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Reducing PICC migrations and improving patient outcomes

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Abstract

Inadvertent migration of central venous catheters can lead to several issues including delayed therapy and clinical morbidities such as thrombosis. Peripherally inserted central catheters (PICCs) are particularly at risk of movement. An innovative new device which allows anchorage of the catheter has proved very successful in the minimisation of catheter migration. The SecurAcath device incorporates a small blunt anchor which lies beneath the skin in order to secure the catheter in place and prevent inadvertent movement. An evaluation of 31 patients with a SecurAcath device in situ to secure a PICC found only one case of insignificant catheter migration. Some initial problems with infection and pain were encountered and interventions were put in place to minimise their incidence. SecurAcath removal proved to be the most significant challenge but this can be overcome with suitable guidance and training.

Key words: Peripherally inserted central catheters (PICCs)
■ SecurAcath ■ Migration

Catheter migration can lead to adverse outcomes both in financial terms and in relation to the clinical management and outcomes of patients (Frey and Schears, 2001; Yamamoto et al, 2002). The concept of the SecurAcath device was originally conceived by Michael Rosenberg, an interventional radiologist in clinical practice in the USA who recognised the need to minimise the incidence of central venous catheter migrations.

The SecurAcath device is a subcutaneous catheter securement system which can be placed alongside indwelling catheters in order to prevent migration (*Figure 1*). The device incorporates a small blunt anchor which is placed under the skin during catheter placement and can remain in situ for the duration of the catheter dwell time eliminating the need for any adhesive dressings or sutures (*Figure 1*). To date, the device has been placed alongside a variety of central venous catheters (CVCs) and has recently been licensed for use with nephrostomy tubes. The device received FDA clearance in July 2010 and a CE mark in January 2011 and is suitable for both silicone and polyurethane catheters.

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The anchor device

- The anchor material is nitinol metal which includes nickel
- Nitinol is highly biocompatible and is used for stents and numerous other medical devices
- The anchors have blunt tips, are not sharp, are inert and are unlikely to cause trauma to the skin, vessels or to the catheter itself
- It incorporates shaped-memory technology; when the anchor is misshapen, it reverts back to its original state
- After SecurAcath is deployed under the skin, fibrin deposits begin to surround the anchor and will coat the nitinol pins
- The flexibility of the anchor allows it to move in compliance with the skin, minimising the likelihood of skin erosion
- The anchor is MRI (magnetic resonance imaging)-compatible and latex-free.

Benefits of using the SecurAcath device

The SecurAcath device eliminates the need for adhesive security devices and wound closure strips beneath the occlusive dressing. This will:

- Minimise allergic reactions to dressings
- Reduce the ongoing cost of weekly dressings
- Simplify the dressing technique owing to minimal dressings
- Allow for 360-degree access to the exit site to facilitate thorough cleansing.

Additionally, it reduces the incidence of inadvertent catheter movement. Migration of the tip into a sub-optimal position can lead to:

- Thrombosis (Abdullah et al, 2005)
- The administration of medication into a sub-optimal position, i.e a small vein
- Increased cost owing to X-ray and PICC replacement



Figure 1. The SecurAcath Device; subcutaneous anchor in situ

- Stress for patients as a result of treatment delay
- Delays in therapeutic management which may lead to disease progression
- Staff time being spent managing migrated PICCs.

Literature review

Two recently published prospective multi-centre studies both evaluated the safety and efficacy of the SecurAcath device. Egan et al (2013) evaluated 68 5French peripherally inserted central catheters (PICCs) with a mean dwell time of 22 days. The primary study goal was to have the SecurAcath device placed and removed successfully without any complications directly linked to the SecurAcath; 91.2% of patients met this goal. Six patients developed device-related complications; two had their SecurAcath device removed as a result of persistent pain; one dislodged (which was described as ‘movement that resulted in loss of function’ caused by the lid of the device not being snapped securely in place); and two PICCs migrated despite the SecurAcath and dressing being applied correctly. Five patients in total complained of pain; two had severe pain resulting in early removal; and three described intermittent pain with catheter movement at dressing changes or lying on the device but none of the three required catheter removal. Additionally, there was one case of cellulitis at the exit site; three cases of bloodstream infection and one case of tissue growth around the anchor. There were no incidences of device damage or catheter constriction. Overall, 84% of patients were either satisfied or very satisfied with the device.

