Cost-effective initial screening for vestibular schwannoma: auditory brainstem response or magnetic resonance imaging?
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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
Auditory brainstem response (ABR), performed using Nicolet Compass (Nicolet Diagnostics Ltd.), and gadolinium-enhanced magnetic resonance imaging (GdMRI) were studied.

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients suffering from asymmetric auditory symptoms.

Setting
The practice setting was secondary care. The economic study was carried out at the Department of ENT, Christian Medical College and Hospital, Vellore, India.

Dates to which data relate
The authors did not state when the clinical study was carried out, nor did they provide dates for the cost data. The price year was also not reported.

Source of effectiveness data
The evidence for final outcomes was derived from a single study.

Link between effectiveness and cost data
The costing was undertaken prospectively on the same patient sample as that used in the effectiveness study.

Study sample
No sample size seems to have been determined in the planning phase of the study. In addition, no power calculations were performed retrospectively. Patients who presented to the ENT Department with asymmetric auditory symptoms of hearing loss and tinnitus were prospectively evaluated by pure tone audiometry, ABR testing and GdMRI of the temporal bone and brain. In total, 90 patients were enrolled in the study and all underwent these three tests. There were 56 males and 34 females, ranging in age from 15 to 66 years. Eighteen patients with no response to ABR, because of severe to profound sensorineural hearing loss, were not considered in the analysis.
**Study design**
The study was a prospective diagnostic cohort study that was carried out at a single centre. Patients who presented to the ENT Department with asymmetric auditory symptoms of hearing loss and tinnitus were prospectively evaluated by pure tone audiometry, ABR testing and GdMRI of the temporal bone and brain. All of the patients received each test. There was no mention of blinding to the test results, but this may not have been necessary as the tests appear to have been relatively objective. The patients were not followed up since the authors were only concerned with the results of the tests.

**Analysis of effectiveness**
All of the patients were accounted for in the analysis. The primary health outcomes were the distribution of ABR responses and the number of VS cases diagnosed with GdMRI. ABR responses were classified as normal, cochlear pathology, retrocochlear pathology, and no response. The sensitivity and specificity of ABR were calculated, taking GdMRI to be the 'gold' standard. A true-positive for ABR was defined as a positive MRI result and a retrocochlear pathology result for ABR. A true-negative result for ABR was defined as a negative MRI result and a cochlear pathology/normal result for ABR.

Retrocochlear pathology was diagnosed when the ABR showed at least one of the following: increased interpeak intervals; interaural latency difference of greater than 0.3 ms; poor waveform morphology and replication; or absent response despite normal or mildly elevated audiometric thresholds. For GdMRI, contralateral responses were recorded using a 2-channel recording protocol, with filter settings fixed at 150 to 3,000 Hz. A total of 1,024 or 2,048 sweeps were acquired for each recording, with the best recording being used in the analysis.

**Effectiveness results**
Of the 30 patients who were found to have retrocochlear pathology on ABR, 4 patients were diagnosed as having VS with GdMRI. Of these, 2 were diagnosed with cerebellopontine angle meningioma, 1 with tortuous vertebral artery indenting the cervicomedulary junction, and 1 with giant cisterna magna. Two of the 18 patients excluded from the analysis were found to suffer from VS.

In the 22 patients with cochlear pathology or normal diagnosis on ABR, MRI was essentially normal. Thus, assuming that patients who were found to have VS on GdMRI and retrocochlear pathology on ABR were true positives, and that all cases without VS were negative, the sensitivity of ABR in this study was 100%. The specificity was 61.7%, the positive predictive value was 13.3%, the negative predictive value was 100%, and the prevalence/pre-test probability was 5.6%.

**Clinical conclusions**
ABR was found to be as good as GdMRI in detecting VS cases when using an interaural latency difference criterion of 0.3 ms.

**Measure of benefits used in the economic analysis**
The measure of health benefit was the number of patients diagnosed correctly.

