Magnetic resonance angiography for the diagnosis of renal artery stenosis: a meta-analysis

K.T. Tan, E.J.R. van Beek, P.W.G. Brown, O.M. van Delden* and L.E. Ramsay+

Section of Academic Radiology and Department of Clinical Pharmacology*, University of Sheffield, Sheffield, UK; Department of Radiology†, Academic Medical Center, Amsterdam, NL.

Renal artery stenosis (RAS) is present in 1-3% of all patients with arterial hypertension, but is important due to different management options.

Catheter arteriography (CA) is the reference method, but is invasive and uses nephrotoxic contrast agents. (1) There is therefore a need for a diagnostic method for RAS that is accurate and non-invasive.

Magnetic resonance angiography (MRA) is non-invasive, does not require ionising radiation and may use non-nephrotoxic contrast agents. Time-of-flight and phase-contrast sequences have now been replaced by contrast-enhanced 3D MRA. (2) Single breath-hold techniques have further improved the image quality. (3,4)

We performed a meta-analysis to evaluate the evidence on MRA as a diagnostic method in patients with suspected RAS, and to compare the accuracy of non-enhanced and Gadolinium-enhanced MRA techniques.

Literature search and evaluation

The English-language literature from 1985 to June 1999 was searched for studies that compared CA with MRA for the diagnosis of RAS. Criteria for inclusion were: (a) blinded comparison with CA, (b) indication for CA stated, (c) clear descriptions of imaging techniques, (d) interval between MRA and CA < 3 months and (e) full peer-reviewed articles, with abstracts or unpublished data excluded.

Statistical analysis

The diagnostic parameters were calculated, using a cut-off value of ≤ 50% versus > 50% stenosis. Total occlusion of a renal artery was analysed separately, and also included among the significant stenoses.

The sensitivity and specificity with exact 95% confidence intervals were calculated for non-enhanced and Gadolinium-enhanced MRA. Accuracy for detection of accessory arteries was assessed.

Statistical analysis was performed using Chi squared test, with p<0.05 considered statistically significant.

Results

A total of 36 studies were identified of which 8 were excluded: not blinded (3), number of arteries not stated (3), distribution or stenosis definition not stated (one each). The remaining 28 studies reported on 1141 patients with suspected RAS. MRA was contraindicated in 47 or inadequate in 10 patients. CA showed 2247 main arteries, 547 (24%) with stenoses ≥ 50%.

Non-enhanced MRA

CA showed 1233 main renal arteries in 620 patients. Non-enhanced MRA showed ≥ 50% stenosis, > 50% stenosis or occlusion in 830, 364 and 39 arteries, respectively. The sensitivity and specificity were 94% (95% CI: 91 – 96%) and 87% (95% CI: 84 – 89%), respectively. Non-enhanced MRA visualised 75 of 142 accessory arteries (53%).

Gadolinium-enhanced MRA

CA showed 1014 main renal arteries in 521 patients. Gadolinium-enhanced MRA showed ≥ 50% stenosis, > 50% stenosis or occlusion in 652, 317 and 45 arteries, respectively. The sensitivity was 96% (95% CI: 92 – 98%) and specificity was 94% (95% CI: 92 – 95%). Gadolinium-enhanced MRA detected 154 of 183 accessory arteries (84%).

Gadolinium-enhanced MRA had significantly better specificity and positive predictive value (p<0.0001) and better detection rate of accessory arteries (p<0.0001).

Discussion

Studies comparing MRA with catheter angiography are generally small, with the largest study including 103 patients. (5) As a result, none of the individual studies can define the value of MRA in the diagnosis of renal artery stenosis, which is the reason for performing this meta-analysis.

MRA appears to be an accurate diagnostic method in patients with suspected renovascular hypertension. Non-enhanced MRA has reasonable sensitivity, but tends to overestimate disease and leads to unnecessary catheter angiography. Gadolinium-enhanced MRA appears to be the technique of choice, because of its high sensitivity in depicting renal artery stenosis and its significantly higher accuracy in excluding the disease. However, the findings of this meta-analysis need to be validated in a large prospective clinical study.

References