

Prospective Analysis of a Screening Procedure for Acoustic Neuroma

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Abstract

A screening protocol of Auditory Brainstem Response audiometry, caloric testing and plain X-rays of the internal auditory meatus was applied prospectively to a series of 50 patients under investigation for acoustic neuroma. Analysis of the results of these tests indicated that the investigative regime provided a reliable indication of whether the clinician should proceed to refined and expensive radiological techniques.

Key words -

Acoustic neuroma,

ABR,

Caloric tests,

Radiological

The development, in recent years, of high resolution imaging of the head, namely Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) has meant that the diagnosis of acoustic neuroma can now be made at an early stage. However, not every patient with a unilateral hearing loss, or tinnitus, or symptoms of imbalance can or should be investigated with these time consuming and expensive techniques.

With this in mind several authors have suggested a 'screening protocol' for acoustic neuroma [1], [2], [3]. The three tests utilised were Auditory Brainstem Response (ABR) audiometry, caloric testing and plain X-rays (or tomograms) of the Internal Auditory Meatus (IAM). If two or more of these three investigations were found to be abnormal then the patient was deemed to have failed the screen and should proceed to either CT or MRI to exclude an acoustic neuroma. Retrospective analysis of series of acoustic tumours indicated that this screening protocol identified 97% [2] to 98.5% [3] of the acoustic neuromas. The traditional series of audio-vestibular tests to determine the cochlear/retrocochlear site of the disorder has been shown to reveal a fully retrocochlear picture in only 27% of the patients found to have an acoustic neuroma, a cochlear picture in 4% and a mixed picture in 69% [3]. This established regime has been found to be disappointing and inefficient with regard to a diagnosis.

It is however one thing to be able to demonstrate the efficiency of the three test screening protocol or 'Rule of Three' in a known series of acoustic neuroma (with the tautology that it implies), and another to show an efficient method of screening in those patients suspected of such a retrocochlear lesion. The latter analysis is essential if the screening procedure is to be widely adopted.

This paper analyses the findings of the three tests on a consecutive series of 50 patients in whom there was clinical suspicion of an acoustic neuroma.

Methods

A series of 50 patients were referred to the Audiology department of the Addenbrookes Hospital to undergo the screening protocol for acoustic neuroma. In addition to pure tone audiometry and plain film bilateral x-rays of the IAM reported upon by a consultant Radiologist each patient also underwent the following tests:

Auditory Brainstem Responses (ABR)

Ipsilateral recordings were made of responses to clicks at 70 dB SL. A Biologic Traveller evoked potentials unit was used to perform ABR on each patient. High and low pass filters were set at 3000Hz and 100Hz and the disposable electrodes [4] were placed at ipsilateral (active) and contralateral (reference) mastoids with the ground electrode at the forehead. An abnormal trace showed one or more of the following:

1. Wave I-V latency longer than 4.25 ms.
2. Interaural wave V latency difference greater than 0.3 ms when a weighting factor for hearing loss was applied, and
3. Absence of repeatable responses in the presence of good hearing.

Caloric testing

Bithermal caloric testing was performed according to the method of Fitzgerald and Hallpike [5]. Testing was carried out with optic fixation and the duration of nystagmus was recorded by an observer. The use of simple caloric testing rather than sophisticated electronystamography (ENG) runs against the general trend of Audiology departments to become more technology oriented and computerised. Retrospective analyses [3], however, of acoustic neuroma patients have demonstrated the accuracy of this simple technique and the increased time and expense of ENG was felt to be inappropriate in a screening procedure.

A response (duration of nystagmus elicited) reduced by 20% or more in comparison with the contralateral stimulation for both 44 degree C and 30 degree C irrigation was considered to be abnormal.

Results

Pure tone audiometry

Audiograms were classified by their shape. The results of audiometry in the suspected ear are shown in Figure 1 and no pattern of findings is apparent. No patients were found to have conductive hearing loss.

ABR testing was normal in 30 (60%) patients. Twelve patients (24%) were found to have abnormal ABR according to the criteria mentioned earlier. Eight patients (16%) had insufficient hearing (80 dB at 4 kHz) for ABR responses to be elicited and were considered to have abnormal ABR for purposes of

screening.

Caloric testing

Normal results were obtained in 33 (66%) patients. Twelve (24%) patients had abnormal results, with complete or partial canal paresis. However, none of the patients exhibited a directional preponderance.

