Winning the war on catheter infections

There is a growing body of evidence to support the use of chlorhexidine releasing dressings, in addition to performing catheter care bundles, as part of a major drive to reduce infection. **LOUISE FRAMPTON** reports.

Catheter-related bloodstream infections (CRBSIs) are an important cause of healthcare-associated infection (HCAI), resulting in significant mortality, morbidity and cost. At a recent conference, held at the Royal College of Physicians, experts discussed how clinicians could *Win the war against infection*, by combining the use of a protective 'sponge disk' containing chlorhexidine gluconate (CHG)with a bundle of other evidence-based interventions.

Dr William R Jarvis, a past director at the Centers for Disease Control and Prevention (CDC) and president of the consultancy company, Jason and Jarvis Associates, provided an insight into chlorhexidine releasing dressings for the prevention of catheter-related infection.

He explained that, in the US, around 1.7 million HCAIS are reported each year, with almost 100,000 deaths. Of these HCAIS, bloodstream infections account for around 18%, while the cost per episode of central line-associated bloodstream infection (CLABSI) is between $7,288 and $29,156.

"In the US, hospitals absorb the majority of these costs. With around 250,000 blood stream infections each year, the cost is estimated to be around $2.3 billion. Having a systematic approach to the prevention of infections is critical, therefore," he commented.

Speakers discussed solutions to tackle catheter-related infection.

He pointed out that even if skin antisepsis is performed well, prior to catheter insertion, the skin will not be sterile: "At least 20% of the microorganisms will remain on the skin and can attach to the external surface of the catheter. This may result in the formation of a biofilm, which effectively helps to protect the microorganisms from the patient's immune defences, as well as antibiotics," he explained.

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He advised that, if the patient is catheterised for 3-4 days, it is important to tackle the threat posed by extraluminal colonisation. However, in certain groups such as oncology patients, who may be catheterised for weeks, months or even years, the maintenance bundle becomes as important as the insertion bundle. He explained that the main source of infection arises from patients' own skin flora and from healthcare worker's hands – in fact 60% of CRBSIs originate from the patient's own skin.

Without continual suppression, bacteria on the skin surface can repopulate and migrate into the bloodstream, elevating the risk of CRBSI. Dr Jarvis pointed out that 80% of resident bacteria exist in the first five layers of the

stratum corneum. Bacteria can be present on the skin follicles or sebaceous glands so they are not removed at the time of skin antisepsis.

"After skin antisepsis is applied, it is like shooting a gun at the start of a race – microorganisms start to grow again. By 18-24 hours they are back to the levels they were at before," he warned, adding that the infection risk varies according to the site on the body, as some areas are more contaminated than others (such as the femoral site, for example).

He explained that chlorhexidine shows affinity to the skin and can provide cumulative and residual activity. It provides rapid attraction with negatively charged organisms, as it is positively charged, and provides both bacteriostatic (inhibits bacterial growth) and bactericidal (kills bacteria) modes of action. It works by being absorbed into the organism, disrupting the cell membrane and resulting in cytoplasm leakage and ultimately cell death.

The evidence base

He went on to highlight the supporting research, citing a multicentre randomised control trial, by Timsit *et al* (2012),[1] which evaluated a total of 1,879 patients (4,163 catheters and 34,339 catheter-days). With chlorhexidine dressings, the major-catheter-related infection rate was 67% lower (0.7 per 1,000 vs 2.1 per 1,000 catheter-days.) This reinforces the findings from an earlier RCT by Timsit *et al* (2009)[2] in which infection rates were reduced to by 69%.

Ruschulte *et al* (2009)[3] also evaluated the effectiveness of chlorhexidine-impregnated sponges for reducing catheter-related infections of central venous catheters inserted for cancer chemotherapy. The incidence of central venous catheter-related infections were 11.3% (34 of 301) and 6.3% (19 of 300) in the control and chlorhexidine-impregnated wound dressing groups, respectively.

Ruschulte *et al* found that catheter-related infections at internal jugular vein insertions could be reduced, in particular, while no adverse effects related to the intervention were observed. They concluded that the use of chlorhexidine-impregnated sponge dressings significantly reduced the incidence of central venous catheter-related infections in patients receiving chemotherapy.

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Dr Jarvis pointed out that there is a significant amount of data on the Biopatch chlorhexidine-impregnated dressing. "The evidence shows that even if you are using an insertion care bundle and impregnated catheters, there is a significant benefit to using the Biopatch, with a 44% reduction in infections," he commented.

The Biopatch dressing is supported by 12 randomised control trials, conducted on a wide variety of patient groups, including two paediatric studies – one by Garland *et al* (2001)[4] involving 705 neonates, and another by Levy *et al* (2005),[5] which focused on paediatric intensive care units.

Paediatric population

The Garland study found that the rate of catheter tip colonisation – for percutaneous catheters and all catheters combined – was lower in the chlorhexidine group than in the 10% povidone-iodine group, but not for surgical catheters. Groups did not differ in terms of CRBSI and for blood stream infections without a source. However, 15% of neonates weighing ≤1000 grams in the chlorhexidine group developed localised contact dermatitis.

"As a significant proportion of those who had adverse skin reactions were of very low birth weight, the entry requirements into the study were changed, and they did not include infants that were less than 26 weeks. They still saw some reactions, which has led to the recommendation that if the Biopatch is going to be used on a neonatal patient, that you should wait until they are at least one week old to allow the skin to mature," commented Dr Jarvis.

The Levy study randomised patients to receive a transparent polyurethane insertion site dressing or a chlorhexidine-impregnated sponge (Biopatch) dressing covered by a transparent polyurethane dressing. The main outcome measures were rates of bacterial colonisation, rates of central venous catheter-associated bloodstream infections and adverse events. The researchers concluded that the chlorhexidine-impregnated sponge significantly reduces rates of central venous catheter colonisation in infants after cardiac surgery.

