CVAD Flushing Literature

**PURPOSE:** This study was undertaken to determine if central venous catheter (CVC)-related infection in children with cancer could be prevented by monthly flushing of the catheter with urokinase.

**PATIENTS AND METHODS:** Between August 1994 and July 1998, 103 patients with cancer were randomized at the time of subcutaneous CVC placement to receive monthly flushing of their catheters with either 5000 IU of urokinase-heparin or heparin alone. Patients subsequently had blood cultures taken from their CVCs during an episode of fever.

**RESULTS:** Seventy-four of the 103 patients (72%) enrolled in the study received at least 6 catheter flushes: 40 with urokinase-heparin and 34 with heparin. The median number of flushes was 9.5 in the urokinase-heparin group and 10.2 in the heparin-only group (P = 0.62). There were 5 positive blood cultures in the urokinase-heparin group and seven in patients receiving heparin alone (P = 0.27). Staphylococcus epidermidis was isolated from the blood of 3 patients receiving urokinase-heparin and 6 in those receiving heparin alone (P = 0.17).

**CONCLUSION:** Prophylactic monthly catheter flushes with 5000 IU urokinase did not significantly decrease the number of documented bacteremic events in children with cancer who have CVCs.


In a 7-month period we studied 38 Hickman central venous catheters (CVCs) positioned in children with hematologic malignancies with the aim of evaluating the incidence and clinical impact of CVC clots. Clots were found in 74% of the CVCs. Three methods of catheter care were developed for flushing the clotted CVCs: (a) use of a heparinized solution (400 IU/mL) on alternate days, (b) use of a heparinized solution (400 IU/mL) and saline solution containing urokinase (10,000 IU/mL) on alternate days, and (c) use of a saline solution containing urokinase (10,000 IU/mL) daily. Only method b decreased clot formation (33% success rate). There were no major mechanical complications in any of the CVCs with clots. Eighteen percent of patients with clots in their CVCs presented with CVC-related infections while no infective complications were observed in the patients without clots in their CVCs. In conclusion, CVC clots may predispose the patient to infections, which must be correctly treated.


We report a case of four-year-old girl who suffered a cardiac arrest under anaesthesia, due to complete heart block without ventricular escape, during the flushing of an errantly placed longterm central venous catheter. It was subsequently found that the central line was placed in a persistent left superior vena cava (LSVC) draining directly into the coronary sinus. Diagnosis was suspected by a chest x-ray and confirmed by two-dimensional echocardiography. The patient made a complete recovery from the event and was discharged from hospital three days later.

PURPOSE: There are limited prospective data on whether the method of flushing affects the complication rate of tunneled central venous catheters (CVCs).

PATIENTS AND METHODS: During a 25-month period, 203 pediatric patients who had newly placed Broviac-Hickman CVCs were randomly assigned to standard flushing with heparin solution or to experimental flushing with normal saline via a positive-pressure cap.

RESULTS: Two hundred twenty-one complications were recorded among 75,249 CVC-days (2.94 per 1,000 CVC-days). A higher incidence of CVC occlusion (83 v 41 episodes; P = .0002) and bacteremia (24 v 9; P = .01) were found in the experimental arm. The cumulative probability of developing at least one CVC complication was higher in the experimental arm than in the standard arm (65.1% [95% CI, 55% to 75%] v 43.8% [95% CI, 34% to 54%], respectively; P = .01). No difference was found in either the cause or the frequency of premature removal of CVCs between the two study arms. After a median follow-up of 360 days (range, 4 to 1,073), CVC survival was similar: 77% (95% CI, 66% to 84%) for the experimental arm and 69% (95% CI, 53% to 80%) for the standard arm (P = .7). The factors associated with the occurrence of CVC complication were a diagnosis of leukemia/lymphoma, double-lumen CVC, and experimental flushing. The only factor significantly associated with premature removal of a CVC was a diagnosis of leukemia/lymphoma (hazard rate, 2.3; 95% CI, 1.1 to 4.7).

CONCLUSION: An increased complication rate was found with normal saline flushing, but additional investigation is warranted to clarify whether it is related to saline use or to once-a-week flushing.


