The Professional Medical Journal
www.theprofesional.com

DOI: 10.29309/TPMJ/2019.26.04.3354

ORIGINAL PROF-0-3354

ACOUSTIC NEUROMA;

DIAGNOSTIC ACCURACY OF MR IMAGING IN THE DETECTION OF ACOUSTIC NEUROMA TAKING HISTOPATHOLOGY AS GOLD STANDARD.

Nazish Hameed[1], Muhammad Tahir[2], Noureen Jahangir[3], Hassan Bukhari[4], Hira Bukhari[5]

1. MBBS, FCPS (Radiology)
Assistant Professor
Department of Radiology
Sargodha Medical College,
University of Sargodha.
2. MBBS, FCPS (Medical Oncology)
Assistant Professor
Department of Oncology
Department of Clinical Oncology
Allied Hospital, Faisalabad.
Faisalabad Medical University,
Faisalabad.
3. MBBS, FCPS
Diagnostic Radiologist
4. MBBS, FCPS (Diagnostic Radiology)
Senior Registrar
Department of Radiology
Allied Hospital, Faisalabad.
Faisalabad Medical University,
Faisalabad.
5. 4th Year MBBS Student
Sargodha Medical College,
Sargodha.

Correspondence Address:
Dr. Hassan Bukhari
Department of Radiology
Allied Hospital, Faisalabad.
drhassanbukhari@hotmail.com

Article received on:
29/03/2018
Accepted for publication:
15/11/2018
Received after proof reading:
26/03/2019

ABSTRACT… Objectives: To determine the diagnostic accuracy of magnetic resonance imaging in the detection of acoustic neuroma taking histopathology as gold standard. **Study Design:** Cross-sectional survey. **Setting:** The Department of Diagnostic Radiology, Lahore General Hospital, Lahore. **Duration of Study with Dates:** Study was completed in six months after approval of synopsis from 14-07-2009 to 14-01-2010. **Subjects & Methods:** This study comprised of 55 patients with clinical suspicion acoustic neuroma. Magnetic resonance imaging on a 1.5-T Philips whole body magnetic resonance system was performed. The cases were operated and histopathological results were recorded. The results of magnetic resonance imaging and histopathology were compared taking histopathology as gold standard. **Results:** Out of 55 patients, 43 patients (78.2%) had acoustic neuroma on magnetic resonance imaging. After comparison of results of magnetic resonance imaging with histopathology, the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of magnetic resonance imaging were 97.7%, 91.7%, 97.7%, 91.7% and 96.4% respectively. **Conclusion:** Magnetic resonance imaging is a highly accurate, non-invasive, safe and convenient imaging modality for the evaluation of acoustic neuromas and is valuable for guiding surgical biopsies thereby decreasing unnecessary intervention. It allows detection of small tumours which is very useful in tumour characterization and plays an integral role in early detection, planning management and estimating patient's prognosis.

Key words: Acoustic Neuroma, Cerebellopontine Angle, Magnetic Resonance Imaging.

Article Citation: Hameed N, Tahir M, Jahangir N, Bukhari H, Bukhari H. Acoustic neuroma; diagnostic accuracy of MR imaging in the detection of acoustic neuroma taking histopathology as gold standard. Professional Med J 2019; 26(4):578-584. **DOI:** 10.29309/TPMJ/2019.26.04.3354

INTRODUCTION

Among the cerebellopontine angle masses, Acoustic neuroma is the most common benign tumour.[1] It accounts for 8-10% of all primary intracranial tumours and 80% of CPA tumors.[2] The second most common is Meningioma and accounts for 5-10% of CPA tumours, and rare tumours constituting only a small percentage and among the rare tumours epidermoid is the most frequent.[3] Acoustic neuroma is a a benign tumour that arises from schwann cells.[4] Adults with mean age ranging from 46-58 yrs shows an increased incidence of Schwanoma with clinical incidence of 10-15% / million / yr.[5] The tumour is generally composed of histologically two types of cells, Antoni A and B.[2] Type A tissue with little extra cellular matrix and highly intracellular matrix gives the appearance of dark on T2w images while type B tissues exhibit more loosely arranged cells and fluid contents while less cellular that's why appears T2w bright. Imaging characteristics are influenced by these histological types.[6]

