Efficacy of revascularization for renal artery stenosis caused by fibromuscular dysplasia: a systematic review and meta-analysis

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CRD summary
The authors concluded that angioplasty or surgical revascularisation yielded moderate benefits in patients with fibromuscular dysplasia renal artery stenosis with substantial variation across studies. The included studies were limited by sample size and varied considerably. Given the lack of information on the types of included studies and their quality, the reliability of the results is uncertain.

Authors' objectives
To assess the benefits and risks of renal artery revascularisation (using surgical reconstruction or percutaneous transluminal renal angioplasty) in patients with hypertension and renal artery stenosis caused by fibromuscular dysplasia.

Searching
MEDLINE and EMBASE were searched up to October 2009. There were no language restrictions. Search strategies were available online. Reference lists of relevant articles and reviews, relevant textbooks and conference proceedings from cardiovascular and radiological societies (2000 to 2008) were searched manually.

Study selection
Eligible studies included more than five patients with hypertension and renal artery stenosis caused by fibromuscular dysplasia. Patients underwent renal artery revascularisation by surgical reconstruction or percutaneous transluminal renal angioplasty. Studies had to report hypertension cure rates (defined according to each study). Secondary objectives were revascularisation success rates, risk of complications (as defined in the review), rate of hypertension cure or improvements (defined according to each study) and the effect of revascularisation on renal function. Case studies were excluded.

Included studies were multinational and published between 1973 and 2008. Study and population details were not clear in most original articles. Most studies were in adults. Reported mean ages ranged between 24 and 59 years; the mean age of children was nine years. Most participants were women. Most patients had medial fibromuscular dysplasia. Definitions for hypertension and cure rates varied across studies. Where reported, adults took an average of two antihypertensive drugs. Mean duration of hypertension was approximately seven years. Surgical techniques included surgical repair or reconstruction and bypass grafts.

Two reviewers independently screened studies for inclusion; discrepancies were resolved through consensus.

Assessment of study quality
Studies were considered at low risk of bias if recruitment was prospective and consecutive, they described the study population adequately, reported complete follow-up and had adequate outcome measurement (as defined in the review).

It was not clear how many authors assessed risks of bias.

Data extraction
Two reviewers extracted the proportion of patients who experienced each outcome.

Methods of synthesis
Freeman-Tukey arcsine transformation was used to adjust proportions to make the distribution more similar to a normal distribution. A random-effects model (DerSimonian Laird) was used to calculate weighted means and 95% confidence intervals (CIs). Statistical heterogeneity was assessed with $X^2$ and $I^2$. 
Sensitivity analysis was undertaken by removing small studies to assess the effect on blood pressure. Subgroup analyses compared patients with bilateral versus unilateral renal artery stenosis, medial versus non-medial fibromuscular dysplasia and branch versus non-branch stenosis. Meta-regression was performed to assess the influence of mean age, duration of hypertension, baseline blood pressure and duration of follow-up on the outcome.

Publication bias was assessed using funnel plots.

Results of the review
Fifty studies assessed percutaneous transluminal renal angioplasty: 47 studies of adults (1,616 participants, range five to 442) and three paediatric studies (47 patients). Twenty-five studies assessed surgery: 23 studies of adults (1,014 participants, range six to 179) and two paediatric studies (60 patients).

Five studies reported prospective recruitment, 17 reported consecutive recruitment, 21 provided details on study population and 58 reported complete patient follow-up. No other details on study type were reported.

Technical success:

The success rate for percutaneous transluminal renal angioplasty in adults was 88.2% (95% CI 83.5% to 92.2%; 27 studies) with statistical heterogeneity ($I^2=77\%$).

Complications:

For percutaneous transluminal renal angioplasty the combined rate in adults was high at 11.8% (95% CI 8.2% to 15.9%; 20 studies) but with statistical heterogeneity ($I^2=55\%$). Complication rates included 0.9% (death) and 8.3% (kidney complications).

The combined rate in adults who underwent surgery was high at 16.9% (95% CI 10.3% to 24.7%) and most were major complications. There was statistical heterogeneity ($I^2=52\%$). Sixteen of 18 studies reported no deaths; perioperative risk of death was 1.2% (95% CI 0.5% to 2.1%). Three children experienced complications.

Blood pressure outcomes:

In adults, the hypertension cure rate for percutaneous transluminal renal angioplasty was 45.7% (95% CI 39.8% to 51.7%; 47 studies) but with statistical heterogeneity ($I^2=78\%$). The combined rate for cure or improvement was 86.4% (95% CI 83.2% to 89.3%) with statistical heterogeneity ($I^2=58\%$). Cure rates in the three studies in children were high at 100%, 67% and 80%.

In adults who underwent surgery the combined cure rate was 57.5% (95% CI 53.0% to 62.0%; 23 studies) with statistical heterogeneity ($I^2=47\%$). The combined rate for cure or improvement was 88.3% (95% CI 83.2% to 92.6%) with statistical heterogeneity ($I^2=80\%$). Sensitivity analyses did not significantly alter the findings. In the two paediatric studies cure rates were 59.2% (16 of 27 children) and 87.9% (29 of 33 children).

Hypertension cure rates using different study definitions were reported in the review.

Results from subgroup analyses and meta-regression were reported in the review. There was no evidence of publication in the funnel plots.

Authors’ conclusions
Angioplasty or surgical revascularisation yielded moderate benefits in patients with fibromuscular dysplasia renal artery stenosis with substantial variation across studies.

CRD commentary
The review question and inclusion criteria were clearly stated. The literature search seemed appropriate. Study quality was assessed but was not clear for most studies. Study and population details were not clearly reported for most studies; as it was unclear what study designs were used it may not have been appropriate to pool the data. There was evidence of statistical heterogeneity for the main outcomes; appropriate methods were used to investigate potential causes.
The authors acknowledged differences in definitions, surgical methods and study populations. Included studies were also limited by sample size and unclear quality. There were very few studies in children. The reliability of the results is uncertain given the lack of information on the types of included studies and their quality and uncertainty regarding the appropriateness of the data synthesis.

**Implications of the review for practice and research**

**Practice:** The authors did not state any implications for practice.

**Research:** The authors stated a need for further well-designed prospective cohort studies using standardised outcome definitions. A RCT should be considered to compare percutaneous transluminal renal angioplasty versus medical treatment for fibromuscular dysplasia.

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