Comparison of High Resolution T2W and Gd-T1W of MRI Internal Acoustic Canal in Sensorineural Hearing Loss

Panida Charnchaowanish BSc*,
Orasa Chawalparit MD*

* *Department of Radiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand*

Objective: *To evaluate the concordance of high resolution T2-weighted (HR-T2W) and Gd-T1W for mass detection in internal acoustic canal (IAC) or cochlear in sensorineural hearing loss (SNHL).*

Material and Method: *The retrospective study of patients with SNHL undergoing magnetic resonance imaging (MRI) IAC protocol was performed. HR-T2W and Gd-T1W were separately reviewed for any mass in IAC or cochlear.*

Results: *One hundred eight cases were available for evaluation with 43 males and 65 females (mean age of 56.04 years old; range 15 to 86 years old). Symptoms of SNHL on right side were 39 cases (36.1%), left side 39 cases (36.1%), both sides 15 cases (13.9%), and asymmetric SNHL 15 cases (13.9%). Twenty two (20.4%) cases had mass in IAC and/or cochlear demonstrated on both HR-T2W and Gd-T1W. No discrepancy of abnormality detection between both pulse sequences was found.*

Conclusion: *HR-T2W was as accurate as Gd-T1W in detecting mass in IAC and cochlear in patients with SNHL. Screening with HR-T2W could be used with confidence and might be reasonable to reducing cost of the MRI study in appropriate setting of patients presenting with SNHL.*

Keywords: *MRI, IAC, Sensorineural hearing loss, High resolution*

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Patients presenting with acquired hearing loss are classified into conductive and sensory hearing loss. When the diagnosis is sensorineural hearing loss (SNHL), the first imaging investigation is magnetic resonance imaging (MRI) to exclude mass or tumor in retrocochlear region including internal acoustic canal (IAC). MRI, especially post contrast T1-weighted (Gd-T1W), has been accepted as standard imaging in this clinical context[1-3]. The Gd-T1W is usually performed with high resolution and fat suppression technique. At least coronal and axial planes are needed for the Gd-T1W of IAC. Through good in plane resolution, the slice thickness cannot go down to less than 2 mm with proper scan time in clinical scanner. With revolution and development of MRI technology, high resolution techniques were introduced to increased sensitivity in small acoustic nerve[4-6]. One of these was high resolution heavy T2-weighted (HR-T2W) such as driven equilibrium (DRIVE), constructive interference in steady state three-dimensional (CISS) [7-10]. The pulse sequences also give 3D data set for multiplanar reconstruction (MPR) with excellent quality. The pitfall of HR-T2W is no information of enhancement in normal size cranial nerve or tiny mass with diameter equal to the diameter of the nerve. However, the clinical presentation of inflammation is not the same as tumor. Even through in very tiny mass, the treatment is usually observed.

In our institute, we realized that most of the cases were negative MRI and screening for retrocochlear mass with HR-T2W might be enough. The present study was to compare concordance of HR-T2W and Gd-T1W in evaluating small acoustic tumor in patients presenting with SNHL.

Material and Method

The present study was approved by the Institutional Ethic Committee. The retrospective review of MRI with internal acoustic canal protocol at our hospital was performed between 2010 and 2014. Only cases with available imaging data on the institute archiving system and history of sensory hearing loss on the requested forms were recruited. The cases with previous surgery of the cranium and incomplete MRI study were excluded. Demographic data of the patients including age, sex, and side of the SNHL were collected.