**Direct costs**
The resource quantities and the costs were not reported separately. The direct costs included in the analysis were those of the hospital. These were for testing using GdMRI and ABR. The direct cost data were derived from the authors' setting. The authors only reported the total costs. Discounting was unnecessary since all the costs were incurred during a short time and, appropriately, was not performed. The price year was not reported.

**Statistical analysis of costs**
The total costs were treated as point estimates (i.e. the data were treated deterministically).
Indirect Costs
The indirect costs were not included in the analysis.

Currency
The costs were presented in Indian Rupees (R) and also presented in US dollars ($). No conversion rate or date was reported.

Sensitivity analysis
No sensitivity analyses were performed.

Estimated benefits used in the economic analysis
The estimated number of patients correctly diagnosed for VS was six.

Cost results
The authors calculated that the cost of GdMRI was around 15 times the cost of ABR. The costs of performing ABR and GdMRI to all 90 patients were R54,000 ($1,200) and R810,000 ($18,000), respectively. Thus, if only the 48 patients with no response or evidence of retrocochlear pathology on ABR underwent GdMRI, the cost of screening would be R432,000 ($9,600), saving up to R324,000 ($7,200).

Synthesis of costs and benefits
The benefits and costs were combined as the savings in cost per patient diagnosed correctly. This was found to be R63,000 ($1,200).

Authors' conclusions
Auditory brainstem response (ABR) continues to be the best screening test in patients with asymmetric symptoms. Only patients with features of retrocochlear pathology, or severe/profound hearing loss with no known no causative factor, should need to proceed to gadolinium-enhanced magnetic resonance imaging (GdMRI).

CRD COMMENTARY - Selection of comparators
The choice of GdMRI as the comparator was justified on the grounds that it represented the current 'gold' standard in the authors' setting. However, the sensitivity and specificity of GdMRI were not explicitly stated.

Validity of estimate of measure of effectiveness
The analysis used a diagnostic cohort study. This was appropriate for the study question since all the patients underwent both ABR and GdMRI, thus there would not have been any work-up bias. The tests appear to have been objective, so blinding may not have been necessary. There was no mention of blinding to the test results in the study. Review bias was probably not a problem. Also, there did not appear to be any possibility of withdrawal or disease progression bias. The study sample was representative of the study population. Further, the reasons for exclusions from the study sample were satisfactorily reported, and the effect of these exclusions on the authors' results were appropriately considered in the conclusions.

Validity of estimate of measure of benefit
The estimation of benefits was obtained directly from the effectiveness. The authors did not explicitly justify their choice of using the numbers of patients diagnosed correctly.
Validity of estimate of costs
All the categories of cost relevant to the perspective adopted by the authors (i.e. the hospital) seem to have been included in the analysis. However, the lack of detail in the authors’ cost data makes it impossible to infer whether, for each category of cost, all the relevant costs were included in the analysis. The cost data for the diagnostic tests were taken from the authors' hospital. Only the total costs for each intervention were reported, which hampers the generalisability of the results to other settings. Further, the authors failed to take account of uncertainty in the cost data and did not perform appropriate statistical or sensitivity analyses (the total costs were treated as point estimates). The price year used was not stated, thus making any reflationary exercises difficult.

Other issues
As few studies had prospectively compared and evaluated ABR and GdMRI in a population similar to the one used in this study, and none had been carried out in a developing country setting, the authors made no comparisons with those from other settings. The issue of generalisability to other settings was not addressed. The authors do not appear to have presented their results selectively and their conclusion reflected the scope of the analysis. The effects of any exclusions in their results were appropriately addressed in their conclusions and in the suggested protocol for screening for VS. No further limitations were reported.

Implications of the study
The authors suggested a protocol for screening for VS, whereby only patients with features of retrocochlear pathology, and severe/profound hearing loss with no known causative factor, should proceed to GdMRI. They concluded that such a protocol would considerably reduce the financial burden of identifying patients with VS.

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Bibliographic details

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Other publications of related interest


Indexing Status
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