Efficacy of prophylactic antibiotics against meningitis after craniotomy: a meta-analysis

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CRD summary
This review found that the administration of prophylactic antibiotics prior to craniotomy can lead to clinically significant reductions in post-operative meningitis. These conclusions are likely to be reliable but should be interpreted with some degree of caution because of shortcomings in the reporting and review methodology.

Authors' objectives
To determine the effectiveness of antibiotics in preventing postcraniotomy meningitis.

Searching
MEDLINE and the Cochrane CENTRAL Register were searched from inception to March 2006. No language restrictions were applied. In addition, a citation search was performed and retrieved articles, textbook chapters and review articles were screened for additional relevant studies.

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

Specific interventions included in the review
Studies that assessed prophylactic antibiotics were eligible for inclusion. The specific antibiotics assessed in the included studies were clindamycin, vancomycin, piperacillin, cloxacillin, oxacillin and cefotiam. No details of the control interventions were provided.

Participants included in the review
Studies of patients undergoing craniotomies were eligible for inclusion. No further details of the patients in the included studies were provided.

Outcomes assessed in the review
Studies that provided data on meningitis reported as a specific end point were eligible for inclusion. The definition of meningitis varied in the included studies.

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

Assessment of study quality
The author did not state how the validity assessment was performed. Blinding status was reported.

Data extraction
The author did not state how many reviewers performed the data extraction.

Definitions of meningitis reported by the included studies were used. Where possible, craniotomies that included implantation of craniospinal fluid shunts, Ommaya reservoirs or cranioplasties were excluded from the analysis, as were transsphenoidal operations. Data were extracted on a per-patient basis if possible, but some studies included data on multiple operations for some patients and in some cases it was only possible to extract data on a per-operation basis. Data were extracted as odds ratios (ORs) and 95% confidence intervals (CIs) for the treatment effect of prophylactic antibiotics on meningitis.

Methods of synthesis
How were the studies combined?
The DerSimonian and Laird random-effects model was used to calculate summary ORs. Publication bias was assessed using funnel plots.

How were differences between studies investigated? Heterogeneity was assessed using the Q and I-squared statistics. The following sensitivity analyses were conducted: single versus double-blinded studies; antibiotics with versus without significant Gram-negative coverage; and effects of different definitions of meningitis.

Results of the review
Six trials (n=1,729) were included.

Two trials were single-blinded and four were double-blinded.

The pooled OR was 0.43 (95% CI: 0.20, 0.92, p=0.03), suggesting that prophylactic antibiotics reduce the risk of meningitis following craniotomy. There was no evidence of heterogeneity (p=0.6; I-squared 0%). None of the sensitivity analyses showed significant differences for the single- versus double-blind trials or Gram-negative coverage subgroups. The specific definition of post-operative meningitis showed modest changes in the effect size.

There was some suggestion of publication bias based on the funnel plots, but as only six trials were included the ability of the funnel plot to detect publication bias is low.

Authors' conclusions
The administration of prophylactic antibiotics prior to craniotomy results in clinically and statistically significant reductions in the risk of post-operative meningitis.

CRD commentary
The review addressed a focused question that was supported by clearly defined inclusion criteria. The literature search was adequate but, since no specific attempts were made to locate unpublished studies, publication bias remains a possibility. Details of the review process were not reported, so it is not possible to determine whether appropriate steps were taken to minimise bias. A formal quality assessment was not undertaken and the only quality-related feature discussed was blinding. The reliability of the findings of the primary studies therefore remains unclear, although given that all included studies were RCTs and either single- or double-blinded this is less problematic than it would be for less reliable study designs. There was very little information, such as control interventions and participant details, on the included studies. Appropriate methods were used to pool study results and the results were clearly presented. Overall, the author's conclusions are likely to be reliable but should be interpreted with some degree of caution given the aforementioned shortcomings.

Implications of the review for practice and research
Practice: The author did not state any implications for practice.

Research: The author stated that future research in this area should use a rigorous definition of post-operative bacterial meningitis. In addition, administering antibiotics directly into the cerebrospinal fluid (CSF) during operation, or reducing the rate of post-operative CSF leak, should be further investigated. Techniques of obtaining watertight skin closures or dural sealant techniques are likely to make larger contributions to eliminating postcraniotomy meningitis than research on systemically administered antibiotics.

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