Correspondence to:
Chawalparit O, Department of Radiology, Faculty of Medicine Siriraj Hospital, 2 Wanglang Road, Bangkok 10700, Thailand.
Phone: +66-2-4197086, Fax: +66-2-4127785
E-mail: oak_art@yahoo.com

MRI IAC protocol

All patients underwent MRI with 3.0 T machine (Achieva, Philips Medical System, Best, the Netherlands) and 8 channels sense head coil. The image protocol composed of non-contrast axial T1W, T2W, T2W/FLAIR for screening brain lesion. The imaging of IAC included coronal T2W with fat suppression (TR/TE = 4,500/80 msec, slice thickness/gap = 3/0.3 mm, matrix size = 360x640, FOV = 230x160 mm), axial T1W (TR/TE = 485/10 msec, slice thickness/gap = 3/0.3 mm, matrix size = 304x576, FOV = 180x125 mm), axial 3D-DRIVE (TR/TE = 3,000/140 msec, slice thickness/gap = 0.7/0.35 mm, matrix size = 352x512, FOV = 180x180 mm with sense factor = 2.2, scan time 8.09 minutes). In post contrast scan, the high resolution T1W with fat suppression were performed in axial and coronal planes (TR/TE = 552/10 msec, slice thickness/gap = 3/0.3 mm, matrix size = 304x576, FOV = 180x125 mm, scan time 5.18 minutes each).

MRI evaluation

One neuroradiologist with more than 30 years' experience reviewed the HR-T2W first on the PACS (Synapse 3.2.1 SR-361, Fujifilm Medical Systems, USA) without awareness of the patients' history. The source images were evaluated with MPR in three orthogonal planes and oblique plane parallel to the basal turn of each cochlear. Then 4 mm slap of maximum intensity projection (MIP) images were evaluated. After two months interval, the Gd-T1W with fat suppression technique of IAC in axial and coronal planes were evaluated together. The neuroradiologist was blinded from previous result of HR-T2W evaluation. The findings of any mass like lesion in IAC or cochlear, side of the lesion and size of cochlear nerve compared with facial nerve in the canalicular part were collected (Fig. 1).

Statistical analysis

All data were analyzed using SPSS V.18 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics and crosstab analyses of age, sex, and findings of each imaging techniques were presented as frequency and percentage. Two by two tables with percentage of HR-T2W and Gd-T1W were calculated. Sides of symptom of hearing loss with lesion detection were calculated as percentage of incidence.

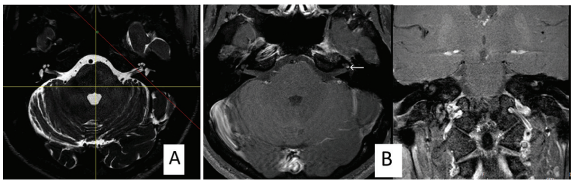

Fig. 1 MPR planes of HR-T2W for MRI IAC (A) compared with coronal and axial Gd-T1W (B).

Results

One hundred eight cases fulfilled the inclusion criteria. Forty-three were males and 65 were females with mean age of 56.04 years old (range 15-86 years old). Patients presenting with symptoms of SNHL on right side were 39 cases (36.1%), left side 39 cases (36.1%), both sides 15 cases (13.9%), and asymmetric SNHL 15 cases (13.9%). Twenty-two (20.4%) cases had mass in IAC and/or cochlear demonstrated on both HR-T2W and Gd-T1W. No discrepancy of abnormality detection between both pulse sequences was found.

Twelve lesions were detected in right IAC, one in right cochlear, 10 in left IAC, and four in left cochlear. One case known as neurofibromatosis had bilateral IAC mass, one had only cochlear mass and four had both IAC and cochlear mass.

Patients with right SNHL showed right sided lesion in 11 cases (28.2% of 39 cases), left sided lesion in one case (2.6%). Patients with left SNHL had left sided lesion in seven cases (17.9% of 39). Patients with bilateral SNHL had lesion in left side in one case (6.7% of 15), and both sides in one case (6.7%), whereas only one case of patients with asymmetric SNHL (6.7% of 15) had lesion in left side (Table 1).

