Efficacy of antiseptic-impregnated central venous catheters in preventing catheter-related bloodstream infection: a meta-analysis

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Authors' objectives
To assess the efficacy of antiseptic-impregnated central venous catheters in preventing catheter-related bloodstream infection (CR-BSI).

Searching
The authors searched the MEDLINE electronic database (January 1966 to January 1998) for studies in any language using the keywords 'chlorhexidine', 'antiseptic', and 'catheter'. The authors also scanned the reference lists of identified articles and review articles, and queried principal investigators and the catheter manufacturer.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) comparing chlorhexidine-silver sulfadiazine-impregnated central venous catheters (treatment group) with non-impregnated catheters (control group). Quasi-randomised studies were also included.

Specific interventions included in the review
Central venous catheters (triple-, double-, and single-lumen catheters) impregnated with chlorhexidine-silver sulfadiazine antiseptic combinations, compared with non-impregnated catheters.

Participants included in the review
Results were catheter-based rather than patient-based (as one patient could receive more than one catheter). About one-third of catheters were from patients in the ICU, the remainder were from various hospital settings.

Outcomes assessed in the review
Catheter colonisation confirmed by semi-quantitative or quantitative catheter culture techniques and catheter-related bloodstream infection confirmed by isolation of the same organism from blood and catheter cultures of a patient using semi-quantitative or quantitative catheter culture techniques with or without accompanying clinical symptoms of bloodstream infection or evidence of other sources of infection.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were assessed for the review, or how many of the reviewers performed the selection.

Assessment of study quality
The authors assessed the methodological components: appropriateness of randomisation, extent of blinding, and description of eligible subjects. Two authors independently assessed the methodological components of each of the selected studies. Any discrepancies between the abstractors were resolved by a third author.

Data extraction
Two authors independently abstracted information from each of the selected studies. One abstractor was blinded to author, journal, title, year, study site and source of support of the publication. Any discrepancies between the abstractors were resolved by a third author.

Data were extracted for sample size, patient population, type of catheters used, catheterization site, use of catheter exchange with guide wire, concurrent interventions, catheter colonisation and CR-BSI definitions, catheter colonisation and CR-BSI incidence in treatment and control groups, duration of catheterization, and reports of adverse effects.
Methods of synthesis

How were the studies combined?
The pooled odds ratio (OR) with 95% confidence interval (CI) and p value was calculated using the Mantel-Haenszel fixed-effect model.

How were differences between studies investigated?
Tests for heterogeneity were performed using the Woolf method (see Rothman, in Other Publications of Related Interest no.1).

Tests for publication bias was investigated using tests for association between effect size and study size.

Sensitivity analyses were conducted to explore the effect of using different definitions of CR-BSI. A sensitivity analysis was performed to investigate within-patient correlation arising from using the patient as the unit of randomisation (because some patients used more than one catheter).

Sensitivity analyses were also conducted to investigate the effect of excluding studies with quasi-randomised design and studies that did not use only triple-lumen catheters, as well as to investigate any sources of heterogeneity.

Results of the review

Thirteen RCTs met the inclusion criteria, of which 12 RCTs (with 2,611 catheters) met the inclusion criteria for the outcome of catheter colonisation and 11 studies (with 2,603 catheters) met the inclusion criteria for the outcome of catheter-related bloodstream infection.

The pooled OR for catheter colonisation was 0.44, 95% CI: 0.36, 0.54; p < 0.001, indicating a statistically significant decrease in catheter colonisation associated with impregnated catheters. The test for heterogeneity of treatment effect was statistically significant (p = 0.005). There was some evidence of publication bias because the smaller trials tended to show a greater reduction in the odds of catheter colonisation. There was no obvious trend in the study ORs with duration of catheterisation.

The pooled OR for catheter-related bloodstream infection was 0.56, 95% CI: 0.37, 0.84; p = 0.005, indicating a statistically significant decrease in catheter-related bloodstream infection associated with impregnated catheters. The test for heterogeneity of treatment effect was not statistically significant (p = 0.81). There was no evidence of publication bias. There was no clear relationship between the mean duration of catheterisation and the study ORs. None of the sensitivity analyses had significant effects on the summary results.

No adverse effects were reported in any of the trials or have been reported to date in patients in the United States although there have been reports of immediate hypersensitivity reactions to chlorhexidine-silver sulfadiazine-impregnated central venous catheters in Japan, including 1 potentially associated death.

Authors’ conclusions

The authors state that central venous catheters impregnated with a combination of chlorhexidine and silver sulfadiazine appear to be effective in reducing the incidence of both catheter colonisation and catheter-related bloodstream infection in patients at high-risk for catheter-related infections.

CRD commentary

The authors have clearly stated their research question and their inclusion and exclusion criteria. The literature search is good but the authors may have missed studies published outside the United States by focusing the search on only the MEDLINE database.

The quality of the included studies was assessed and the authors have reported on how the articles were selected, and how many of the reviewers were involved in the data selection and extraction.
The data extraction is reported in tables and text. Given the event rate, it may have been more appropriate to use relative risk (RR) calculations rather than the OR calculation. There were tests for heterogeneity and further sub-group and sensitivity analyses were performed to assess the effects of the heterogeneity on the results. The authors conclusions appear to follow from the results but should be viewed with caution because of the methodological limitations stated above.

Implications of the review for practice and research
Practice: The authors suggest that the decision to use these catheters should be made based on considerations of the baseline risk of CR-BSI in specific patient populations, potential reductions in morbidity and mortality, economic costs, and the risk of adverse events.

Research: The authors suggest that a large multicentre clinical trial may be warranted to confirm the results of this review which would require a study size of 2,115 catheters in both treatment and control groups to have 90% power to detect a reduction in incidence of CR-BSI from 5% to 3%. Further research is also needed to investigate the efficacy of antiseptic-impregnated catheters in other patient populations and catheter types such as peripheral venous catheters and tunnelled catheters, which are at lower risk for catheter-related infections. Further investigation is required to evaluate the risk of hypersensitivity reactions to these catheters.

Bibliographic details

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Other publications of related interest
   This additional published commentary may also be of interest. Kruse JA. Review: central venous catheters coated with chlorhexidine and silver sulfadiazine reduce bloodstream infections. ACP J Club 1999;131:15.

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.