In patients with Schwanoma wide variety of symptoms seen, such as, Dizziness, progressive hearing loss, fluctuating deafness and tinnitus. It is detected in 41% of patients presenting with hearing loss.[7]

Acoustic neuroma is diagnosed simply by the virtue of various non-invasive imaging modalities such as computed tomography and magnetic resonance imaging[8] CPA tumours owes MRI as the imaging modality of choice for preoperative work up. Being non-invasive, reliable, radiation free MRI allows proper characterization and precise localization of these CPA tumours because of its multiplanar and multi-parameter capabilities.[9,10]

MRI superceeds CT in the evaluation of Internal auditory canal (IAC) and is considerably more sensitive than CT. Reliability of MRI rates higher by the use of gadolinium based contrast media and CEMR scan is currently considered to be the most reliable and accurate indicator for diagnosing acoustic neuroma.[8]

Sensitivity of 94% to 100% and Specificity of 94% to 98% is achieved with MRI for diagnosis of acoustic neuroma.[11]

The rationale of this study is to assess the diagnostic accuracy of MRI for acoustic neuroma so as to consider it as a valuable, radiation free, non-invasive, safe and convenient imaging modality for early detection of acoustic neuroma in our setting and to eliminate the role of biopsy.

DATA COLLECTION

All patients presenting with clinical suspicion of Acoustic neuroma referred by neurosurgeons from outdoor of Lahore General Hospital, Lahore meeting the inclusion criteria were taken. Patients with residual, recurrent or metastatic acoustic neuroma were excluded from the study to avoid confounding variables. Informed consent for magnetic resonance imaging and histopathology from all the patients included in the study was taken. All the patients were recorded for their demographic features i.e. age, gender and address. Magnetic resonance imaging on a 1.5-T Philips whole body MR system using standard imaging coil was then be carried out. T2-weighted and both unenhanced and contrast-enhanced T1-weighted images in the axial, sagittal and coronal projections were obtained. magnetic resonance imaging diagnosis i.e. presence or absence of Acoustic neuroma was recorded made by the same observer. The cases were operated and histopathological results were recorded. The results of magnetic resonance imaging and histopathology were compared taking histopathology as gold standard. All this information was collected through a specially designed proforma which is attached herewith.

DATA ANALYSIS

All the data was analyzed with SPSS version 10. The variables included age, gender, magnetic resonance imaging diagnosis i.e. presence or absence of acoustic neuroma and histopathological result. For quantitative data i.e. age, mean and standard deviation were calculated. For qualitative data i.e. gender, magnetic resonance imaging diagnosis i.e. presence or absence of acoustic neuroma and histopathological result, frequencies and percentages were calculated. A 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value and accuracy of magnetic resonance imaging for acoustic neuroma taking histopathology as gold standard.

RESULTS

This study was conducted on 55 patients with clinical suspicion of acoustic neuroma for a period of six months in the Department of Diagnostic radiology, Lahore General Hospital, Lahore with collaboration of neurosurgical units of Lahore General Hospital, Lahore.

The age of patients ranged from 10 to 70 years with mean age 51.9 ± 10.5 years. The highest number of patients were aged between 51-60 years i.e. 25 (45.5%). 01 patients (1.8%) was aged between 10-20 years. 04 patients (7.3%) were aged between 21-30 years. 03 patients (5.5%) were aged between 31-40 years. 13 patients (23.6%) were aged between 41-50 years. 09 patients (16.4%) were aged between 61-70 years. (Table-I).