In patients with no mass detected, size of right cochlear nerve smaller than facial nerve was

Table 1. Side of symptomatic sensorineural hearing loss (SNHL) and magnetic resonance imaging (MRI) finding of mass

SNHL	No mass	Right mass alone	Left mass alone	Bilateral mass	Total
Right side	27 (69.2%)	11 (28.2%)	1 (2.6%)	0	39 (100%)
Left side	32 (82.1%)	0	7 (17.9%)	0	39 (100%)
Bilateral	13 (86.7%)	0	1 (6.7%)	1 (6.7%)	15 (100%)
Asymmetric	14 (93.3%)	0	1 (6.7%)	0	15 (100%)
Total	86	11	10	1	108

found in five cases of right SNHL, three of left SNHL, two of bilateral SNHL, and one of asymmetric SNHL. The size of left cochlear nerve smaller than facial nerve was found in two cases of right SNHL, five of left SNHL, two of bilateral SNHL, and two of asymmetric SNHL. Concordance of small cochlear nerve size with symptomatic side was 12.9% (15 in 86).

Discussion

Generally, two groups of pulse sequences, 3D fast gradient echo (3D-FGRE), and 3D fast spin echo (3D-FSE), have been suggested for high resolution of temporal bone and cisternographic effect of IAC(6-8). Many techniques in 3D-FGRE (such as CISS, bFFE, FIESTA) and 3D-FSE (such as DRIVE) were popular for IAC and retrocochlear study due to good signal of the structure with fluid as major content and lower artifact and scan time(9-12). Major drawbacks of 3D-FGRE are susceptibility artifact and band (zebra strip) artifact(9,10). The technique used in our institute is DRIVE which is fast spin echo technique with additional -90° pulse at the end of echo train to enhance the recovering of the longitudinal magnetization from transverse magnetization(12). Comparing studies between 3D-FSE and 3D-FGRE for IAC imaging found superior contrast to noise and image quality in FSE. Less CSF pulsatile artifact and no band artifact in the FSE was also reported in these studies both 1.5T and 3T(13,14). However, controversy of the best technique is still noted(5,15).

Many previous studies compared CISS and Gd-T1W and found high accuracy of CISS in detecting IAC or retrocochlear lesions in SNHL(16-18). Our study also confirmed the findings. With HR-T2W technique, all lesions detected on Gd-T1W were also demonstrated. The scan time of the technique was shorter than Gd-T1W (8.09 vs. Gd-T1W in axial 5.18 + Gd-T1W in coronal 5.18 = 10.36 minutes) and MPR could be performed. The incidence of mass found in retrocochlear and IAC in our study was 22 in 108 (20.37%). To compromise with the standard care, we recommended screening with HR-T2W first, especially in bilateral SNHL and asymmetric SNHL, and scanning Gd-T1W if any lesion seen on HR-T2W. For patients with unilateral symptom or with underlying systemic or syndromic conditions such as neurofibromatosis, both HR-T2W and Gd-T1W are mandatory in order to evaluate mass in other locations. Study of incidence of IAC mass in specific clinical setting may be helpful for reducing cost for unnecessary contrast used in MRI(19-21).

The limitation of the present study was no pathological result to confirm the findings from MRI. Due to MRI IAC has been performed as routine service and familiar for all neuroradiologists in our institute for a long time, no interobserver reliability test was studied.

Conclusion

There was concordance of lesion detection with HR-T2W and Gd-T1W of IAC MRI in patients with SNHL. Screening with HR-T2W could be used with confidence and might be reasonable to reducing cost of the MRI study in appropriate setting of patients presenting with SNHL.

What is already known on this topic?

Many previous studies compared CISS and Gd-T1W and found high accuracy of CISS in detecting IAC or retrocochlear lesions in SNHL.

What this study adds?

With DRIVE technique, all lesions detected on Gd-T1W were also demonstrated. The scan time of the technique was shorter than Gd-T1W (8.09 vs. Gd-T1W in axial 5.18 + Gd-T1W in coronal 5.18 = 10.36 minutes) and MPR could be performed.

