Chlorhexidine compared with povidone-iodine solution for vascular catheter-site care: a meta-analysis

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Authors' objectives
To evaluate the efficacy of skin disinfection with chlorhexidine gluconate, compared with povidone-iodine solution, in preventing vascular catheter-related bloodstream infection.

Searching
MEDLINE (1966 to 2001), CINAHL (1982 to 2001), Doctoral Dissertation Abstracts (1861 to 2001), International Pharmaceutical Abstracts (1970 to 2001), EMBASE, LexisNexis, ISI Web of Sciences and the Cochrane Library (dates not specified) were searched. The MeSH terms 'chlorhexidine' and 'catheterization' and the exploded keywords 'chlorhexidine' and 'catheter' were used for the searches. No language restrictions were applied. Index Medicus was searched manually for 1960 to 1965 and the reference lists of the retrieved articles were examined for further relevant articles. Studies presented at recent scientific meetings in the area of infection control were also identified. The reviewers also contacted the manufacturer of chlorhexidine gluconate solution, the corresponding authors of relevant studies, and experts in the field to inquire about possible additional studies.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were included in the review.

Specific interventions included in the review
Studies that compared chlorhexidine gluconate solutions with povidone-iodine solution were eligible for inclusion. The included studies used several formulations of chlorhexidine gluconate: alcoholic solutions (5 studies) and aqueous solutions (3 studies). All studies used a 10% povidone-iodine solution for the control group; however, only one specified the sequence of applications of 70% alcohol and 10% povidone-iodine. Five studies specified their procedures for catheter site care, with the dressing being changed and the insertion site cleansed every 48 to 72 hours. Sterile gauze was used for dressing in 3 studies, whilst one study used semiocclusive dressing and another study opaque and transparent dressings. Four of the studies specified that antibiotic ointments were not used; 3 studies specifically indicated that no antimicrobial-impregnated catheters were allowed.

Participants included in the review
Patients with a vascular catheter where eligible for inclusion. The types of catheter included central venous, peripheral venous, peripheral arterial, pulmonary arterial, peripherally inserted central venous, introducer sheaths and haemodialysis catheters.

Outcomes assessed in the review
The primary outcome was catheter-related bloodstream infection, which was defined as the isolation of the same organism from a peripheral blood culture and a semi-quantitative or quantitative culture of a catheter segment. The secondary outcome was catheter colonisation, which was defined as the significant growth of micro-organisms from a catheter segment, according to quantitative (greater than 1,000 colony-forming units (CFU) per mL) or semi-quantitative (greater than 15 CFU) culture techniques.

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

Assessment of study quality
Studies were evaluated on the basis of randomisation procedure, extent of blinding and the description of eligible participants. The authors of studies that did not contain sufficient data were contacted for additional information.
reviewers independently assessed the validity of the studies. The authors did not state how any discrepancies were resolved.

Data extraction
Two independent reviewers extracted the data using a standardised data form. The authors did not state how any discrepancies were resolved. Data were extracted on: study sample size, patient population, type of vascular catheter, type of antiseptic, anatomic site of insertion, use of catheter exchange with guide wire, concurrent use of other interventions, and the incidence of catheter colonisation and catheter-related blood stream infection.

Methods of synthesis
How were the studies combined?
The incidences of catheter colonisation and catheter-related bloodstream infection were analysed separately. The summary risk ratios (RR) and 95% confidence interval (CI) were calculated using the random-effects model of DerSimonian and Laird (see Other Publications of Related Interest no.1). As some studies allowed patients to receive more than one vascular catheter during the study period, the variance of the RR for each study was inflated by multiplying it by the average number of catheters per patient to investigate within-patient correlation (see Other Publications of Related Interest no.2).

Publication bias was explored using funnel plots.

How were differences between studies investigated?
A statistical test of heterogeneity was performed using the Mantel-Haenszel method. Sensitivity analyses were performed according to study characteristics, participants, types of catheters used, outcome definitions, and concentrations of antiseptics used.

Results of the review
Eight RCTs involving 4,143 catheters in 3,404 participants (1,589 in the chlorhexidine gluconate group and 1,815 in the povidone-iodine group) were included. In one trial the number of patients was not available.

The RR of catheter colonisation and catheter-related bloodstream infection was significantly lower with chlorhexidine gluconate than with povidone-iodine. The summary RR was 0.49 (95% CI: 0.31, 0.71) for catheter colonisation and 0.49 (95% CI: 0.28, 0.88) for catheter-related bloodstream infection.

The absolute risk reduction was 7.1% for colonisation and 1.1% for catheter-related blood-stream infection.

The test for heterogeneity was significant for catheter colonisation (P<0.001), but not for catheter-related bloodstream infection (P>0.2). The sensitivity analysis indicated that one trial was the predominant source of heterogeneity. In that study the mean duration of catheterisation was longer in the chlorhexidine gluconate group. When that study was excluded from the analysis heterogeneity was no longer statistically significant. Analysis of the other 7 studies produced a summary RR for catheter colonisation of 0.43 (95% CI: 0.33, 0.55). There was no evidence of publication bias.

Cost information
The authors stated that, although chlorhexidine gluconate is approximately twice as expensive as povidone-iodine, the absolute difference is relatively small (approximately $0.92 versus $0.41 for a quantity sufficient to prepare an insertion site for a central venous catheter). They also stated that despite the meta-analysis suggesting the use of chlorhexidine gluconate is likely to be cost-effective, or even cost-saving, a formal economic analysis is needed.

Authors’ conclusions
The incidence of bloodstream infections is significantly reduced in patients with central vascular lines who receive chlorhexidine gluconate versus povidone-iodine for insertion-site skin disinfection.
CRD commentary
This was a well-conducted review in which the review methodology was clearly reported in the paper. The authors addressed a clear review question with the types of interventions, outcome measures and study designs being clearly defined. The literature search was thorough and without any language restrictions. However, it was not stated how decisions on the relevance of primary studies were made, and it is therefore not possible to comment on whether bias and errors may have been present in this process. The authors systematically assessed the validity of the included studies, allowing any differences in results to be examined by recourse to study quality. The data extraction was undertaken independently by two reviewers to minimise errors and bias.

The authors provided adequate details of the included studies for the reader to judge the content. The statistical analysis was appropriate and heterogeneity was investigated; the authors also looked for publication bias. Overall, many steps were taken to minimise bias in the review process. The authors’ conclusions appear to be a fair reflection of the primary research reviewed.

Implications of the review for practice and research
Practice: The authors stated that chlorhexidine gluconate should be used for vascular site catheter care in preference to povidone-iodine. Clinicians should also be alert to potential side-effects.

Research: The authors did not state any implications for further research. However, a formal economic analysis is needed.

Bibliographic details

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Other publications of related interest

This additional published commentary may also be of interest. Krau SD. Review: chlorhexidine gluconate is more effective than povidone-iodine for preventing vascular catheter related bloodstream infection. Evid Based Nurs 2003;6:18.

Indexing Status
Subject indexing assigned by NLM

MeSH
Aged; Anti-Infective Agents, Local /therapeutic use; Catheterization, Central Venous /adverse effects; Chlorhexidine /analog & derivatives /therapeutic use; Disinfectants /therapeutic use; Humans; Middle Aged; Povidone-Iodine /therapeutic use; Randomized Controlled Trials as Topic; Risk Factors; Sensitivity and Specificity; Sepsis /prevention & control; Solutions

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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.