

# Cost effectiveness of contrast-enhanced magnetic resonance imaging for screening retrocochlear pathologies in unilateral hearing loss

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## INTRODUCTION

Unilateral hearing loss is a common symptom encountered in the otorhinolaryngology clinics. A survey reported the prevalence of unilateral hearing loss as 7.6% in the United States (1). Niskar et al. screened school-aged children, and reported that 3% of them had unilateral hearing loss (2). Those rates indicate that approximately 4% of the population develop unilateral hearing loss later in life. Even if the middle and outer ear diseases that cause conductive hearing loss are excluded, retrocochlear and cochlear disorders are to be differentiated in a significant number of cases.

Audiogram, computerized tomography (CT), auditory evoked brainstem responses (AEBR), and magnetic resonance imaging (MRI) may be used in the diagnosis of cochlear disorders (3). Usually *T1-weighted spin-echo* MRI with contrast is the preferred imaging method. Some different non-contrast MRI methods such as high-resolution fast spin-echo T2-weighted MRI and T2\*-weighted three dimensional Fourier transformation-constructive interference in steady state (3DFT-CISS) have been shown to have similar success rates with the methods with contrast (4).

In this study, we aimed to investigate the factors that affected the cost of temporal MRI with contrast which had been employed for screening the patients with unilateral hearing loss in our clinic.

## MATERIAL AND METHODS

A total of 695 patients that admitted to our clinic with unilateral sensorineural hearing loss and had temporal bone MRI with contrast between July 2009 and May 2015 were included in this retrospective study. The patients that admitted to other clinics (neurosurgery, neurology), and diagnosed with cerebellopontine angle tumors were not included.

Temporal bone MRI was done with a 1.5 Tesla MRI device (GE Signa Excite HD, GE Medical Systems, Milwaukee, Wisc., USA). The following imaging protocols were employed:

- T1W (TR, 500 ms; TE, 15.7 ms; slice thickness 3 mm; interslice gap 0.5 mm; FOV 20 × 20 cm; matrix 320 × 224; NEX 3)
- T2W (TR 3000 ms; TE 104.8 ms; slice thickness 3 mm; interslice gap 0.5 mm; FOV 22 × 22 cm; matrix 320 × 224; NEX 3). T2W images were obtained with FSE sequences.
- 3D FIESTA (TR 4.8 ms; TE 1.4 ms; slice thickness 0.5 mm; FOV 18 × 18 cm; matrix 352 × 192; NEX 4).

The serum creatinine levels were measured, and a venous access was established in all patients before imaging. MRI protocol was first employed without giving the contrast, then the contrast material was given, and T1AG axial and coronal images were obtained.

The contrast agents used were either 0.2 ml/kg gadobenat dimeglumin (Multihance, Bracco S.p.A, Italy) or 0.2 ml/kg gadodiamid (Omniscan, Amersham Health, Ireland), and both were administered intravenously.

The MRI images were re-examined in 19 patients that were reported to have a vestibular schwannoma (VS). T1 and T2 weighted scans with and without contrast were compared.

The factors that were determined to affect the cost of the imaging including serum creatinine measurement, establishing a vascular access, and use of a contrast material were analyzed both for cost and the time consumed.

		With contrast		
		VS +	VS -	Total
Without contrast	VS +	18	0	18
	VS -	1	676	677
	Total	19	676	695

Table 1: The specificity and sensitivity of non-contrast 3D FIESTA technique have been determined as 100% and 94.7%, respectively.

The parameters resulting in an additional cost	Cost per procedure (TL)	Time needed per procedure (min)
Blood creatinine measurement	1.3	5
Establishing vascular access	8	5
Use of a contrast agent	137 (mean price)	2
Imaging with contrast	88	10
Subtotal (1 patient)	234.3	22
Total (695 patients)	162,835.5 TL	15,290 min

Table 2: The parameters that affect the cost of MRI imaging. (1 euro=2.3 TL)

## RESULTS

All 695 patients had audiological tests, and they were diagnosed with asymmetrical sensorineural hearing loss. MRI was performed for screening for retrocochlear pathologies. There was a positive result in 19 (2.73%) patients. There was a unilateral VS in 17 of 19 patients diagnosed with VS while 2 patients had bilateral VSs. The patients with bilateral VSs have been followed up with the prediagnosis of neurofibromatosis type 2 (NF2).