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Potential conflicts of interest

None.

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การเปรียบเทียบภาพเอ็มอาร์ไอของช่องประสาทสมองคู่ที่ 8 ระหว่างภาพที(T) 2 ที่มีความละเอียดสูงกับภาพที(T) 1 หลังฉีดสารปรับความเปรียบต่างในผู้ป่วยที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียง

พนิดา ชาญเชาว์วานิช, อรสา ชวาลภาฤทธิ์

วัตถุประสงค์: *เพื่อเปรียบเทียบหาความสอดคล้องระหว่างเทคนิคการตรวจกับการบ่งบอกถึงรอยโรคในผู้ป่วยที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียง ที่มารับการตรวจวินิจฉัยหารอยโรคบริเวณช่องประสาทสมองคู่ที่ 8 ด้วยเครื่องตรวจเอ็มอาร์ไอด้วยเทคนิคที 2 ที่มีความละเอียดสูง (HR-T2W) กับที 1 หลังฉีดสารปรับความเปรียบต่าง (Gd-T1W)*

วัสดุและวิธีการ: *การศึกษาย้อนหลังตั้งแต่ พ.ศ. 2553 ถึง พ.ศ. 2557 ด้วยการนำภาพเอ็มอาร์ไอของช่องประสาทสมองคู่ที่ 8 ของแต่ละเทคนิคให้รังสีแพทย์ผู้เชี่ยวชาญทางด้านภาพวินิจฉัยประสาทวินิจฉัย เพื่อติดตามหาก้อนเนื้องอกบริเวณช่องประสาทสมองคู่ที่ 8 หรือคอเคลียอย่างอิสระ คนละห้วงเวลาเพื่อไม่ให้เกิดอคติในการแปลผลของแต่ละเทคนิค*

ผลการศึกษา: *พบว่าผู้ป่วยที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียง จำนวน 108 ราย แบ่งเป็นเพศชาย 43 ราย เพศหญิง 65 ราย อายุระหว่าง 15-86 ปี (อายุเฉลี่ย 56.04 ปี) ผู้ป่วยเหล่านี้แยกตามอาการของหูข้างที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียงดังต่อไปนี้ ข้างขวา 39 ราย (36.1%) ข้างซ้าย 39 ราย(36.1%) มีอาการทั้งสองข้าง 15 ราย (13.9%) และมีอาการทั้งสองข้างไม่เท่ากัน 15 ราย (13.9%) พบก้อนเนื้องอกที่ช่องประสาทสมองคู่ที่ 8 และหรือคอเคลียในผู้ป่วยที่ทำการศึกษา 22 ราย (20.4%) โดยที่ทั้ง 2 เทคนิค (HR-T2W และ Gd-T1W) สามารถบ่งบอกถึงก้อนเนื้องอกได้อย่างชัดเจนไม่แตกต่างกัน*

สรุป: *เทคนิค HR-T2W มีความแม่นยำในการบ่งบอกก้อนเนื้องอกบริเวณช่องประสาทสมองคู่ที่ 8 หรือคอเคลีย เทียบเท่ากับเทคนิค Gd-T1W ในผู้ป่วยที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียง ดังนั้นเทคนิค HR-T2W เป็นเทคนิคที่เหมาะสมสำหรับการตรวจหาความผิดปกติช่องประสาทสมองคู่ที่ 8 หรือคอเคลีย ซึ่งเป็นเทคนิคการตรวจที่มีความถูกต้องแม่นยำโดยไม่ต้องมีการฉีดสารปรับความเปรียบต่างร่วมด้วย เป็นการลดค่าใช้จ่ายให้กับผู้ป่วยที่มีอาการสูญเสียการได้ยินจากพยาธิสภาพของประสาทการรับเสียงและต้องวินิจฉัยหารอยโรคด้วยการตรวจเอ็มอาร์ไอของช่องประสาทสมองคู่ที่ 8*