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Use of an ethanol lock to prevent catheter-related infections in children with short bowel syndrome ☆

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Abstract

Background: Children with short bowel syndrome (SBS) requiring central venous catheters (CVCs) may experience frequent catheter-related infections (CRIs). Treatment strategies include antibiotic- and ethanol-containing locks, with CVC removal if the CRI cannot be cleared. Ethanol lock therapy has been reported for CRI treatment in children but not for CRI prevention.

Methods: Medical records of children with SBS receiving cycled home parenteral nutrition via a silicone CVC and who received a daily 70% ethanol lock at some time during their therapy were reviewed retrospectively.

Main Results: Ten patients had 26 CVCs for a total of 3556 catheter-days and received a daily ethanol lock for 4 to 14 hours during a total of 3018 catheter-days. Before ethanol lock therapy (n = 5), there were 6 CRIs in 538 catheter-days (rate, 11.15 per 1000 catheter-days). During ethanol lock therapy in the same 5 patients, the CRI rate decreased to 2.06 per 1000 catheter-days (4 CRIs in 1936 catheter-days). In the 5 patients with no ethanol lock-free period, the CRI rate was 1.85 per 1000 catheter-days. Overall, CRI rate with ethanol lock therapy was 1.99 per 1000 catheter-days (2 CRIs in 1081 catheter-days). Four patients developed 6 CRIs during ethanol lock therapy. Four of these CRIs were cleared with systemic anti-infective and ethanol lock therapy; 2 CVCs were removed owing to infection. No adverse reactions were reported during ethanol instillation.

Conclusion: A daily 70% ethanol lock for CRI prevention was safe and effective in a series of 10 patients with SBS.

Children with short bowel syndrome (SBS) frequently require parenteral nutrition (PN) via central venous catheters (CVCs) to maintain adequate hydration and nutritional status. A common morbidity associated with indwelling CVCs is catheter-related infection (CRI) with the incidence of infection ranging from 3% to 60% over the life span of the catheter [1,2]. Current Infectious Disease Society of America (IDSA) guidelines state that infected tunneled CVCs may be salvaged if the infection is uncomplicated and caused by coagulase-negative *Staphylococcus* spp, *S aureus*, or Gram-

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negative bacilli [1]. Current salvage treatment recommendations include appropriate systemic antibiotic treatment as well as the use of various antibiotic [1,3] or ethanol lock techniques [3,4].

The use of antibiotic locks has been described for both the prevention and treatment of CRI in children [1,3]. Although antibiotic lock therapy is currently recommended by the IDSA for CRI treatment, concern exists for the development of resistant organisms while antibiotic lock therapy is being used [1]. In addition, heparin must be added to an antibiotic lock solution to maintain catheter patency. Recently, the use of a 70% ethanol lock has been described for CRI treatment in children and adults [4-7].

When instilled into a CVC at a concentration between 40% and 100%, ethanol has been shown to be rapidly bactericidal and fungicidal in vitro, with no concern for development of resistant organisms [6]. In addition, ethanol exhibits thrombolytic effects, eliminating the need for heparin to maintain catheter patency. The use of an ethanol lock has been shown to effectively treat CRIs in a series of pediatric patients with silicone catheters [4,5]; however, the use of ethanol locks has not been described for CRI prevention in children. We retrospectively reviewed the charts of 10 children with SBS who, over a 3-year period, received cycled PN at home and a 70% ethanol lock daily during the "cycled off" period for at least a portion of the duration of the need for central venous access.

1. Patients and methods

After institutional review board approval, the medical records of children with SBS receiving cycled PN at home via a tunneled silicone CVC and a daily 70% ethanol lock during their "cycled off" period were reviewed. Other CVCs such as percutanously placed CVCs and implanted ports were excluded from ethanol lock use because the safety of ethanol instillation into these catheters has not been demonstrated. Our ethanol lock technique consisted of instillation of 0.5 to 2 mL, predominantly 1 mL, of 70% ethanol while the patient was cycled-off PN. At the end of the dwell period which varied depending on the cycling schedule, the ethanol lock was flushed through the catheter before beginning the PN infusion.

The following information was collected: patient age at the time of the first CVC placement and the beginning of ethanol lock therapy, blood and catheter culture results before and after initiation of ethanol lock therapy, causes for CVC removal including CRIs, catheter dislodgement or malfunction, or elective removal, and adverse events. After consultation with a statistician regarding appropriateness of statistical analysis in this small sample size, no statistical evaluation was done.

2. Results

Ten children (average age at the time of the first silicone CVC placement, 3.6 months; range, 1.75-8 months) received ethanol lock therapy beginning at an average age of 7.55 months (range, 3-27 months) for 4 to 14 hours daily for a total of 3021 catheter-days during a 36-month period. For 5 children, pre- and postethanol lock therapy data were available; for the remaining 5, ethanol lock therapy was initiated immediately after first CVC placement so no pre-ethanol data were available. Table 1 summarizes the CRI data for all 10 patients. More detail is provided for the 5 patients with pre- and postethanol data.

Patient 1, a girl with SBS after bowel resection for necrotizing enterocolitis, received her first silicone CVC at

Table 1 Summary of CRI data before and after ethanol lock therapy use

Patient	Pre-EtOH CVC (d)	Post-EtOH CVC (d)	Age EtOH lock therapy started (mo)	CRIs		Causative organisms
				Pre-EtOH	Post-EtOH	
1	177	227	11.5	3	0	MSSA; *C parapsilosis*; CONS
2	182	211	27	2	0	*K pneumoniae*; *E coli*
3	72	667	4	0	1	*Enterococcus*
4	61	741	4	1	3	CONS; *Enterobacter*; *Enterococcus*; *C parapsilosis*
5	46	91	6.25	0	0	NA
6	NA	115	3.5	NA	0	NA
7	NA	323	3	NA	1	MSSA
8	NA	208	4.25	NA	0	NA
9	NA	326	9	NA	1	*K pneumoniae*
10	NA	109	3	NA	0	NA
Total	538	3018	Mean, 7.55	6 [a]	6 [b]	

CONS indicates coagulase-negative *Staphylococcus*; EtOH, ethanol lock; MSSA, methicillin-sensitive *Staphylococcus aureus*; NA, not applicable.

[a] 11.15 CRIs per 1000 catheter-days.

[b] 2.07 CRIs per 1000 catheter-days.