The use of central venous catheters (CVCs) has revolutionized practice within paediatric oncology settings. However, many children experience problems with occlusion of these devices. When working effectively, CVCs can assist the administration of medication and withdrawal of blood samples and minimize the need for venepuncture, thus considerably easing the trauma of children undergoing treatment for malignant disease. However, when lines are occluded children will be subjected to venepuncture or anaesthetic for line replacement. There are a myriad of factors that may lead to occlusion. A study was undertaken to identify these and explore the effects that occlusion of a CVC can have on the child and family. The research was conducted in two phases. Phase one consisted of a review of case notes of 63 children from which five families were selected for interview. These were undertaken to examine the possible factors that may have precipitated line occlusion and the subsequent effect of this on their lives. The issues arising from the interviews and review of the case notes were used inform phase two, which comprised the development and distribution of a questionnaire in order to investigate key aspects within a larger population of 63 families. This article explores the information gained from children and families about the effect occlusion can have on them and their lives. Overall the findings revealed that parents felt anxious, angry and helpless when faced with occlusion and they described the coping strategies they used when the problem arose. Furthermore, providing information and education to parents regarding the care of the CVC was crucial. Following an analysis of the implications for practice the main recommendations were twofold. First, that structured teaching programmes and shared learning protocols should be developed to ensure that parents are fully conversant with the possible complications associated with the CVC. Second, parents should be
provided with the knowledge and skills to feel competent in flushing their child’s line when they go home. Both these recommendations have subsequently been introduced within the unit.


PURPOSE: To determine whether an antibiotic flush solution containing vancomycin, heparin, and ciprofloxacin (VHC) can prevent the majority of line infections.

PATIENTS AND METHODS: A prospective double-blind study was performed comparing VHC to vancomycin and heparin (VH) to heparin alone in 126 pediatric oncology patients.

RESULTS: The 153 assessable lines resulted in 36,944 line days studied. There were 58 blood stream infections (43 gram-positive, 14 gram-negative, and one fungal). Forty were defined as line infections (31 heparin, three VH, six VHC). The time to develop a line infection was significantly increased using either antibiotic flush (VH, P =.011; VHC, P =.036). The rate of total line infections (VH, P =.004; VHC, P =.005), gram-positive line infections (VH, P = .028; VHC, P =.022), and gram-negative line infections (VH, P =.006; VHC, P =.003) was significantly reduced by either VH or VHC. Sixty-two (41%) of the lines developed 119 occlusion episodes (heparin, 3.99 per 1,000 line days; VHC, 1.75 per 1,000 line days; P =.0005). Neither antibiotic could be detected after flushing, and no adverse events were detected, including increased incidence of vancomycin-resistant Enterococcus colonization or disease.

CONCLUSION: The use of either VH or VHC flush solution significantly decreased the complications associated with the use of tunneled central venous lines in immunocompromised children and would save significant health care resources.


A 7 month old male had been born with jejunal atresia and had undergone some small bowel resection. A later episode of necrotizing enterocolitis resulted in ileal resection. The infant received parenteral nutrition through a Broviac catheter. The external part of the catheter later developed a tear and was repaired, using a standard catheter repair kit. The catheter later became obstructed and was cleared with urokinase and later still flushed at home. On the day of admission, the child had had mild respiratory symptoms for two to three days and a chest X-ray showed the presence of a foreign body in the left lung. The foreign body was the metal splice segment of the catheter repair kit. It had apparently been dislodged during the flushing of the catheter and had embolized into a pulmonary artery. The foreign body was removed percutaneously in the cardiac catheterization laboratory.

There is little published information describing standards of practice in the placement, use, and maintenance of peripherally inserted central catheter (PICC) devices in children. A Web-based survey tool was designed to query these issues, and 72 intravenous therapy nurses from 72 hospitals provided complete responses to the survey. The respondents were predominantly (81%) from healthcare organizations inserting 40 or fewer PICC devices per month. These hospitals were equally divided in using 0.9% sodium chloride (USP) (saline) or heparinized saline flush to maintain patency, whereas 76% used catheters for blood sampling. Flushing and blood sampling practices were not related to catheter occlusion rates. From their survey, the authors conclude that the standards of practice for 3-Fr PICC devices, the most commonly used for children, are quite variable and in need of standardization for this specific population.


We report the case of a 3-year-old boy with severe haemophilia A presenting with recurrent haemarthroses despite daily infusions of factor VIII delivered through a central venous access device (CVAD). Regular rinsing of the CVAD with heparin, according to a standard protocol, resulted in systemic anticoagulation, as demonstrated by prolonged thrombin time and therapeutic anti-Xa levels. The bleeding symptoms resolved after replacing heparin with a normal saline solution. This case illustrates that heparin administered to maintain CVAD patency should be used with caution in young haemophiliacs. Prolonged thrombin time should alert the physician to this possible CVAD complication.


