Diagnosis and treatment of renovascular hypertension: a cost-benefit analysis


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
Different diagnostic tests for predicting a patient's clinical response to renal angioplasty were compared. The diagnostic tests evaluated were Doppler sonography, magnetic resonance (MR) angiography and captopril-enhanced renal scintigraphy.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised a hypothetical cohort of 1,000 patients referred for a diagnostic test due to suspected renal artery stenosis.

Setting
The study setting was secondary care. The economic study was undertaken in Canada.

Dates to which data relate
The effectiveness data were derived from studies published between 1996 and 2003. The price year was 2001.

Source of effectiveness data
The effectiveness data were derived from a review of published studies.

Modelling
Although not stated clearly, an analytic model was used. The model combined the outcomes from the different published studies to examine the clinical and economic impacts of each screening strategy on a hypothetical cohort of 1,000 patients with a 30% prevalence of renal artery stenosis. The time horizon was 6 months after angioplasty or stenting. The model assumed a 30% rate of angioplasty and a 70% rate of angioplasty with stenting.

Outcomes assessed in the review
The outcomes assessed were:

the diagnostic performance (i.e. sensitivity and specificity) of each screening test for detecting renal artery stenosis; and

the prediction of therapeutic response following angioplasty (i.e. positive predictive value, negative predictive value,
negative finding and positive finding).

Study designs and other criteria for inclusion in the review
Not reported.

Sources searched to identify primary studies
Not reported.

Criteria used to ensure the validity of primary studies
Not reported.

Methods used to judge relevance and validity, and for extracting data
Not reported.

Number of primary studies included
Two primary studies were included in the review. The diagnostic performance for each test was derived from a recent meta-analysis (Boudewijn et al. 2001, see Other Publications of Related Interest- below for bibliographic details). The prediction of therapeutic response was derived from a published prospective clinical study conducted by the authors (Soulez et al. 2003, see Other Publications of Related Interest- below for bibliographic details). This study, which was conducted between 1998 and 2002, included 74 patients (39 women; mean age 65 +/- 9 years) who underwent renal angioplasty and were evaluated prospectively with Doppler sonography and scintigraphy. Of these, 57 patients underwent MR angiography before angiography and renal angiography. Treatment outcomes were evaluated 3 months after angioplasty.

Methods of combining primary studies
Each primary study provided effectiveness evidence for one specific outcome.

Investigation of differences between primary studies
No differences between the primary studies were investigated.

Results of the review
The sensitivity of angiography was 100%, Doppler sonography 80.1%, MR angiography 96.4%, captopril-enhanced renal scintigraphy 80.8%, MR angiography combined with Doppler sonography 77.2%, and MR angiography compared with captopril-enhanced renal scintigraphy 77.9%.

The specificity of angiography was 100%, Doppler sonography 88.9%, MR angiography 92.2%, captopril-enhanced renal scintigraphy 78.0%, MR angiography combined with Doppler sonography 99.1%, and MR angiography compared with captopril-enhanced renal scintigraphy 98.3%.

The positive predictive value for clinical improvement was 50% with angiography, 43% with MR angiography, 58% with scintigraphy, 47% with Doppler sonography, 50% with scintigraphy and MR angiography, and 48% with Doppler sonography and MR angiography 48%.

The negative predictive value for clinical improvement was 100% with angiography, 100% with MR angiography, 50% with scintigraphy, 80% with Doppler sonography, 64% with scintigraphy and MR angiography, and 82% with Doppler sonography and MR angiography 48%.
The authors also reported the prediction of therapeutic response for strategies adding a resistive index (RI) threshold value to a positive finding on Doppler sonography as criteria for patient selection (e.g. unilateral before captopril RI <0.70 or <0.75, or bilateral before captopril RI <0.70 or <0.75). The reader is referred to the paper for more detailed results.

**Measure of benefits used in the economic analysis**

The measure of benefit used was the number of patients with a positive result on a screening test who would have improved after angioplasty. For this, the authors combined parameters of prevalence of renal artery stenosis, diagnostic performance and the positive predictive value of each screening strategy for predicting clinical improvement.

**Direct costs**

The direct costs included were those incurred by the health care system. The resources used in the economic analysis were those associated with diagnosis and treatment. For each diagnostic procedure, the costs included the use of diagnostic equipment, supplies, technician time and physician fees. For patients undergoing angioplasty, the costs of catheters, balloons, stents and hospital stay were also included in the analysis. The quantities and the costs were not reported separately. The unit costs were derived from reimbursement values published by the Ministry of Health and Social Services of Quebec. As the costs were incurred during a very short time, discounting was not relevant and was not performed. The study reported the total costs. The price year was 2001.

**Statistical analysis of costs**

The costs were treated as point estimates (i.e. the data were deterministic).

**Indirect Costs**

The indirect costs were not included.

**Currency**

Canadian dollars (CAD).

**Sensitivity analysis**

No sensitivity analyses were performed.

**Estimated benefits used in the economic analysis**

The number of patients improved (based on a hypothetical cohort of 1,000 patients) was:

150 with angiography,

124 with MR angiography,

141 with scintigraphy,

112 with Doppler sonography,

117 with scintigraphy and MR angiography, and

111 with Doppler sonography and MR angiography.

