultant radiologists;
- Although screening was used during the pilot, X-rays showed that all but one of the catheters had their tip in the superior vena cava or right atrium, which is the preferred site;
- One catheter was slightly short (the tip was in the upper superior vena cava) but stable and the radiologist decided that it was satisfactory;
- Only 26 per cent of patients required sedation with midazolam (in the past both midazolam and diamorphine were used);
- Nursing staff successfully placed 19 out of 20 of the catheters in the audited group. Medical staff placed the remaining one.

**Patient satisfaction**

Since its initiation in October 2002, the nurse-led service has successfully placed approximately 160 central lines. Nursing staff now perform all the training in catheter placement. This work has proved to be very beneficial and, according to initial results from satisfaction questionnaires, in general patients are very pleased with the care they receive.

Patients were questioned on the following: waiting times, the verbal explanation offered, patient information booklets received; care during the procedure; pain control and also information regarding the aftercare of their catheters.

It is hoped that the full audit will be completed in December 2003. Patient satisfaction will continue to be audited in order to ensure continued good practice or to implement a change in practice, if necessary.

**Changes in practice**

The evidence from the literature and our pilot results, have led to us making changes to our practice. These changes include:
- Using chlorhexidine (0.5 per cent) as a cleaning agent. Previously betadine alcoholic solution was used. Chlorhexidine is the most effective agent for the prevention of vascular catheter related bloodstream infections (Veenstra et al, 2002);
- Anatomical landmarks, rather than X-rays, are used to place catheters. The landmarks, such as the clavicle, are used to gauge the length required to position the tip in the superior vena cava prior to cutting the catheter.
- A chest X-ray is performed after the procedure in order to confirm correct positioning. The pilot study results showed that correct tip placement could be achieved without using X-rays. This finding is echoed by a previous study (Starkhammer et al, 1996);
- Antibodies are not given routinely;
- Previously, at least four people were present during catheter insertion, now only two nurses are present;
- Single lumen catheters are used, where appropriate, to reduce infection (Asch, 2001);
- Patients are not routinely sedated. Instead, nurses administer an appropriate amount of local anaesthesia, and talk to patients during the procedure, providing comfort and support.

Patients are always informed that they can be sedated if necessary, although the audit results showed this was the case in only 26 per cent of patients.

In the past, patients were given conscious sedation – a minimally depressed level of consciousness that retains their ability to independently and continuously maintain an airway and respond to stimulation or verbal command (Milgrom et al, 1993).

This was achieved by combining a benzodiazepine, such as midazolam, and an opiate such as diamorphine.

**Long-term plans**

**Service questionnaires**

The services are currently being audited in an attempt to maintain best practice and improve current practice where necessary.

These audits will include patient satisfaction questionnaires and satisfaction questionnaires for staff referring patients to the service.

**Accredited courses**

The long-term plan is for staff to travel to the hospital where the patient is being treated in order to perform the procedure.

We aim to have pre-booked sessions in the radiology departments with consultant cover available on an advisory basis. We are also in talks with the local university about developing an accredited course for the insertion of tunnelled central venous catheters, which will be open to nursing staff from all over the country.

**Service developments**

We are bidding for funds to begin training in the insertion of dialysis catheters, which are larger bore catheters. This is a further service development and will require additional funding.

**Conclusion**

In conclusion, we have identified a service need and have gone on to provide a proven solution. We have taken research and evidence into account and have changed our practice accordingly. We will continue to consider and implement ways of improving the service that our patients receive.