BACKGROUND: Central venous catheters (CVCs) have provided many benefits in modern-day medical practice; however, they also put patients at risk of catheter-related complications. Numerous studies have been carried out in relation to the management of central venous catheters with conflicting results. While there were several systematic reviews of central venous catheter-related issues, it is clear that there was no systematic review of CVC-related studies specific to the paediatric population in the acute care setting.

OBJECTIVE: To present the best available evidence for effective management of central venous catheters and catheter sites in the prevention and/or reduction of catheter-related complications in hospitalised paediatric patients. METHODS: A systematic review was undertaken according to the approach of the Centre for Reviews and Dissemination (CRD; http://www.york.ac.uk/inst/crd).

DATA SOURCE: Literature was identified by electronic searching of Cochrane Library, MEDLINE, CINAHL, HealthSTAR, and CancerLit; checking references of all review articles; hand searching of key relevant journals and conference proceedings; and contact with expert informants, medical suppliers, and pharmaceutical companies.

INCLUSION/EXCLUSION CRITERIA: The review included randomised and non-randomised controlled trials conducted with hospitalised paediatric patients. Studies that included mixed adult and paediatric populations and mixed hospitalised and home care settings were excluded.

DATA EXTRACTION: Two independent reviewers extracted data onto a standard data extraction form, with differences resolved by discussion.
QUALITY ASSESSMENT: The quality assessment of retrieved studies included: study design, the degree to which systematic bias was avoided or minimised, the degree to which the assessment was "blind," the degree to which follow up was completed.

DATA SYNTHESIS: Quantitative pooling of studies was not feasible due to the diversity of interventions and outcome measures between similar studies. A narrative account of the study characteristics and results was therefore undertaken.

RESULTS: Thirty-eight randomised and quasi-randomised controlled trials were retrieved for critical appraisal. Of these, 32 were excluded from the review because the studies did not meet the inclusion criteria and some lacked reporting of appropriate data. Six studies met the criteria with interventions such as antibiotic flushes, antiseptic skin preparations, and dressing materials.

CONCLUSION: Quality of reporting was generally lacking. Statistical pooling of results was not possible due to diversity in the reporting of outcomes. There was no evidence to make recommendations on the degree of barrier precautions and the type of aseptic technique to be used at the time of catheter insertion in the paediatric population to prevent catheter-related infection. There was insufficient evidence to support the routine use of an antibiotic flushing solution. There was a lack of randomised controlled trial (RCT) evidence on the benefit of heparin flushes, the use of in-line filters, the frequency of fluid administration set changes, or the type of dressing to use and the frequency of dressing changes. There was some evidence to suggest that chlorhexidine lotion is superior to povidone iodine as a cutaneous antiseptic at the catheter insertion site. However, no recommendation can be made for the use of chlorhexidine in neonates less than 2 weeks old or in premature infants. This systematic review concluded that there is an urgent need for well-designed randomised controlled trials with sufficient power to determine the effectiveness of various interventions in relation to management of CVCs. [References: 29]


An evaluation of totally implanted venous access systems inserted in 163 consecutive children with cancer is reported. From 1988 to 1994, 180 subcutaneous ports were inserted in children more than 1 year old. Initial diagnosis was acute leukaemia (n=79), non-Hodgkin's lymphoma (n=33), and solid tumour (n=51). Median age was 85 months. All venous procedures were performed through the device. Chemotherapy was either moderate (n=13) or intensive (n=119) or very intensive (n=48), including 16 patients undergoing marrow transplantation. Cumulative venous access totalled 55 770 patient days with a mean of 305 days/subcutaneous port. The cause of device removal was, end of treatment (n=111), death due to malignancy (n=20), catheter related infection (n= 7), and occlusion of the system (n=4). Mechanical complications occurred in 19 ports; 16 were due to clots, of which 14 were cleared with instillation of urokinase. Documented infectious episodes occurred in 47 ports, recurred once in 14, and twice in five cases. Among these infections, 47 were septicaemic; 31 due to Staphylococcus epidermidis. Twenty seven of initial septic episodes were considered to be catheter related; the rate was 15%/subcutaneous port or 0.05/100 catheter days. Risk factors for the development of a first infection were age below 4 years and the time of use. Since February 1993, vancomycin (50 mug/ml) has been given and this has reduced the rate of S epidermidis infection from 26/83 subcutaneous port to 4/97. Life table analysis showed that the infection free interval for staphylococcus was significantly better after this technique was initiated (log rank test=0.02). Time saved was approximately 30 minutes/patient/ week compared with external catheters, or 45 hours/month for the cohort of children treated. Subcutaneous ports in paediatric cancer patients are
reliable, safe, and durable and may offer an attractive alternative to external catheters for prolonged venous access and intensive treatment.