A systematic review by the American Pediatric Surgical Association Outcomes and Clinical Trials Committee (Huang *et al*, 2011)[6] also found that:

- Chlorhexidine skin prep and chlorhexidine-impregnated dressing can decrease central venous catheter colonisation and bloodstream infection.
- Use of heparin and antibiotic-impregnated central venous catheters can decrease central venous catheter colonisation and bloodstream infection.
- Ethanol and vancomycin lock therapy can reduce the incidence of catheter-associated bloodstream infections.

Weitz *et al* (2013)[7] reported on seven cases of erosive contact dermatitis with chlorhexidine dressings and advised that healthcare providers should be aware of this risk, particularly in young children and immune suppressed and/or critically ill patients, who may be more susceptible to the irritant effects of the dressings. Therefore, when the dressings are used, patients should be monitored closely for skin breakdown.

He went on to discuss a study by Sengupta *et al* (2010),[8] which highlighted

the fact that catheter duration is an important risk factor for CLABSI when using peripherally inserted central catheters (PICCs) in the neonatal ICU. The authors concluded that the significant daily increase in the risk of CLABSI after 35 days may warrant PICC replacement if intravascular access is necessary beyond that period.

Cost evaluation

Evidence of the cost benefits associated with using chlorhexidine-impregnated sponge dressings was further explored during the presentation, including an economic evaluation by Schwebel et al (2012).[9] The evaluation found that the median direct cost of major catheter-related infection was $792, while the estimated added length of stay due to major catheter-related infection was 11 days. The overall cost of major catheter-related infection was $24,090/episode, while each dressing cost $9.08 and each chlorhexidine-impregnated sponge cost $9.73.

The authors estimated that the use of chlorhexidine-impregnated sponges saved $197 per patient with a three-day chlorhexidine-impregnated sponge dressing change strategy, and $83 with a seven-day standard dressing change strategy. They concluded that chlorhexidine-impregnated sponge use for arterial and central venous catheters saves money by preventing major catheter-related infections, even in intensive care units with a low baseline of infection levels.

Dr Duncn Wyncoll, Guy's and St Thomas' NHS Foundation Trust.

Dr William R Jarvis, Jason and Jarvis associates.

Guidance

Dr Jarvis went on to highlight current guidance on the use of chlorhexidine-impregnated sponge dressings. The CDC guidelines includes a category 1B recommendation to: "Use a chlorhexidine-impregnated sponge dressing for temporary short-term catheters in patients older than two months of age if the CLABSI rate is not decreasing despite adherence to basic prevention measures..."[10]

He explained that 'Category 1B' means that the solution is 'strongly recommended for implementation and supported by some experimental, clinical or epidemiologic studies, and a strong theoretical rationale." However, in his opinion, the use of chlorhexidine-impregnated sponge dressings should be a 'Category 1a recommendation'.

EPIC 3 guidelines also include a Class B recommendation to: "Consider the use of a chlorhexidine-impregnated sponge dressing in adult patients with a central venous catheter as a strategy to reduce catheter related bloodstream infection."

In his closing comments, Dr Jarvis summarised that, when evaluating the increasing variety of chlorhexidine-impregnated dessings, "one should not assume that they all deliver the same results."

He pointed out that the Biopatch dressing offers 360 degree protection at the insertion site, ensures CHG is delivered continuously for up to seven days and it is capable of absorbing eight times its own weight. It is also FDA approved and has a large body of scientific evidence supporting its efficacy, and is supported by multiple national guidelines.

Dr Jarvis added that some products – which have been developed since the publication of the CDC guidelines – look similar, but may not contain the same concentrations of chlorhexidine.

"They have different sponge characteristics, different chlorhexidine concentrations, different indications and you are going to get different results," Dr Jarvis warned. He urged clinicians to ask sales representatives to show the package insert and question them on the product's FDA indication, as well as the peer-reviewed evidence and guidance to support their claims. He advised users to look very carefully at the evidence to support the products they are considering. "There are increasing options, but data should drive your selection," he commented.

Dr Duncan Wyncoll discussed infection prevention in the ICU and 'what really works'.

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In conclusion, Dr Jarvis commented that that there is a major drive to reach zero catheter-related infections in the US. "While it may not be possible to achieve zero every day, in every ICU, at every hospital, it should be our goal," he asserted. "In the US, we have had mandatory reporting of CLABSI on ICUs for several years and this has now been extended to reporting of all hospital CLABSIs, since January 2015. Ultimately, I believe the CDC will change its surveillance systems to include data on all intravascular lines, in the future." ✚

References

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9 Schwebel *et al*, Economic evaluation of chlorhexidine-impregnated sponges for preventing catheter-related infections in critically ill adults in the Dressing Study. *Crit Care Med.* 2012 Jan;40(1):11-7. doi: 10.1097/CCM.0b013e31822f0604.

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About the conference

Other highlights at the conference, *Win the war against infection*, included a presentation by Dr Duncan Wyncoll, consultant intensivist, Guy's and St Thomas' NHS Foundation Trust, on: 'Infection prevention on the ICU: what really works and what you need to know about Epic 3'; a thought-provoking discussion on line care and maintenance from a patient's perspective, by Jo Rawston; as well as an insight into case studies at King's College Hospital, presented by the lead intravascular practitioner, Jennifer Caguioa, and at Bristol Royal Infirmary, presented by the vascular access coordinator, Jody Coram. The event was hosted by Ethicon, a division of Johnson & Johnson Medical Limited.