Antimicrobial central venous catheters in adults: a systematic review and meta-analysis

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CRD summary
This review assessed the efficacy of antimicrobial central venous catheters in adults, concluding that chlorhexidine-silver sulfadiazine or minocycline-rifampicin central venous catheters can be considered when the baseline incidence of catheter-related bloodstream infections is above institutional goals. The authors’ conclusions reflect the limitations of the evidence and are likely to be reliable.

Authors’ objectives
To assess the efficacy of antimicrobial central venous catheters in adults.

Searching
MEDLINE, EMBASE, CINAHL and the Cochrane Library were searched to April 2008. Search terms were reported. The reference lists of included papers were also manually searched to identify additional articles. Additionally, data from abstracts, conference proceedings and correspondence were included. The manufacturers of antimicrobial central venous catheters were contacted to locate any additional studies. There was no restriction based on language.

Study selection
Randomised controlled trials (RCTs) in adults that compared commercially available antimicrobial central venous catheters with standard non-surface modified polyurethane or silicone central venous catheters were eligible for inclusion. RCTs comparing various commercially available antimicrobial central venous catheters were included in a separate analysis. Included studies were in differing patient groups and compared different types of antimicrobial central venous catheters, including first and second generation coated with chlorhexidine-silver sulfadiazine, silver alloy, minocycline-rifampicin, silver iontophoretic and benzalkonium chloride. Outcomes included either catheter colonisation or catheter-related bloodstream infections or both.

Two reviewers independently selected studies for the review.

Assessment of study quality
Study validity was assessed using the criteria of allocation concealment, blinding of patients, percentage of withdrawals and drop-outs and use of intention-to-treat analysis.

Two reviewers, blinded to information, independently assessed the quality of the included studies. Any disagreements were resolved by discussion.

Data extraction
Data on numbers of participants and events by treatment group were extracted, with rate of central venous catheter colonisation and catheter-related bloodstream infections analysed separately, in order to calculate Peto odds ratios (ORs) and 95% confidence intervals (CIs).

Two reviewers independently extracted the data with disagreements resolved by discussion.

Methods of synthesis
The ORs were pooled using both fixed-effect (Peto) and random-effects (DerSimonian and Laird) models, with the fixed-effects model used unless substantial heterogeneity was present. The number-needed-to-treat (NNT) was calculated for each study that assessed the effect of antimicrobial central venous catheters on rates of catheter-related bloodstream infection (versus standard central venous catheters). Heterogeneity was assessed using Cochran's Q test and the I² statistic; substantial heterogeneity was not defined. In central venous catheter groups in which ten or more studies were included, the association between the mean antimicrobial central venous catheter indwell duration and estimated
effect size for central venous catheter colonisation or catheter-related bloodstream infections was investigated. A sensitivity analysis was conducted for catheter-related bloodstream infections, omitting variables without particular quality features. Asymmetry tests and funnel plots were used to test for publication bias.

**Results of the review**

A total of 34 randomised controlled trials (RCTs) were included (n=10,450 central venous catheters, range 50-777). The included trials were generally of poor quality, with allocation concealment described in eight trials, five trials were double blinded and three trials provided an intention-to-treat analysis.

Statistically significantly better outcomes were reported when comparing antimicrobial central venous catheters with standard central venous catheters for central venous catheter colonisation (OR 0.54, 95% CI: 0.43, 0.67, 29 trials) and for catheter-related bloodstream infections (OR 0.58, 95% CI: 0.45, 0.75, NNT 77, 28 trials).

Reduced colonisations with antimicrobial central venous catheters compared with standard central venous catheters for first-generation chlorhexidine-silver sulfadiazine were reported (OR 0.51, 95% CI: 0.42, 0.61, 13 trials). First generation chlorhexidine-silver sulfadiazine central venous catheters also reduced catheter-related bloodstream infections (OR 0.68, 95% CI: 0.47, 0.98, NNT 72). Second generation chlorhexidine-silver sulfadiazine central venous catheters (three trials) reduced central venous catheter colonisation (OR 0.39, 95% CI: 0.25, 0.60) but not catheter-related bloodstream infections.

Four trials assessed colonisation associated with minocycline-rifampicin central venous catheters with a reduction in colonisations compared with standard central venous catheters (OR 0.39, 95% CI: 0.27, 0.55). Five trials assessed the catheter-related bloodstream infection outcome (OR 0.29, 95% CI: 0.16, 0.52, NNT 21), showing reduced catheter-related bloodstream infection incidence with antimicrobial central venous catheters compared with standard central venous catheters.

Under sensitivity analysis, minor increases in effectiveness for catheter-related bloodstream infections were reported where trials were excluded that: allowed the use of more than one study central venous catheters per patient; allowed guide wire exchange; did not report the requirements of clinical symptoms; and drop-outs were greater than 15% or were not reported. Significant publication bias was not detected.

**Authors’ conclusions**

Chlorhexidine-silver sulfadiazine or minocycline-rifampicin central venous catheters can be considered when the baseline incidence of catheter-related bloodstream infections is above institutional goals, despite full implementation of infection prevention interventions. No recommendations can be attached to the other central venous catheters.

**CRD commentary**

This review addressed a clear question and undertook a thorough search for studies with no language restrictions. No evidence of publication bias was detected. Appropriate methods were used to minimise reviewer error and bias during the review process. Only RCTs were included and the validity of the included trials was assessed with many found to be of poor quality. Exclusion of lower quality trials resulted in minor differences in effectiveness estimates, though trends associated with the use of antimicrobial central venous catheters were still apparent. Suitable methods were used for the meta-analysis and heterogeneity was assessed. The review was generally well conducted and clearly reported. The authors’ conclusions reflect the limitations of the evidence and are likely to be reliable.

**Implications of the review for practice and research**

Practice: The authors stated that chlorhexidine-silver sulfadiazine or minocycline-rifampicin central venous catheters can be considered when the baseline incidence of catheter-related bloodstream infection is above institutional goals.

Research: The authors stated that further clinical trials of benzalkonium chloride central venous catheters and rifampicin-miconazole central venous catheters are required, as well as close monitoring for the development of resistance.
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