



## Review

# Heparin versus 0.9% sodium chloride intermittent flushing for the prevention of occlusion in long term central venous catheters in infants and children: A systematic review<sup>☆</sup>



Natalie K. Bradford<sup>a,b,\*</sup>, Rachel M. Edwards<sup>c</sup>, Raymond J. Chan<sup>d,e</sup>

<sup>a</sup> The Centre for Online Health, School of Medicine, The University of Queensland, Brisbane, Australia

<sup>b</sup> Queensland Youth Cancer Service, The Lady Cilento Children's Hospital, Brisbane, Australia

<sup>c</sup> Queensland Children's Cancer Institute, The Lady Cilento Children's Hospital, Brisbane, Australia

<sup>d</sup> Institute of Health and Biomedical Innovation and School of Nursing, Queensland University of Technology, Brisbane, Australia

<sup>e</sup> Cancer Nursing Professorial Precinct, Royal Brisbane and Women's Hospital, Metro North Hospital and Health Service, Brisbane, Australia

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## ABSTRACT

**Background:** Around the world, guidelines and clinical practice for the prevention of complications associated with central venous catheters (CVC) vary greatly. To prevent occlusion, most institutions recommend the use of heparin when the CVC is not in use. However, there is debate regarding the need for heparin and evidence to suggest normal saline may be as effective. The use of heparin is not without risk, may be unnecessary and is also associated with increased costs.

**Objectives:** To assess the clinical effects (benefits and harms) of heparin versus normal saline to prevent occlusion in long-term central venous catheters in infants, children and adolescents.

**Design:** A Cochrane systematic review of randomised controlled trials was undertaken. **Data sources:** The Cochrane Vascular Group Specialised Register (including MEDLINE, CINAHL, EMBASE and AMED) and the Cochrane Register of Studies were searched. Hand searching of relevant journals and reference lists of retrieved articles was also undertaken. **Review Methods:** Data were extracted and appraisal undertaken. We included studies that compared the efficacy of normal saline with heparin to prevent occlusion. We excluded temporary CVCs and peripherally inserted central catheters. Rate ratios per 1000 catheter days were calculated for two outcomes, occlusion of the CVC, and CVC-associated blood stream infection.

**Results:** Three trials with a total of 245 participants were included in this review. The three trials directly compared the use of normal saline and heparin. However, between studies, all used different protocols with various concentrations of heparin and frequency of flushes. The quality of the evidence ranged from low to very low. The estimated rate ratio for CVC occlusion per 1000 catheter days between the normal saline and heparin group was 0.75 (95% CI 0.10 to 5.51, two studies, 229 participants, very low quality evidence). The estimated rate ratio for CVC-associated blood stream infection was 1.48 (95% CI 0.24 to 9.37, two studies, 231 participants; low quality evidence).

<sup>☆</sup> This paper is based a Cochrane Review published in the Cochrane Library 2015, issue 11, Art. No.: CD010996. DOI: 10.1002/14651858.CD010996.pub2. Cochrane reviews are regularly updated as new evidence emerges and in response to feedback, and the Cochrane Database of Systematic Reviews should be consulted for the most recent version of the review.

\* Corresponding author at: Queensland Children's Cancer Service, Level 12, Lady Cilento Children's Hospital, South Brisbane 4101, Australia.  
E-mail address: [Natalie.bradford@health.qld.gov.au](mailto:Natalie.bradford@health.qld.gov.au) (N.K. Bradford).

**Conclusions:** It remains unclear whether heparin is necessary for CVC maintenance. More well-designed studies are required to understand this relatively simple, but clinically important question. Ultimately, if this evidence were available, the development of evidenced-based clinical practice guidelines and consistency of practice would be facilitated.

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### What is already known about this topic?

- Central venous catheters maintenance practices vary around the world.
- Variations include the quantity of flush and lock solutions, the proportional volume of heparin lock solution, and the frequency of flushes and locks.
- The use of heparin may be unnecessary, is costly and is not risk free.