BACKGROUND: Long-term tunnelled central venous catheters (TCVCs) are increasingly used when treating oncology patients. Despite international guidelines on sterile insertion, appropriate catheter maintenance and use, infections still a complication of TCVC. These infections are mainly caused by Gram-positive bacteria. Antimicrobial prevention strategies aimed at these micro-organisms could potentially decrease the majority of TCVC infections. The aim of this review was to evaluate the efficacy of antibiotics in the prevention of early TCVC infections.

OBJECTIVES: To determine the efficacy of administering antibiotics prior to insertion of a TCVC with or without vancomycin/heparin flush technique in the first 45 days after insertion of the catheter to prevent Gram-positive catheter-related infections in oncology patients.

SEARCH STRATEGY: We searched the Cochrane Central Register of Controlled Trials (CENTRAL) to July 2006. MEDLINE (1966 to 2006) and EMBASE (1966 to 2006). Reference lists from relevant articles were scanned and conference proceedings were hand searched. The authors of eligible studies were contacted to obtain additional information.

SELECTION CRITERIA: We selected RCTs which administered prophylactic antibiotics prior to insertion of the TCVC, and RCTs using the combination of an antibiotic and heparin to flush the CVC in oncology patients (both adults and children).

DATA COLLECTION AND ANALYSIS: The studies identified were assessed and the data extracted independently by the two authors. Authors were contacted for details of randomization, and a quality assessment was carried out. The analysis was carried out using the standard Cochrane software package, RevMan 4.2.

MAIN RESULTS: We included nine trials with a total of 588 patients. Four reported on vancomycin/teicoplanin prior to insertion of the TCVC compared to placebo, and five trials reported on antibiotic flushing combined with heparin, compared to heparin flushing only. The overall effect of administering an antibiotic prior to insertion of the catheter decreases the number of Gram positive TCVC infections (odds ratio [OR] = 0.42, 95% confidence interval (CI) 0.13 to 1.31), this effect is not significant. Flushing the TCVC with antibiotics and heparin proved to be beneficial (OR = 0.43, 95% CI 0.21 to 0.87). For intraluminal colonization the baseline infection rate is 15% which leads to a number needed to treat (NNT) of 13 (95% CI 5 to 23).

AUTHORS’ CONCLUSIONS: Flushing of the catheter with a vanco/heparin lock solution leads to a positive overall effect. Depending on the baseline TCVC infection rate it is justified to flush the catheter with a combination of an antibiotic and heparin, if the catheter related infection-rate is high. [References: 38]

Flavimonas oryzihabitans bacteremias, which occurred immediately after the flushing or use of an implanted central venous catheter (Port-A-Cath) in two patients at the same pediatric ward, were studied by arbitrarily primed PCR. We conclude that the colonization of the Port-A-Cath with F. oryzihabitans described here lasted for several months.


BACKGROUND: Safe and reliable central venous access is critical in the management of children with cancer. A recently described valved catheter (Groshong) requires less frequent flushing to preserve catheter patency, theoretically reducing daily care costs for the catheter as well as lessening the risk of mechanical or infectious complications. This study compared standard Hickman to Groshong catheters in a group of pediatric oncology patients.

STUDY DESIGN: From December 1992 to May 5, 1994, 20 consecutive pediatric oncology patients were randomized by medical record number to receive either a standard dual lumen Hickman (7F) or Groshong (9.5F) catheter. All patients were prospectively followed on a weekly basis and a log was maintained regarding complications and cost of maintenance of the catheter until it was removed.

RESULTS: Ten patients received Groshong catheters and ten received Hickman catheters. Total catheter days for each group were similar (Hickman, 2,599 compared with Groshong, 2,389 days). Five Groshong catheters required removal because of mechanical complications and several required daily flushes because of blood backing up into the catheter lumen. When taking into account the cost of associated complications, no differences were noted in daily cost for maintenance between the two catheters.

CONCLUSIONS: When considering the cost of complications, Groshong catheters were no less expensive to maintain compared with standard Hickman catheters. Furthermore, Groshong catheters malfunctioned more frequently and required a greater number of urokinase instillations for withdrawal occlusion. The use of the Groshong catheter in pediatric oncology patients cannot be supported by the present study.