Comparison of posterior fossa decompression with and without duraplasty for the surgical treatment of Chiari malformation Type I in pediatric patients: a meta-analysis

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CRD summary
The authors concluded that for children with Chiari malformation type one, posterior fossa decompression with duraplasty had a lower risk of re-operation but higher risk of postoperative cerebrospinal fluid-related complications than posterior fossa decompression alone. The data presented did not support these conclusions due to strong confounding associated with baseline differences between the surgical groups in the primary studies.

Authors’ objectives
To compare the effectiveness of posterior fossa decompression with duraplasty versus posterior fossa decompression for children with Chiari malformation type one (CM-1).

Searching
MEDLINE and The Cochrane Library were searched in October 2007 for studies published since 1993. Search terms were reported. The ClinicalTrials.gov website was searched, as was the Internet using tools such as Google Scholar. The reference lists of articles retrieved and the 2000 to 2007 conference proceedings of the Joint Section on Pediatrics of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons were handsearched.

Study selection
Studies comparing posterior fossa decompression with duraplasty with posterior fossa decompression for treating CM-1 in patients younger than 18 years were eligible, provided that they were conducted among similar patients within the same surgical series. Studies of more invasive intradural techniques were excluded.

Patients in the included studies were aged from six months to 18 years. Approximately half were female (where reported). Syringomyelia was present in approximately 38 per cent of posterior fossa decompression with duraplasty and 18 per cent of posterior fossa decompression patients. The type of surgery performed was in most cases determined by intraoperative ultrasonography. Primary outcomes reported in the review were need for re-operation, postoperative clinical improvement and improvement in syringomyelia (decrease in size of syrinx). Secondary outcomes were surgical complications. Follow up, where reported, ranged from two to 120 months (mean approximately two years). All studies were of cohort design and were set in tertiary centres.

Studies were selected for inclusion by two reviewers working independently, with disagreements resolved by discussion.

Assessment of study quality
Study validity was assessed using the Newcastle-Ottawa scale for cohort studies, which awards points for criteria associated with participant selection, group comparability and outcome ascertainment. Studies scoring less than 5 points (of a possible 9) were considered low quality. Validity assessment was conducted by two reviewers working independently, with disagreements resolved by discussion.

Data extraction
Risk ratios (RRs) were calculated from the number of events in the two groups in each study, with 95% confidence intervals (CIs). Intention to treat analysis was used when possible. Data were extracted by two reviewers working independently, with disagreements resolved by discussion. Study authors were contacted for more information if required.

Methods of synthesis
Where possible, data were combined to calculate pooled RRs and 95% CIs using a fixed-effect model. Heterogeneity was assessed using the X² test. Publication bias was assessed (for the outcome of re-operation) using a funnel plot. Sensitivity analysis was conducted by study quality. Subgroup analyses by age, sex and presenting symptoms were
planned.

Results of the review
Seven cohort studies (n=582) were included in the review: two prospective (n=154); and five retrospective (n=428). Quality scores ranged from 4 to 8 points (out of 9). Group comparability was poor: four studies addressed confounding variables, but only one performed formal statistical adjustment. Only one study reported consecutive enrolment. In most cases outcome ascertainment was poorly described. No studies reported completeness of follow up or blinded outcomes assessment.

Posterior fossa decompression with duraplasty versus posterior fossa decompression:

Clinical outcomes
Pooling of studies showed a significantly lower rate of re-operation in the posterior fossa decompression with duraplasty group (RR 0.23, 95% CI: 0.08, 0.69, p=0.01, five studies). However, no statistically significant difference between the groups was found in rates of clinical improvement (four studies) or postoperative decrease in syringomyelia (five studies).

Surgical complications
Pooling of studies showed a significantly higher rate of postoperative cerebrospinal fluid-related complications in the posterior fossa decompression with duraplasty group (RR 7.64, 95% CI: 2.53, 23.09, p=0.0003, four studies). However, no statistically significant difference between the groups was found in rates of wound infection, occipital neuralgia or bleeding complications (four studies each).

Sensitivity analyses omitting low quality studies did not change the significance of any analysis. Significant heterogeneity was not detected for any analysis. The funnel plot did not suggest publication bias. There were insufficient data to perform subgroup analyses.

Authors’ conclusions
For children with Chiari malformation type one, posterior fossa decompression with duraplasty had a lower risk of re-operation but higher risk of postoperative cerebrospinal fluid-related complications than posterior fossa decompression alone.

CRD commentary
The objective of the review was clearly stated and the inclusion criteria appeared appropriate. However, the inclusion criterion for patient similarity was not implemented rigorously. Parts of the text suggested a different objective incompatible with the inclusion criteria (that is, to identify which patients might most benefit from posterior fossa decompression). Relevant sources were searched for studies without restriction by language or publication status. Steps were taken to minimise the risk of error and bias in the review by having two reviewers independently select studies, assess study validity and extract data. Suitable statistical methods appeared to be used to pool studies and assess for heterogeneity and publication bias. However, the review findings were confounded totally by selection bias, as in most studies posterior fossa decompression was apparently reserved for children with favourable signs on intraoperative ultrasonography. Although the authors acknowledged the problem of selection bias in the text, it was not reflected in their conclusions. The data presented did not, therefore, support the conclusions due to the strong confounding associated with baseline differences between the surgical groups in the primary studies.

Implications of the review for practice and research
Practice: The authors stated that it was unclear which children with CM-1 would benefit most from posterior fossa decompression rather than posterior fossa decompression with duraplasty.

Research: The authors stated that a randomised controlled trial should be conducted comparing posterior fossa decompression with posterior fossa decompression with duraplasty. It should have sufficient power to permit investigation of the effects of patient age, sex, presenting neurological symptoms, presence of syringomyelia and other anatomical factors, surgical technique and type of outcome assessment.
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