### What this paper adds

- There was not enough evidence to determine which solution, heparin or normal saline, was superior to prevent occlusion in long-term central venous catheters in infants and children.
- There is a need for healthcare organisations to consider undertaking further research in this area to contribute to the evidence base.
- Nurses are ideally placed to contribute to such research and ultimately this would facilitate the development of evidence-based clinical practice guidelines and consistency of practice

## 1. Introduction

Central venous catheters (CVCs) are commonly used in hospital-based care to enable the administration of medications and fluids, as well as for the collection of blood specimens. Long term CVCs are typically inserted when the administration of intravenous medication or nutritional support is required over a considerable time period. The use of long term CVCs for the management of complex or chronic medical conditions, such as cancer, in infants, children and adolescents, has greatly improved the quality and safety of care provision (Gonzalez et al., 2012).

Adverse events associated with CVCs, such as mechanical failure or central line associated-blood stream infection (CLABSI) may cause complications in up to 46% of children (Athale et al., 2012). Mechanical failure is often attributed to catheter occlusion. Over time, it is common for a fibrin sheath to develop at the tip of the catheter. The fibrin sheath may prevent aspiration of blood from the catheter and cause resistance when infusing fluids. An intraluminal clot can also occur, which can totally occlude the catheter. Occlusion can result in the need for the catheter to be removed (and replaced), interrupting and delaying treatment of the underlying disease (Shah et al., 2007).

To prevent occlusion, it is common to regularly flush the CVC with 0.9% sodium chloride, and to use a heparin lock when the CVC is not in use. However, there is debate regarding the effectiveness of heparin to prevent occlusion

over long time periods, given its short half-life (Young, 2008). The evidence to support the use of heparin to prevent occlusion in adult CVCs is inconclusive and there is growing evidence to support the use of 0.9% sodium chloride (normal saline) to lock CVCs, particularly in the paediatric population (Bertoglio et al., 2012; Lee and Johnston, 2005). Normal saline, when used with pulsatile (push-pause rather than continuous) flushing techniques and a positive pressure lock or positive displacement device, may be as effective in preventing thrombus formation in catheters – eliminating the need for heparin to be used.

Catheter maintenance practices vary among institutions because of the lack of evidence regarding best practice to prevent occlusion of CVCs (Lee and Johnston, 2005; Conway et al., 2014). Variations include the quantity of flush and lock solutions, the proportional volume of heparin lock solution, and the frequency of flushes and locks. The use of heparin is not risk free and in certain instances may actually cause harm, including infection (Shanks et al., 2005) and heparin-induced thrombocytopenia (HIT) (Barclay et al., 2012). Additionally, treatments for diseases such as cancer involve the use of medications that can affect coagulation. For these reasons the use of heparin to prevent CVC occlusion should be judicious and evidence-based. While the risks of adverse effects from the use of heparin may be regarded as less than the potential occlusion of a catheter and subsequent replacement, it is important to ensure interventions are based on evidence.

In the adult population, there have been several trials (Goossens et al., 2013; Schallom et al., 2012) a systematic review (Mitchell et al., 2009), and a Cochrane Review of the use of heparin versus normal saline to prevent occlusions in CVCs (Lopez-Briz et al., 2014). As evidence from adult studies is not directly transferable to paediatrics, a systematic review focused on infants and children is required. A review published in 2014 that did relate specifically to paediatrics (Conway et al., 2014) did not identify all relevant studies and made recommendations based on the current practice of several institutions. These recommendations were not evidence-based, and are contrary to the practice of many other institutions. Therefore, it is important to systematically appraise the evidence for the use of heparin compared with normal saline to prevent occlusion of central venous catheters.

## 2. Aims

To compare the clinical effects (benefits and harms) of heparin versus normal saline to prevent occlusion in long-term central venous catheters in infants, children and adolescents.

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