Cordovani and Cooper (2013) performed an observational study of 7French SecurAcath devices placed to anchor short-term jugular venous catheters. In total, 74 SecurAcaths were placed and successful securement was achieved in 72 of those patients. Two catheters became dislodged as a result of incorrect coupling of the two separate SecurAcath portions at placement. No other complications were experienced, however, it is worth noting that the dwell time of the catheters was short at a mean indwelling time of 3.1 days, therefore, later complications would not be experienced. Fourteen out of fifteen patients who had experienced a similar catheter placed with sutures stated that the SecurAcath device was more comfortable. The highest pain score recorded was 1.6 on a scale of 1–10.

Evaluation of the device

At the cancer hospital at which the author is employed, approximately 460 Groshong-valved PICCs are currently placed annually; 96% 4French catheters and 4% 5French dual-lumen catheters. The PICCs are managed over an approximate 50-mile radius in a variety of locations including the community, cottage hospitals, district general hospitals, teaching hospitals and hospices. PICCs are secured using wound closure strips and an adhesive securement device with a semi-permeable dressing to cover both. The hospital has experienced many episodes of catheter migration ranging from a few centimetres requiring no intervention to significant movement requiring catheter re-placement. In 2012, 21 patients had PICCs replaced as a direct result of migration leading to distress and inconvenience for patients. The estimated cost of the 21 replacements was £5250.

Prior to introducing the SecurAcath device into routine clinical practice, an evaluation was undertaken between June and November 2012. The purpose of this evaluation was to establish the benefits and efficacy of the device. The process followed 31 patients throughout the dwell time of the SecurAcath. Four of those patients still had their PICCs in situ at the time of data collection. All 31 patients were questioned by phone retrospectively by the same practitioner.

Findings

Age and gender

Of the participants in this evaluation, 58% were female and 42% were male; 59% of patients were over the age of 50, 32% were aged 40–50 and 9% were under 40.

PICC placers

Only three individuals were involved in placing the SecurAcath devices, with 79% being placed by one individual. All placers work in the same PICC insertion clinic and follow one placement policy.

Ease of placement — SecurAcath

Placement can sometimes be difficult but it is not insurmountable. The dermatotomy incisions (small incisions made to the side of the wire on insertion to accommodate the PICC) were made with a 14-gauge needle which is standard practice within the PICC insertion team. This opening can occasionally be a tight fit when attempting to place the SecurAcath device to the side of the PICC. More than one attempt at deployment was necessary on occasion to aid placement but the incision was not increased in size at any time. Additionally, the two nitinol pins leading towards the anchor would overlap and twist but slight manipulation would revert the device back to its original form. All SecurAcaths were placed successfully; 70% were placed with ease, 19% with slight difficulty and 11% with difficulty.

Pain during placement

No patients reported any pain during placement. Local anaesthetic administered to place the PICC as routine practice prevented any pain.

Days in situ

The pie chart in *Figure 3* demonstrates the dwell time of the device. One SecurAcath remained in situ for over 200 days.

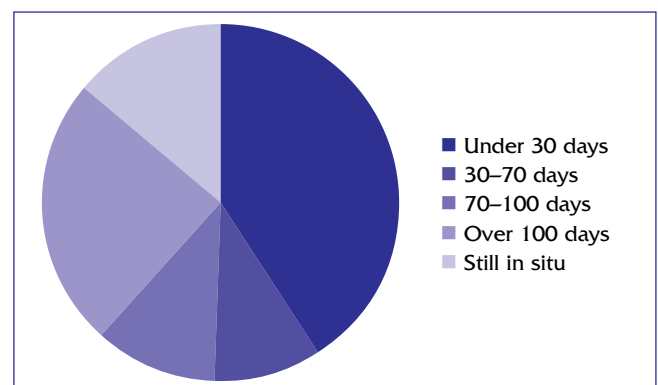


Figure 3. Dwell time of the device

Movement

All PICCs were measured routinely during dwell time and on removal. Only one catheter moved by 1 cm. In this case, the SecurAcath device was deployed correctly.

