A comparison of heparin and saline flush to maintain patency in central venous catheters

Heparin is routinely used to keep central venous catheters patent, but is it the most effective flush solution? A systematic review was undertaken to find out.

The use of heparin to flush central venous catheters (CVCs) has been accepted practice for decades. Heparin is thought to prevent clots developing in the catheter, which would decrease or prevent flow through it and might be a potential focus for infection. Using CVCs carries risks and their insertion is usually undertaken for specific reasons. Preventing functional loss of the catheter is an essential component of nursing care.

An evaluation of our policy for maintaining CVCs highlighted significant differences among members of our policy and procedure committee regarding the use of heparin flush to maintain catheter patency. Several members believed that research suggested using a normal saline flush was sufficient (American Association of Critical Care Nurses, 1993); however, a review of the study found that it involved flushing arterial catheters and was not applicable to our practice question.

As CVC maintenance varied throughout our organisation, with some health professionals using heparin and others using normal saline, we decided to look for evidence to guide our policy decision.

We asked the hospital librarian for a literature review on flushing central lines. At the same time, we researched practice standards of professional nursing organisations whose specialty involved caring for patients with central venous access (Infusion Nurses Society, 2006; Camp-Sorrell and Cope, 2003; American Society for Parenteral and Enteral Nutrition, 2002). When recommendations were made, they called for heparin use at 100 units/mL. We were unable to identify any organisations that recommended flushing with normal saline only.

We also examined the policies of other hospitals in the region, most of which used heparin for central line flushing. Few policies cited evidence to support this choice, and one used a study of peripheral intravenous (IV) catheters, which we did not consider applicable to CVC care. Despite anecdotal comments from the nursing community, there was little in organisational or local nursing standards to suggest that we should stop using heparin flush.

Evidence-based practice models allow us to consider expert consensus. We asked experts in other areas of the country about their practice. Although many had similar questions about using heparin versus normal saline, none could cite evidence to support doing so.

Use of positive pressure caps

Many policies we examined suggested using positive pressure caps on central venous access lines to eliminate the need for heparin. These caps provide pressure in IV lines when flush syringes are removed, preventing backflow of blood into the catheter, thereby preventing clotting.

When we raised this as a potential solution, the infectious diseases specialist from whom we consulted had concerns, as anecdotal evidence was emerging about increased risk of infection with positive pressure caps; he recommended that these should not be used.

Heparin induced thrombocytopenia

At this point, the evidence appeared to support using heparin to maintain catheter patency. However, we were not completely satisfied with our results as concerns about heparin induced thrombocytopenia (HIT) had been raised (Swanson, 2007).

HIT results from the formation of
antibodies that target the heparin/PF4 antigen, resulting in thrombosis; the consequences can often be serious and life threatening. Even the small amounts of heparin required for flushing a CVC can trigger HIT in susceptible patients (Muslimani et al, 2007).

HIT is most common in patients undergoing cardiac surgery and, as our centre has such patients in this group, doctors were concerned about any unnecessary heparin exposure. They wanted heparin flushing of central lines to stop.

WEIGHING THE EVIDENCE
The policy and procedures committee faced a dilemma. We had an obligation to maintain necessary and often life sustaining CVCs. If we decided to stop using heparin, this might result in the clotting in catheters. We also had an obligation to prevent them from becoming infected, which can increase mortality risk, length of hospital stay and costs.

Pressure caps might allow us to stop using heparin but appeared to increase patients’ risk of infection. HIT was a danger and a strong argument against using this drug.

The patient health system of our hospital established the Center for Evidence Based Practice (CEP) in 2006 to obtain and analyse clinical evidence, and assist administrative and clinical departments with decision making. The CEP reviews high cost new technologies as well as topics relating to processes of care in which cost plays little part. It worked with the nursing policy and procedure committee to investigate the practice of flushing CVCs and to evaluate competing factors to help determine what best practice should be.

METHODS
After nursing leaders of the policy and procedures committee had presented the clinical problem, the CEP review began by outlining the clinical question using the PICO (patients, intervention, comparison, outcomes) framework. Terms used in the literature search followed these parameters. If the topic had not been clearly outlined at the outset, evidence could have been missed in the literature search. Criteria for including and excluding studies for analysis were set to minimise selection bias.

The CEP first sought evidence based guidelines on the topic, searching the National Guideline Clearinghouse, MEDLINE and the Cochrane Library. We then searched for systematic reviews and published clinical trials of different catheter maintenance protocols. Multiple databases were searched. A total of 17 searches were run from November 2007 until January 2008. They yielded six relevant guidelines and six systematic reviews. The searches for published clinical trials returned a total of 1,145 hits, from which 94 papers were retrieved for review. Twenty-two met the inclusion criteria for our evidence analysis.

RESULTS
Some of the systematic reviews on heparin for catheter flushing combined results from different interventions, such as heparin added to total parenteral nutrition, subcutaneous heparin and heparin flushes. Combining those results for a single conclusion about the efficacy of heparin would not give a valid result as there is no reason to believe that all interventions are equally effective.

We compiled evidence tables (Mitchell et al, 2009) examining:
- Six studies directly comparing heparin flushing with other interventions;
- Four other heparin flush studies;
- Three studies of continuous heparin infusion;
- Four studies of a heparin bonded catheter;
- Three studies of a urokinase flush;
- Four studies of pressure caps.

In no case was there sufficient data from similar trials to allow meta-analysis. Some studies were not randomised trials, and could have been affected by differences in patient groups. In short, the evidence base on heparin for catheter maintenance is small and of low quality.

The randomised trials found no significant difference in catheter patency rates between flushing with heparin and saline. One non-randomised trial found a significant effect favouring heparin flush.

There was no evidence that could help us quantify the risk of HIT from heparin used to maintain catheter patency. As HIT is uncommon, it would take an extremely large study to measure this risk. We did not find evidence that other interventions, such as continuous heparin infusion or urokinase flushing, had an effect on catheter patency.

Only one published study compared pressure caps with conventional caps in adults; it was confounded because pressure caps were used only for inpatient care and conventional caps were used for outpatients. Any measured difference in occlusion or infection could have been the result of differences in the patient groups.

We broadened our criteria to include paediatric studies. None of the three trials including paediatric patients was randomised; all reported increased bloodstream infection rates with pressure caps. In one study, the difference was statistically significant.

Results of studies measuring the effect of pressure caps on catheter patency were inconsistent.

CONCLUSION
The evidence for using heparin to flush CVCs is small, and the published studies are of low quality. There was some evidence that pressure caps are associated with increased risk of infection. The CEP stated there was insufficient evidence to conclude that flushing with heparin is more effective than flushing with saline alone.

In light of this, nursing policy for maintaining CVC patency was changed to include flushing catheters with only saline. We have implemented this over the past 18 months, during which time we have reduced the catheter associated bloodstream infection rate, have not had an increase in catheter or vein occlusion and have reduced nursing workload without compromising patient safety.

This is a summary of a paper first published in the Journal of Advanced Nursing (Mitchell et al, 2009).

REFERENCES