Plain X-rays of the IAM

In 43 (86%) patients this investigation was said to be normal, the IAM's being symmetrical. Significant abnormalities were noted in the x-rays of Seven patients (14%).

Combination

The results of combining the outcome of these three tests into a screening procedure are illustrated in Figure 2.

Twenty-one patients (42%) had normal findings on all the three investigations, and were said to have passed the screening. Eighteen 18 (36%) patients had abnormal results in one of the three tests of the protocol. These were also said to have passed the screening, with the proviso that any progression of their symptoms and signs would lead to further investigation.

Seven (14%) yielded abnormal results on two of the three tests. All these were considered to have failed the screening and underwent further radiological investigation.

Four (8%) failed on all the three tests. Thus 78% of patients passed to screening and 22% failed.

Further investigation

Each of the 11 patients who failed the screening had cranial CT at Addenbrookes Hospital. One of these patients (2%) was found to have a 3 cm acoustic neuroma by CT. Another patient (2%) was found to have cerebellar damage resulting from head injury some years previous, and her hearing loss was later found to have dated from that time.

In all the other patients the findings by CT were normal (9 patients). One of these patients who had been complaining of blurred vision was diagnosed by a neurologist to have multiple sclerosis by ABR and visually evoked potentials.

Of all the 11 patients who failed the screening 8 patients were found to be normal by CT. These patients were reviewed at one year and found to be unchanged.

Discussion

As a result of the recently recognised inefficiency of the established audio vestibular investigative regime in the diagnosis of acoustic neuroma [3], it could be suggested that patients with a unilateral sensorineural hearing loss and in whom this diagnosis needs to be excluded, should have a pure tone audiogram and MRI. In this country otologists and neurologists are aware that this is not practicable in view of the enormity of the cost and limited availability of sophisticated imaging techniques. For this reason, it is important that an efficient investigative regime be adopted. Our retrospective study has shown that the 'Rule of three' screening protocol is positive (2 out of 3 tests or 3 out of 3 tests abnormal) in 98.5% of the patients with an acoustic neuroma [3].

The aim of this prospective study was to assess the efficiency of the 'Rule of three' in limiting the need

for expensive radiological investigations and to determine the false positive rate.

Thirty-nine patients (78%) passed the screening and did not require further investigation for retrocochlear hearing loss, though further testing may have been required for the diagnosis of a cochlear lesion. The 18 patients with abnormal result on 1 test were said to have passed the screening and our policy is a one year follow up for this group. Patients whose one abnormal result on 1 test were said to have passed the screening and our policy is a one year follow up for this group. Patients whose one abnormal result was on ABR were followed up at yearly intervals for 3 years in view of this test's accuracy [6] in detecting retrocochlear lesion.

Of the 11 patients who failed the screening, one had an acoustic neuroma and another had a previous cerebellar damage and the third a multiple sclerosis. Even if the latter two patients are excluded, it can be assumed that 1 in 11 patients failing the screening will have acoustic neuroma and this gives us a false alarm rate of 90.0%..

Actually if all the 50 patients in this series are considered then the false alarm rate turns out to be 20% (10 of the 50 patients who were predicted to have acoustic neuroma by the screening protocol turned out not to have acoustic neuroma).

Considering the absence of consistent ABR waveform as abnormal along with those patients with significant recordable abnormalities partly explains the high false positive rate in this series. In this way the scope of the protocol is increased by embracing all patients rather than excluding those in whom no consistent ABR can be measured. Further, it can be expected that combining two or more tests and calling the combined test positive if any two of the tests are positive generally increases both the hit and the false alarm rates [6]. However, if the two patients with cerebellar damage and multiple sclerosis are also considered (the audiovestibular tests are effective in diagnosing the site of pathology rather than type of pathology) the false alarm rate would decrease to 72%.

As well as the false positive rate it is important to consider that 4 out of 5 patients screened do not require expensive imaging techniques because of the screening protocol and that the three tests involved are relatively inexpensive and can be completed rapidly.

The application of 'Rule of three' screening protocol to this series of patients has demonstrated a considerable saving in out-patient time and expense of investigations thus confirming its usefulness in the investigation of patients suspected of having an acoustic neuroma. A cost benefit analysis of the screening protocol is warranted.

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