Patient satisfaction

The pie chart in *Figure 4* outlines the level of satisfaction from the patients' perspective; 83% were very satisfied with the device. Of the three patients who were not satisfied, the devices were removed. One female requested the removal as she was experiencing sharp shooting pains when she would place her arms behind her back.

Overall pain score throughout the dwell time

Patients were asked to score the overall pain using a Likert scale from 0 to 10—10 being the most severe. *Figure 5* demonstrates the overall pain scores; 28 patients evaluated their pain score as zero. Five patients scored their pain to be over 5; of these, three had the device removed owing to severe or unresolved pain. Worthy of note was the articulation by some patients to staff that there was some discomfort, especially the description of 'picking' in the first few days up to a week after placement. For the vast majority, this settled.

Removal

There were removal difficulties in 25% of cases (*Figure 6*):

- Problems folding the lower portion of the SecurAcath device together to allow the pins to meet
- Removing the anchor from the skin because of resistance
- Pain experienced by patients.

Pain at removal

The result demonstrated in *Figure 7* is based on a Likert scale assessment. Patients were asked to rate the pain of removal from 0 to 10 with 10 being the worst. Half the patients experienced a pain score of above 3 and 24% of patients scored between 6 and 10.

Infection

Contrary to expectation that securing the device at the exit site would minimise infection, the incidence of PICC-related infection increased from 1% to 12%. This is based on 4 of the 31 patients developing an infection. *Table 1* outlines the infection status of the patients. It is worthy of note that the small sample in this evaluation influences this result.

The increased rate of infection was of great concern as the PICC infection rates ranged from 0.8 to 2% prior to the introduction of the SecurAcath device. It was determined that the possible cause may be the unfamiliarity of the device thus leading to poor management. About 8 months after the first SecurAcath was placed, when most of the staff had received training, a repeat assessment of the infection rates of 100 PICCs placed with a SecurAcath in situ was performed. Of the 100 patients, one patient had an exit-site infection. This was a light growth of *Staphylococcus aureus* at the exit site, which resolved after oral antibiotics. One patient had a systemic infection of methicillin-resistant *Staphylococcus aureus* (MRSA). This patient had previously tested positive for MRSA and developed an acute exacerbation of her eczema post PICC insertion. This reduction from 12% to 2% supported the hypothesis that routine catheter maintenance

