Extracranial-intracranial bypass to reduce the risk of ischemic stroke in intracranial aneurysms of the anterior cerebral circulation: a systematic review

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CRD summary
This review concluded that neurological function and subsequent stroke in patients with otherwise untreatable intracranial aneurysms improved significantly with extracranial-intracranial bypass surgery if the brain area with impaired neurological function remained viable. The author's conclusions may not be reliable given the poorly described review methods, risk of missing data and methodological limitations of the included trials.

Authors' objectives
To evaluate the clinical effectiveness of extracranial-intracranial bypass for cerebral revascularisation in patients with Hunterian ligation and an otherwise untreatable aneurysm of the anterior cerebral circulation.

Searching
MEDLINE was searched for trials published in English, French or German from November 1985 to November 2002. Search terms were reported. Reference lists of retrieved articles were searched for further studies.

Study selection
Randomised controlled trials (RCT), controlled trials, and case-series (of four or more patients) that evaluated extracranial-intracranial bypass for revascularisation in patients with Hunterian ligation and an otherwise untreatable aneurysm of the anterior cerebral circulation were eligible for inclusion in the review. Aneurysms had to be neuroradiologically documented by intra-arterial and/or computed tomography (CT)/magnetic resonance angiography (MRI) with clinical evidence of transient ischaemic attack. Eligible studies had to report data on the symptoms of occlusive cerebrovascular disease in the carotid territory. Studies were excluded if they had patients with: cerebral ischaemic episodes that affected more than one vascular territory; or large/multiple areas of hypodensity on a CT scan or MRI that caused disabling hemispheric stroke (modified Rankin scale score of more than 3).

Included outcomes were mortality, disability, stroke, haemodynamic parameters, balloon occlusion test, graft failure, modified Rankin scale score (neurological and radiological) and complications.

The mean age of participants in the included studies was 59 years (range 18 to 82); their preoperative mean neurological state score ranged from 1.0 to 2.0, where reported. Most patients had aneurysms of the internal carotid artery (C3: 18%; C4-5: 45%; C6: 2%; C7: 2%); the remainder had aneurysms in the middle cerebral artery (12%) or anterior communicating artery (2%), although the location could not be specifically determined in 19% of patients. The size of the aneurysm was reported in just under half of the included studies; the size was described as 'giant' in 42% of patients, 'large' in 5%, and 'small' in 2% of patients. Most of the patients (79%) had either minimal or no functional impairment, but 21% had some form of abnormality upon neurological examination.

The author did not state how papers were selected for the review.

Assessment of study quality
The quality of the included controlled trials was assessed using the Jadad criteria (randomisation, blinding, and withdrawals/drop-outs). Each trial was awarded a score out of a maximum of 5 points. The quality of cohort studies was assessed according to the following eight criteria: clear definition of the study cohort; early inception point; clear pathway of patient entry; complete follow-up; description of drop-outs; objective outcome criteria; blinded outcome assessment; and adjustment for extraneous factors.

The author did not state how many reviewers performed the validity assessment.
Data extraction
Data were extracted by more than one reviewer (total number not reported) and discrepancies were resolved through discussion. The number and percentage of patients in each treatment group experiencing dichotomous outcomes were extracted.

Methods of synthesis
Studies were grouped by outcome and differences between treatment groups were compared using the $\chi^2$ test, with $P$ values less than 0.05 reported significant. Pre-planned sensitivity analyses were conducted to investigate the effects of methodological quality criteria (blinding, allocation concealment method, presence of mortality as a study end point, and crossover).

Meta-regression was used to assess the predictive accuracy of the review findings, by excluding studies for which individual data were available. The expected risk with 99% confidence intervals (CIs) at the median follow-up was calculated for each individual study and the expected and observed risks compared graphically.

Publication bias was assessed using the Egger test.

Results of the review
Twenty controlled trials ($n=408$ patients) were included in the review. The average Jadad quality score for the trials was between 0 and 1. The median sample size was 21 (range 4 to 61). The median duration of follow-up was 39 months (range 1 to 86), where reported.

The perioperative risk for death (0.8%) or stroke (1.5%) during the first month after operation did not change substantially in the following two to 12 months after surgery.

Neurological function was improved compared with the preoperative state in 74% of the patients, but was unchanged in 9%.

The postoperative modified Rankin scale score was 0 to 1 in 81% of patients and 2 in 6% of the patients.

The long-term patency of the extracranial-intracranial bypass was excellent, with only a 2.3% failure rate per year after the first year after surgery. There was no evidence of de novo aneurysm formation during the postoperative follow-up period.

Sensitivity analyses did not substantially alter the findings.

Small-trial bias assessments suggested no risk of bias.

Authors’ conclusions
Neurological function and subsequent stroke attributable to haemodynamic insufficiency in patients with otherwise untreatable intracranial aneurysm improved significantly by extracranial-intracranial bypass surgery if the brain area corresponding to the impaired neurological function remained viable. The haemodynamic parameters observed for patients who experienced improved neurological function or diminished stroke risk profile after extracranial-intracranial bypass surgery contained both significantly elevated oxygen extraction fraction and cerebral blood flow/volume.

CRD commentary
This review assessed a clearly defined review question using a broad range of eligible study designs. Searches for relevant data were limited to one database, with limitations were placed on language and publication status, which suggested that the review was at risk of both language and publication bias. Although data extraction was performed by multiple reviewers, it was unclear whether similar precautions to reduce the risk of reviewer error and bias were taken when assessing the studies for eligibility and validity.

Study quality was assessed using the Jadad score, which was appropriate for controlled trials, but the total assessment
scores suggested that the trials were of poor methodological quality, so the data may not be reliable. The trials were also quite limited in sample size. Given the differences in populations, interventions and outcomes between the trials, a narrative synthesis of the review data appeared appropriate.

The author’s findings may not be reliable due to the poorly described review methods, the risk of missing data and methodological limitations of the review data.

**Implications of the review for practice and research**
The authors did not state any implications for practice or research.

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