Treatment of intracranial aneurysms by embolization with coils: a systematic review
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Authors’ objectives
To assess the percentage of complications, the percentage of aneurysm occlusion, and the short-term outcome in the treatment of intracranial aneurysms by embolisation with controlled detachable or pushable coils.

Searching
The authors searched the MEDLINE database (1990 onwards) using the keywords 'aneurysm', 'ruptured', 'unruptured', 'therapy', 'coil', 'Guglielmi', and 'endovascular'. The reference lists of retrieved studies were also checked for additional studies, until no further studies were found. The authors also handsearched the 1996 volumes and the January through March 1997 issues of 25 neurological, neurosurgical and radiological journals, and also performed a search of the Science Citation Index using the keyword 'Guglielmi'. The search was not limited to English language studies.

Study selection
Study designs of evaluations included in the review
Studies (prospective and retrospective) including case reports.

Specific interventions included in the review
Embolisation with controlled detachable coils (Guglielmi detachable coils, mechanical detachable spirals or interlocking detachable coils) or pushable coils for intracranial aneurysms.

Participants included in the review
Patients, 18 years of age and older, with intradural saccular aneurysms treated by embolisation with controlled detachable coils or with pushable coils. Patients younger than 18, patients with fusiform, traumatic, mycotic, or dissecting aneurysms, patients with an aneurysm associated with an arteriovenous malformation, and patients with an aneurysm in the cavernous sinus were not eligible. Mean age of patients ranged from 47-56 years.

Outcomes assessed in the review
Percentage of complications (permanent complications, aneurysm perforations during embolisation, ischemic complications), the percentage of aneurysm occlusion (occluded > 90%, and completely occluded), the short-term outcome (patients with a Rankin grade 0 to 2 versus grade 3-5, patients who had died at the initial outcome assessment, and the mortality related to the procedure) and rebleeds (after embolisation).

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

Assessment of study quality
The authors do not report the method used to assess quality, or how the quality assessment was performed.

Data extraction
Two authors independently extracted the data from eligible studies using a standardised data extraction form. In case of disagreement, both observers reviewed the article in question together. Foreign language publications were extracted by a translator where necessary. data were extracted for:

1. Study design (prospective or retrospective, study period, criteria for inclusion, outcome assessor, and definition of outcome).
2. Baseline characteristics (number of patients, mean age, number of ruptured aneurysms and unruptured aneurysms, clinical condition before embolisation, time interval between subarachnoid haemorrhage (SAH) and embolisation, aneurysm location, size, and aneurysm neck size).

3. Procedure (type of coils used, number and type of complications, and degree of aneurysm occlusion).

4. Outcome (rebleeds, short-term survival, and functional outcome after embolisation and the time interval between embolisation and outcome assessment).

**Methods of synthesis**

**How were the studies combined?**

The authors calculated the percentage (with 95% confidence intervals (CIs)) of all complications of the embolisation procedure, permanent complications, aneurysm perforations during embolisation, ischemic complications, aneurysms occluded > 90%, completely occluded aneurysms, patients with a Rankin grade 0 to 2, patients who had died at the initial outcome assessment, and the mortality related to the procedure. These calculations were performed separately for patients treated with any type of controlled detachable coil, patients treated with Guglielmi detachable coils, and patients treated with pushable coils.

**How were differences between studies investigated?**

Initially, all studies were included in the analysis, then recalculations were performed after studies with less than 5 patients were excluded from the regression analyses. A further analysis was performed including only those studies that were prospective and reported on 5 or more patients treated with controlled detachable coils, in which all outcome data were available.

The authors performed a weighted linear regression analysis on those studies with 5 or more participants and quantified the relationship of aneurysm type (ruptured, unruptured symptomatic aneurysms, additional, and incidental), clinical condition before embolisation, aneurysm location, and aneurysm size with percentages of permanent complications, of aneurysms occluded > 90%, and of patients with a Rankin grade 0 to 2 at follow-up.

The authors also performed weighted linear regression analyses to quantify the relationship of Hunt and Hess grade before embolisation or time interval between SAH and embolisation on the one hand with percentage of permanent complications, degree of aneurysm occlusion, and functional outcome in the subgroup of patients with a ruptured aneurysm on the other.

**Results of the review**

Forty-eight studies met the inclusion criteria with 1,383 participants. Nine studies were non-English (6 languages). Fourteen studies (798 participants, 58%) were prospective, and 18 studies (39 participants, 3%) were retrospective. The study design was not specified for 16 studies (546 participants, 39%).

Nineteen studies had fewer than 5 patients per study. The period of follow-up was < 1 month in 9 studies (82 participants, 6%), ranged from 1.5 to 24 months in 14 studies (593 participants, 43%), and was not reported in 13 studies (95 participants, 7%).

Permanent complications of embolisation with controlled detachable coils occurred in 46 of 1,256 participants (3.7%; 95% CI: 2.7, 4.9%) and 400 of 744 aneurysms were completely occluded (54%; 95% CI: 50, 57%).

There were no statistically significant differences in percentages of permanent complications between the different patient and treatment groups. Treatment with controlled detachable coils resulted in a smaller percentage of aneurysm occlusion but better functional outcome than treatment with pushable coils.

Patients with a ruptured aneurysm had a higher percentage of aneurysm occlusion but a worse functional outcome than patients with an unruptured aneurysm.

Exclusion of studies reporting on less than 5 patients did not essentially alter the results, nor did exclusion of patients...
treated with controlled detachable coils other than Guglielmi detachable coils.

By means of weighted linear regression, no relation between baseline characteristics and outcome measurements was found. The results in the prespecified sub-groups of patients with a ruptured aneurysm, an unruptured aneurysm, or a basilar bifurcation aneurysm were essentially the same as the overall results.

In 16 patients who had presented with SAH, the aneurysm rebled after embolisation. Three patients with unruptured aneurysms had an SAH after embolisation.

**Authors' conclusions**
Short-term results indicate that embolisation with coils is a reasonably safe treatment for patients with an unruptured aneurysm and for patients with aneurysmal subarachnoid haemorrhage. The effectiveness in terms of complete occlusion of the aneurysm is moderate.

**CRD commentary**
The authors have stated their research question and inclusion/exclusion criteria and have made a good search of the literature. However it is not clear whether additional relevant data may have been missed since unpublished literature was not included in the review.

The statistical analysis is reported in detail with study characteristics summarised in table format. The authors have assessed heterogeneity using weighted linear regression calculations and found no essential differences between the pre-specified subgroups. These results are also presented in a detailed table.

There may be bias in the review because there is no information on the selection or quality assessment of the individual included studies, therefore it is unclear whether it was appropriate to combine the data.

The results follow from the data presented but, because of the possible bias mentioned above, the results of this review should be viewed with some caution.

**Implications of the review for practice and research**
Specify: The authors do not state any implications for practice.

Research: The authors state that additional RCTs are warranted to compare surgical clipping with embolisation with coils.

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