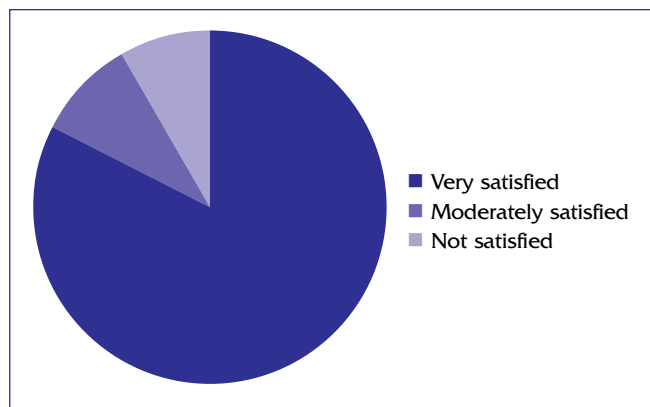


Figure 4. Overall satisfaction with the SecurAcath device

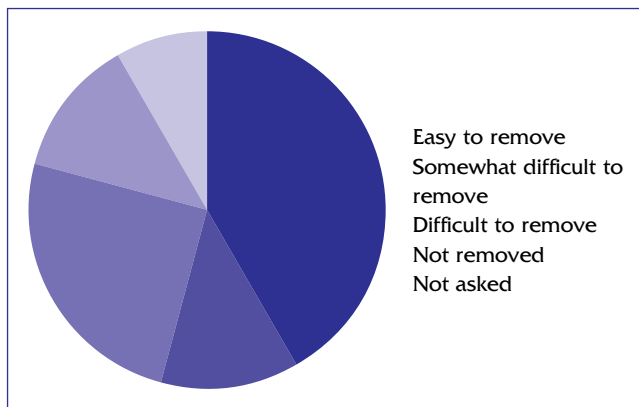


Figure 6. Ease of removal

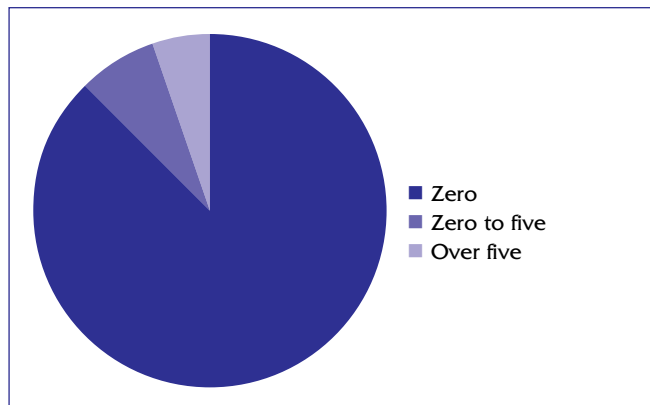


Figure 5. Pain score of the SecurAcath using Likert scale 0-10

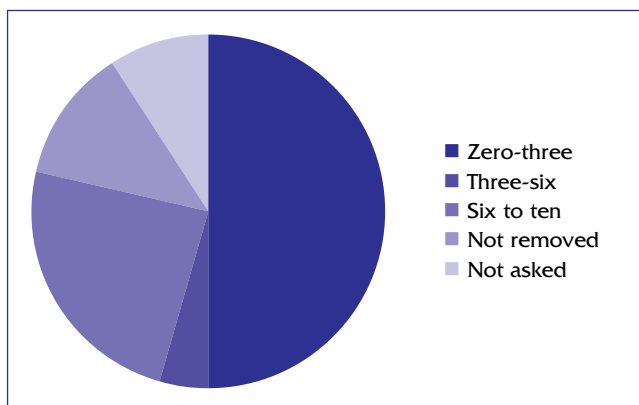


Figure 7. Pain at removal using Likert scale 0-10

| Table 1. PICC-related infection status of the patients in this study | | |
|--|---|-----------------------------------|
| Patient | Organism | Symptoms |
| Pt. One | Light growth of Staph aureous at exit site | Redness at the exit site |
| Pt. Two | Moderate growth of Staph aureous at exit site | Redness at the exit site |
| Pt. Three | Moderate growth of coliform at exit site | Redness and exudates at exit site |
| Pt. Four | Heavy growth of Proteus sp/light growth of non-haemolytic Strep | Redness and exudate ++ at site |

was omitted or poorly performed owing to the altered appearance of the PICC. This was further substantiated by discussions with staff, some admitting to not performing routine cleansing as a result of their unfamiliarity with the device—many referred to it as the ‘new PICC’.

Other miscellaneous findings

- One patient experienced a small area of excoriation at the exit site which healed with povidone-iodine non-adherent dressings (Inadine)
- On two separate occasions, one anchor became stuck fast during the removal procedure. Successful removal was achieved with the use of local anaesthetic
- Two patients experienced significant skin granulation over the nitinol pins. In both cases, the PICC had been in situ for over 100 days. Crucially, it did not cause any discomfort for the patients but posed a challenge during removal
- Staff were unable to flush a PICC post placement and, on investigation, the incorrect coupling of the two SecurAcath parts was the cause, pinching the catheter within the device. The PICC has to be flushed after deployment in order to rule out catheter pinching
- Allergy to the nitinol pins was not observed in the sample.

Staff satisfaction evaluation

Practitioners caring for patients with SecurAcath devices reported prolonged bleeding at the exit site post placement. After the removal of the gauze at the exit site of the PICC 48 hours post placement, staff believed that the PICCs remained to bleed for a longer period than previously. As a consequence, blood appeared to accumulate sandwiched between the two device portions leading to the contamination of the SecurAcath with coagulated dry blood. To resolve this, the SecurAcath was separated and the PICC carefully lifted from the lower portion. Both parts of the device were cleaned thoroughly with sterile water and chlorhexidine.