Among patients with VS, there were 12 females and 7 males with a mean age of 52.8 years. Re-examination of the images of the patients with VS revealed that the tumor could be seen on the images with and without contrast in 18 cases (Figure 1), however it could not be seen on the images without contrast in one case, and could only be seen on T1AG images with contrast (Figure 2). The sizes of the tumors ranged between 2.5 and 15 mm. The specificity and sensitivity of the imaging method are presented in Table 1. Table 2 shows the factors that affect the cost and the time consumed for the imaging including serum creatinine measurement, establishing a vascular access, and use of a contrast agent.

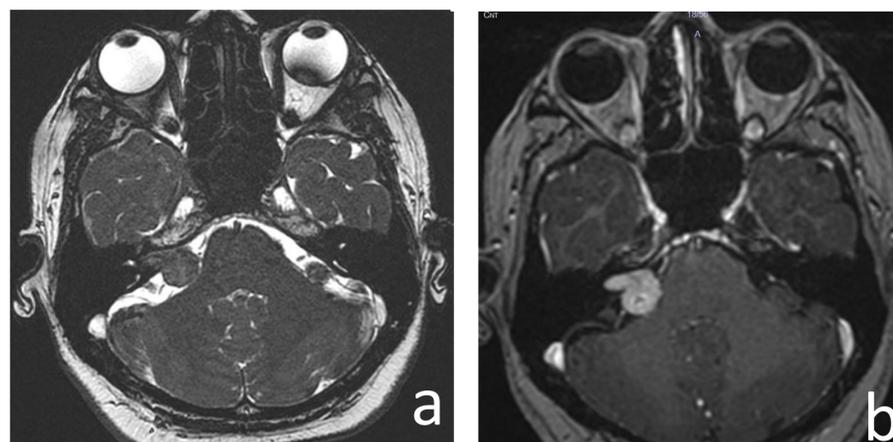


Figure 1: a) The tumor can be seen on axial 3D fiesta sequence. b) The mass is evident on T1 weighted image after injection of the contrast agent.

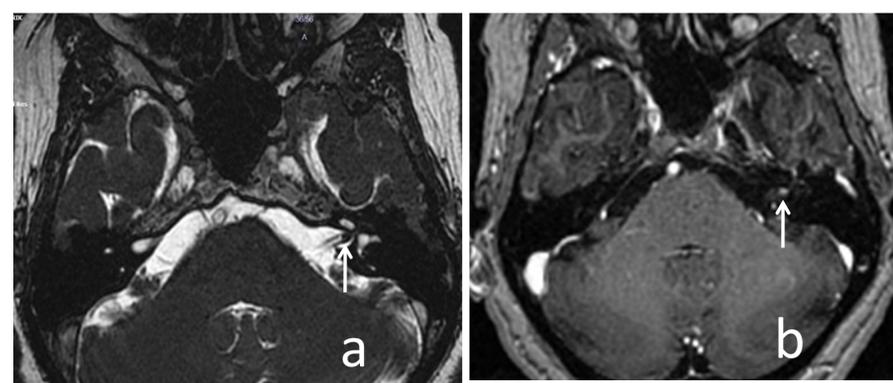


Figure 2: Axial 3D fiesta sequence (a) hardly distinguishable lesion at the distal part of the left internal auditory canal, (b) the lesion is seen more clearly on the image with contrast.

## Conclusion

We suppose that non-contrast MRI may be the preferred imaging modality for screening owing to its high sensitivity, and when the cost and healthcare are taken into account.