The authors also estimated the number of patients improved with different diagnostic strategies involving Doppler sonography with a RI threshold value. The number of patients improved with each of these tests was:
79 with Doppler sonography and unilateral before captopril (BC) RI <0.70,
86 with Doppler sonography and unilateral after captopril (AC) RI <0.70,
99 with Doppler sonography and unilateral BC RI <0.75,
74 with Doppler sonography and bilateral BC RI <0.70,
103 with Doppler sonography and bilateral BC RI <0.75, and
94 with Doppler sonography and renal length >90 mm.

**Cost results**
The total costs for each diagnostic test were:

angiography, CAD 2,486,985;
MR angiography, CAD 2,245,748;
scintigraphy, CAD 1,829,506;
Doppler sonography, CAD 1,414,882;
scintigraphy and MR angiography, CAD $2,487,184; and
Doppler sonography and MR angiography, CAD $2,150,784.

The authors also estimated the total costs of different diagnostic strategies involving Doppler sonography. The total costs for these tests were:

Doppler sonography and unilateral BC RI <0.70, CAD 843,507;
Doppler sonography and unilateral AC RI <0.70, CAD 930,131;
Doppler sonography and unilateral BC RI <0.75, CAD 1,045,515;
Doppler sonography and bilateral BC RI <0.70, CAD 740,164;
Doppler sonography and bilateral BC RI <0.75, CAD 1,041,246; and
Doppler sonography and renal length >90 mm, CAD 879,744.

**Synthesis of costs and benefits**
The costs and benefits were combined using an average cost-effectiveness average ratio (i.e. the cost per improved patient). The cost per improved patient was:

CAD 16,850 with angiography,

CAD 18,119 with MR angiography,

CAD 12,940 with scintigraphy,

CAD 12,579 with Doppler sonography,

CAD $21,288 with scintigraphy and MR angiography, and
CAD $19,413 with Doppler sonography and MR angiography.

The authors also estimated the average cost-effectiveness for each of the diagnostic strategies involving Doppler sonography. For these tests, the cost per improved patient was:

- for Doppler sonography and unilateral BC RI <0.70, CAD 10,641;
- for Doppler sonography and unilateral AC RI <0.70, CAD 10,820;
- for Doppler sonography and unilateral BC RI <0.75, CAD 10,522;
- for Doppler sonography and bilateral BC RI <0.70, CAD 10,045;
- for Doppler sonography and bilateral BC RI <0.75, CAD 10,149; and
- for Doppler sonography and renal length >90 mm, CAD 9,405.

**Authors' conclusions**

Doppler sonography was more cost-effective but less sensitive than magnetic resonance (MR) angiography for diagnosing patient with renovascular hypertension. MR angiography should be favoured in hypertensive patients who are resistant to medical therapy to avoid false-negative examinations.

**CRD COMMENTARY - Selection of comparators**

The authors compared numerous diagnostic tests for predicting a patient's clinical response to renal angioplasty. You should decide if the diagnostic tests evaluated in this study are current practice in your own setting.

**Validity of estimate of measure of effectiveness**

The authors did not state that a systematic review of the literature had been undertaken. They used data from the available studies selectively. The authors used results from a meta-analysis to derive diagnostic performance and a study published by the authors of the present study to determine therapeutic response. To determine the number of improved patients (i.e. health benefits), the authors used the point estimates from these studies. However, no sensitivity analysis was undertaken to determine the impact on health benefit of varying these effectiveness parameters.

**Validity of estimate of measure of benefit**

To derive the measure of benefit, the authors combined parameters of prevalence of renal artery stenosis, diagnostic performance and therapeutic response. Examples were given throughout the paper on how these parameters were combined. The measure used could be useful in this case, but it limits the comparability with other economic evaluations in other health fields.

**Validity of estimate of costs**

All the categories of cost relevant to the health system perspective adopted were included in the analysis. However, not all relevant costs were included in the analysis. For example, the authors did not include the costs of misdiagnosis (e.g. the costs of worsening of disease due to lack of early treatment). The costs and the quantities were not reported separately, which will limit the generalisability of the authors' results. The unit costs were derived from reimbursement values published by the regional ministry of health. Although fees may not represent the actual cost of the health care service being provided, as the perspective was that of the health system, the use of fees in this study is justifiable. No sensitivity analysis of the costs was undertaken, which will further limit the generalisability of the authors' results. Discounting was not relevant, as the costs were incurred during a short time, and was therefore not performed. The price year was reported, which will aid any future inflation exercises.
Other issues
The authors reported the results of one trial comparing enhanced medical treatment without imaging with MR angiography, computed tomographic (CT) angiography, and angiography in a hypothetic cohort of individuals with medication-resistant hypertension. The study found that MR angiography was superior to CT angiography, but angiography was superior to MR angiography if the indirect costs were included. The issue of generalisability to other settings was not addressed. The authors do not appear to have presented their results selectively. The authors only reported the average cost-effectiveness of each intervention (i.e. the cost per patient improved). However, to determine which of the diagnostic interventions was the most cost-effective, the authors should have undertake an incremental analysis to estimate the additional cost per extra patient improved, and then determined whether this additional cost was best value for money or not.

The authors reported a number of further limitations to their study. For example, their method of calculating the costs favoured examinations that were not very sensitive. This was mainly because of the high number of false-negative findings that resulted in excluding patients from the investigation process after the first screening test. In addition, the study did not include any estimates of quality of life or indirect costs.

Implications of the study
The authors reported that Doppler ultrasound could be used as an initial screening tool for medically controlled hypertensive patients with a clinical suspicion of renovascular disease, so as to identify patients who could benefit from revascularisation. MR angiography should be favoured in hypertensive patients who are resistant to medical therapy, to maximise the detection of renal artery stenosis.

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