Staff highlighted the occasional skin discomfort beneath the device; leading to excoriation in some cases. Device removal caused the most dissatisfaction among staff. Difficulty with removal was experienced fairly frequently and patients were complaining of pain or discomfort causing distress for staff.

On a positive note, staff recognised the minimal time spent addressing issues relating to catheter migration and the ease of dressing changes and cleansing. It was also noted that when patients reported few or no problems with the device, the overall experience was much improved than with the previous security method.

How did the evaluation change practice?

Insertion difficulty

Careful attention is given to the dermacotomy immediately

post PICC placement in order to aid the successful insertion of the SecurAcath device. The dermacotomy is marginally deeper, which has proved effective in the deployment of the anchors subcutaneously. A reduction in the twisting action of the nitinol pins has been observed as the placers have become more experienced. It is crucial to attempt to place deep subcutaneously in order to prevent superficial placement which seems to cause more discomfort.

Device discomfort

Prior to PICC placement, all patients are informed verbally and in a patient information booklet that there is a ‘settling-in period’ for the device. During this time of approximately a week or less while the anchors are coated with fibrin, they may experience some discomfort or ‘picking’ at the exit site but that this should settle and resolve within that time. They are also informed that if it does not settle or is painful from the onset, they can have the device removed without having to remove the PICC and an adhesive security device used as an alternative. It is crucial that both patients and staff are made aware of this in order to avoid the dismissal of this technology in the early stages and unnecessary PICC removals.

Indentation and discomfort beneath the device

Members of staff are trained to identify signs of indentation and act to prevent deterioration in the integrity of the skin. A small gauze dressing has proven successful in the management of indentation beneath the device (Figure 8). Additionally, the use of a small piece of hydrocolloid dressing has proved successful in preventing skin excoriation.

Cleansing procedure

A specific procedure outlining how to cleanse the exit site has been taught in order to minimise the incidence of infection.

