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Commentary

Cost-effective Screening for Acoustic Neuroma with Unenhanced MR: A Clinician's Perspective

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In this era of managed care, clinicians and radiologists alike share a common goal of reducing the cost of diagnostic endeavors. Adoption of any new "cost-effective" algorithm should take place only after its diagnostic accuracy has been determined and any degradation in diagnostic capability has been weighed against the potential savings. Three studies in this issue of *AJNR* provide a body of preliminary data on the utility of noncontrast magnetic resonance (MR) sequences, in particular high-resolution T2-weighted images for the detection of acoustic neuroma.

The primary concern with this technique is the frequency of false-negative findings. Determining the rate of false-negative findings requires studying a group of patients with known tumors. Allen et al (1) evaluated 25 acoustic neuromas and found a 4% (2 of 25) false-negative rate. Fukui et al (2) studied 50 known tumors with a 6% (3 of 50) false-negative rate. Stuckey et al (3) evaluated 12 known tumors with a false-negative rate of either 0% or 8% (1 of 12), depending on the observer. It is important to note that each of the six tumors missed in these three studies were small intracanalicular lesions. It is not possible to calculate the precise diagnostic efficiency of noncontrast MR in detecting small tumors from these studies because of the small sample sizes and the noncomparable measurement ranges. The data on the detection of small tumors include: 12 tumors smaller than 10 mm, with 2 missed, both less than 4 mm (Allen et al); 8 tumors smaller than 5 mm, with 3 missed (Fukui et al); and 1 tumor smaller than 5 mm, missed by one of two observers (Stuckey et al). It is evident that a substantial fraction of tumors less than 5 mm in diameter, perhaps 20% to 30% in the hands of expert readers, remain undetected with noncontrast MR imaging.

It is important that the false-negative rates in these three studies were obtained by expert image interpreters who were well aware that they were participating in a study to test their diagnostic accuracy. They also had the considerable advantages of superior software and hardware as well as technicians trained to perform these specialized sequences optimally. Less expert readers, working with less sophisticated images and less adept technical help, can reasonably be expected to have a considerably higher incidence of missed tumors.

What is the cost, in medical and human terms, of a screening algorithm that overlooks perhaps 10% to 20% of acoustic neuromas? Because the tumors at highest risk of remaining undetected are small, the opportunity for them to be removed with functional preservation (eg, hearing, facial expression) may be lost forever. More important, once patients have been reassured that they do not have a tumor, they tend to put the issue out of their mind. Unilateral deafness is readily accepted by most patients. Only when truly alarming symptoms evolve, indicative of major brain stem compression, is another study obtained. This pattern is commonly encountered today among patients reassured in the 1970s and 1980s after "negative" computed tomograms or low-resolution, unenhanced MR studies. Even when the physician requests a follow-up study after an interval (eg, 1 year), compliance is imperfect. Furthermore, the economic advantage of the noncontrast study disappears when the diagnostic algorithm requires one or more repeat studies to ensure sufficient diagnostic accuracy.

It is erroneous to rate the value of an MR

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study as a screening tool for acoustic neuroma by calculating the number of true negatives. In series in which large numbers of suspected acoustic neuromas were imaged, only a small fraction (well under 10%) ultimately proved to have tumors (4–6). Thus, even a completely insensitive diagnostic modality would be expected to have a true-negative rate exceeding 90%. False positives are not a serious issue either, because these can be promptly resolved by administering contrast material. Because only a perfectly normal study carries diagnostic weight in the exclusion of acoustic neuroma, it will often be necessary to proceed with a contrast-enhanced T1-weighted sequence to clarify the issue. The need for this evaluation can be determined only by a skilled radiologist and cannot be relegated to a technician. This decision must be made in a timely fashion in order to complete the study in a single session. Setting up a system that requires the patient to be called back for a second study on another day is highly undesirable. Thus, this method requires a substantial commitment on the part of the radiologist to be available during the study for a timely determination of whether contrast is needed.

A final point is that the evaluation of unilateral or asymmetric hearing loss involves considerably more than just the exclusion of acoustic neuroma. High-resolution T2-weighted MR studies are basically cisternograms that identify mass lesions of the internal auditory canal and cerebellopontine angle by the exclusion of cerebrospinal fluid. Enhanced MR imaging is needed to detect a variety of conditions that can cause the hearing impairment also seen in patients with acoustic neuroma. Enhancement of the inner ear has been increasingly recognized in asymmetric hearing loss, particularly in the acute setting. Presumably this enhancement is caused by viral infection or another inflammatory process involving the labyrinth. Mononeuritis, in which the eight nerve enhances brightly but is of normal diameter, is another example. Diffuse meningeal enhancement, as seen in sarcoidosis, would also be overlooked without contrast material. Certain lesions of the otic capsule, such as cochlear otosclerosis and osteogenesis imperfecta, also may appear only after contrast administration. Although the more accurate differential diagnosis afforded by a contrast-enhanced study is certainly desirable, there is some validity to the argument that identifying such lesions is of low priority, because most of them are neither medically nor surgically treatable.

For all of the above-mentioned reasons, I have little enthusiasm for the widespread adoption of acoustic neuroma searching protocols based on noncontrast, high-resolution, T2-weighted MR images, given the current state of the art. It could be argued that noncontrast studies be reserved for patients at low risk of having an acoustic neuroma. It is true that in some clinical circumstances (eg, slightly asymmetric hearing loss, unilateral tinnitus) the suspicion of acoustic neuroma is lower than in others. However, it would be dangerous for the radiologist to assume the responsibility of assigning risk criteria without familiarity with the neurotologic evaluations (audiology, auditory evoked responses, electronystagmography, etc) needed to establish these factors. Furthermore, subtle or atypical presentations are more common among small tumors, precisely the population most often overlooked with noncontrast studies. The accuracy of these protocols in detecting tumors of larger size makes them suitable in clinical circumstances in which missing a small tumor is of little consequence. Because of the slow growth rate of these lesions, an evaluation of elderly or medically infirm patients with a short predicted life span need not be overly diligent for tiny tumors.

Perhaps the most promising role of high-resolution T2-weighted MR images in otology stems from the ability of these techniques to provide exquisite detail of fluid-filled spaces within bone. This attribute makes them well suited to the evaluation for certain disorders of the inner ear. An increasing body of evidence has shown them to be superior to computed tomography in screening for congenital malformations of the inner ear, detecting labyrinthine fistulas, and evaluating cochlear patency before cochlear implantation (7, 8).

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