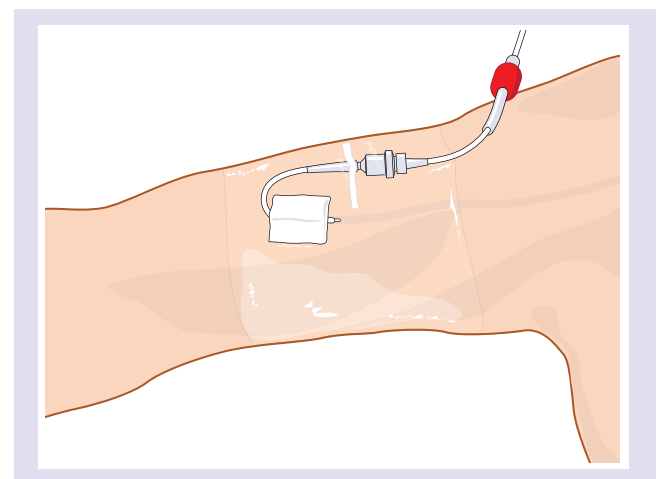


Figure 8. A small gauze dressing can help manage indentation

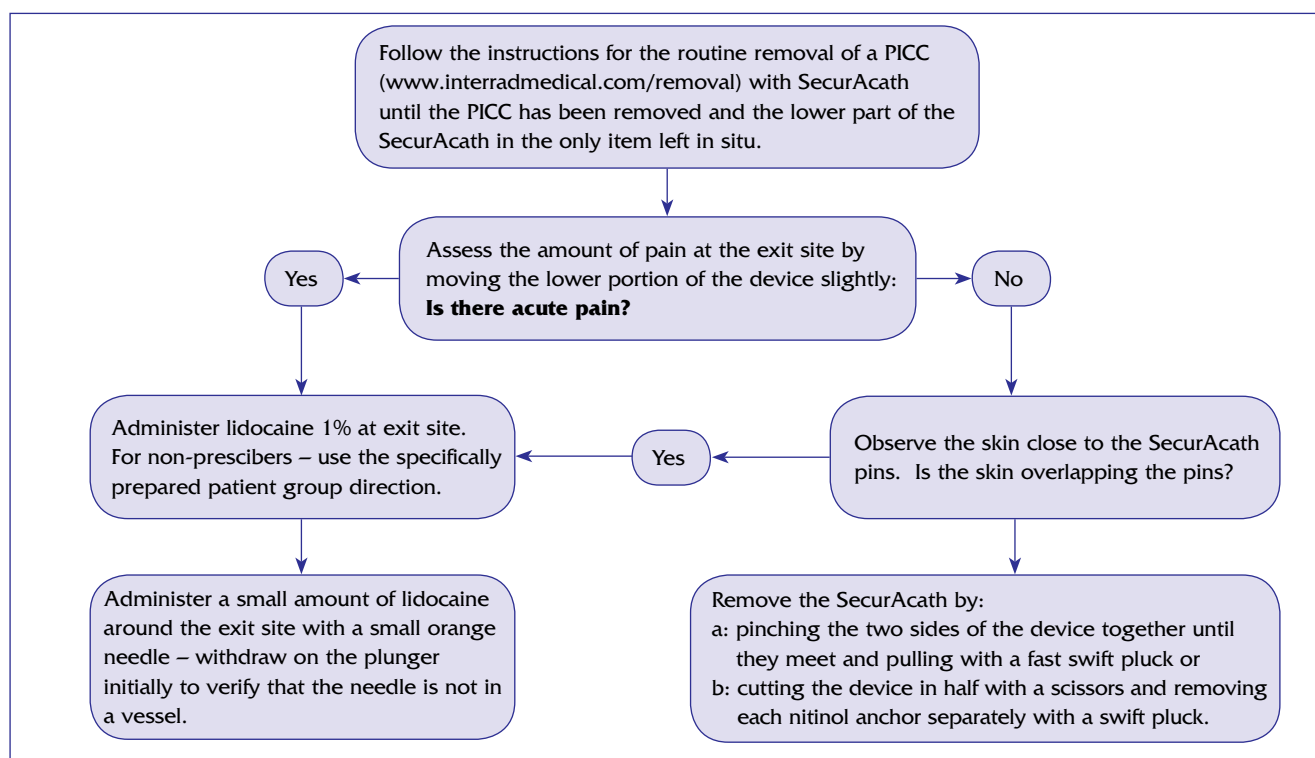


Figure 9. SecurAcath removal

Staff are encouraged to lift the catheter gently to allow for 360-degree cleansing of the site. The use of sterile plastic forceps to clean the difficult-to-access area between the PICC and the nitinol pins has proved effective in order to clear any coagulated blood or debris. The SecurAcath device itself requires a good soaking with chlorhexidine to prevent the collection of blood within it.

Removal

The main area of concern was the removal of the device with both staff and patients expressing dissatisfaction. As a result of this feedback, an algorithm was devised in order to minimise the pain experienced at removal (Figure 9). This aids the prediction of a painful removal and suggests the use of local anaesthesia at the site to be initiated prior to the patient's experience of any pain. As the algorithm illustrates, there are two main assessment points. The first, to assess pain as the device lays flat against the skin and the second to assess the presence of over-granulation on the SecurAcath pins; both would lead to a more problematic and painful removal. The administration of local anaesthesia at the site has proved extremely effective

especially when the device has been difficult to remove. There have been a handful of cases when one or both the anchors have been stuck fast and only a forceful action post anaesthesia enabled removal. It is worthy of note that the majority of patients experienced a routine swift removal of the device without any discomfort or pain. Cutting the SecurAcath into two separate parts can aid the removal procedure. The device can be cut fairly easily using sterile scissors—the two nitinol pins will then separate (Figure 10).

Training

The implementation of the SecurAcath into clinical practice required little training from the perspective of placement technique. All three PICC placers required minimal training before proficiency with insertion technique was mastered. Training concerning the care and maintenance of the device for community and in-house staff was much more challenging mainly owing to the numbers involved. SecurAcath training was incorporated into the monthly PICC training programme. To date, 80% of staff have received this training which has been time-consuming but essential in order to promote compliance. The dressing technique is far simpler and easy to teach when comparing with the previous technique of replacing an adhesive security dressing.

The removal of the device required further training. Experienced staff within the hospital attended a 20-minute training session with the focus on how to identify a potentially painful removal and the administration of local anaesthesia at the exit site. Staff who are not prescribers were able to use a patient group direction written specifically for this purpose. One of the most important aspects to teach is that a removal requires a swift pluck in order to remove the device with minimal pain—this does take some time to master.

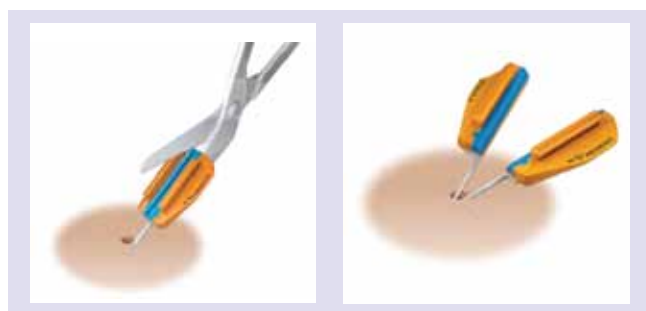


Figure 10. The SecurAcath can be cut in half to aid removal

KEY POINTS

- The SecurAcath device has proved successful in preventing peripherally inserted central catheter (PICC)-related migration
- Overall patient satisfaction with the SecurAcath device is high
- Pain experienced at the exit site or owing to indentation beneath the device can be resolved by removal of the device without PICC removal or more conservative managements such as gauze dressings, which act as a cushion to protect the skin
- Infection rates were initially high in the evaluation as a result of the unfamiliarity of the device. This has been successfully resolved after widespread training sessions
- The introduction of the SecurAcath device has led to a significant overall cost savings in the hospital where this evaluation took place

Cost analysis

PICC dressings

- Cost of weekly dressing
- Items used for weekly PICC dressing which are not required with SecurAcath
 - Adhesive security device £3.17 (changed weekly as per manufacturer's guidelines)
 - Wound closure strips £0.30
 - Total £3.47
- Cost of the above items required for a PICC in situ for 3 months having weekly dressings: £41.64
- The cost of a SecurAcath device: £16 (list price)
- The cost savings per PICC: £25.64.

PICC migration

Over a 12-month period, 21 PICC replacements were performed in the author's hospital exclusively as a result of catheter migration. The cost of a single PICC placement (inclusive of staff and X-ray costs) is: £250. Cost of replacing all 21 catheters: £5250.

Nursing time and X-rays

The cost of nursing time and X-ray to determine tip position is estimated at £45 per case. An audit of the current activity identified an average of 9 cases a month within the chemotherapy service which indicates an estimated cost of £4860.

Overall cost savings

An example of the overall estimated cost savings for the author's hospital for 12 months placing 460 PICCs with a dwell time of 3 months is: £21 610.

Conclusion

The evidence gathered from the SecurAcath evaluation enabled the author's organisation to proceed with the routine use of the device. To date, the hospital team has placed 500 SecurAcath devices and continues to monitor the performance and outcomes. The overwhelming benefit of the device is migration prevention. Not a single catheter has required replacement since their introduction and during the evaluation period, one catheter moved by 1 cm. The reduction in the incidence of migration has had a significant impact on the hospital's PICC insertion service and chemotherapy clinics by minimising the nursing time dedicated to the investigation and management of migrated PICCs and, consequently, a significant cost savings.

As with many new initiatives, practitioners took some time to embrace the concept of the SecurAcath device. After initial concerns, the staff within the clinical areas became more familiar with the device and have expressed their overall satisfaction with its less problematic management. However, issues such as the management of indentation and ease of removal continue to be of some concern. The routine removal of the device does need courage in order to execute the 'swift pluck' required for efficient removal. Training, support and the use of local anaesthesia has improved this procedure for patients and staff alike and it appears that successful problem-free removal is correlated with experience in this instance.

The patient experience has been positive overall with the majority of patients reporting satisfaction with the device. The stress and inconvenience of having a sub-optimally placed PICC has been avoided in the hospital's patient group who already face challenging experiences in view of their cancer diagnosis and management. Dedicated training programmes have assisted in this change-management process together with information and guidance on problem-solving solutions. To date, the information gathered in the author's hospital concerning the safety and efficacy of the SecurAcath device makes this technology suitable for use for patients requiring PICC placement. BJN

Conflict of interest: none.

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