Out of 55 patients, 20 patients (36.4%) were males and 35 patients (63.6%) were females (Table-II).

Out of 55 patients, 43 patients (78.2%) had acoustic neuroma on MRI while 12 patients (21.8%) had no acoustic neuroma on MRI (Table-III).

Out of 55 patients, 43 patients (78.2%) had acoustic neuroma on histopathology while 12 patients (21.8%) had no acoustic neuroma on histopathology (Table-IV).

Out of the 55 patients, 43 patients (78.2%) had

acoustic neuroma, 07 patients (12.7%) had meningioma, 03 patients (5.5%) had epidermoid, 01 patient (1.8%) had arachnoid cyst and 01 patient (1.8%) had abscess on magnetic resonance imaging (Table-V).

Out of the 55 patients, 43 patients (78.2%) had acoustic neuroma; 08 patients (14.5%) had meningioma; 02 patients (3.6%) had epidermoid; 01 patient (1.8%) had arachnoid cyst and 01 patient (1.8%) had abscess on histopathology (Table-VI).

On comparison of results of MRI with histopathology taken as gold standard, out of 55 patients, 42 patients were true positive, 11 patients, true negative; 01 patient, false positive and 01 patient, false negative (Table-VII). The sensitivity of MRI was 97.7%, specificity 91.7%, diagnostic accuracy 96.4%, positive predictive value 97.7% and negative predictive value 91.7% (Table-VIII and Table-IX).

Age (Years)	Number	Percentage %
10-20	01	1.8%
21-30	04	7.3%
31-40	03	5.5%
41-50	13	23.6%
51-60	25	45.5%
61-70	09	16.4%
Total	55	100%
Mean ± SD	51.9 ± 10.5	

Table-I. Distribution of subjects by age n = 55

Gender	Number	Percentage%
Male	20	63.6%
Female	35	36.4%
Total	55	100.0%

Table-II. Distribution of subjects by gender n = 55

Acoustic Neuroma	Number	Percentage%
Present	43	78.2%
Absent	12	21.8%
Total	55	100%

Table-III. Distribution of subjects by Acoustic neuroma on MRI n=55

Acoustic Neuroma	Number	Percentage%
Present	43	78.2%
Absent	12	21.8%
Total	55	100%

Table-IV. Distribution of subjects by acoustic neuroma on histopathology n = 55

MRI Diagnosis	Number	Percentage
Acoustic neuroma	43	78.2%
Meningioma	07	12.7%
Epidermoid	03	5.5%
Abscess	01	1.8%
Arachnoid cyst	01	1.8%
Total	55	100%

Table-V Distribution of subjects by MRI diagnosis n = 55

Histopathology Diagnosis	Number	Percentage
Acoustic neuroma	43	78.2%
Meningioma	08	14.5%
Epidermoid	02	3.6%
Abscess	01	1.8%
Arachnoid cyst	01	1.8%
Total	55	100%

Table-VI. Distribution of subjects by histopathology diagnosis n = 55

MRI	Histopathology (Gold Standard)		Total
	Positive	Negative	
Positive	42 (TP)	01 (FP)	43
Negative	01 (FN)	11(TN)	12
Total	43	12	55

Table-VII. Comparison of MRI and Histopathology n = 55

Key:

TP = True positive
FP = False positive
FN = False negative
TN = True negative

DISCUSSION

Magnetic resonance imaging is the modality of choice and non-invasive, safe imaging modality. MRI is the first-line investigation among the patients who are highly suspected for Acoustic neuroma.[12,13] Currently contrast enhanced using Gadolinium At present the gadolinium enhanced magnetic resonance scan is a definitive examination. Lesions as small as 2 mm in diameter and perhaps smaller than it can be detected with the aid of MRI.[14] The MRI findings of the acoustic neuroma are well known and specific[15-16], but its not unusual to have certain unusual features is not unusuald.[17]

Sensitivity	$\frac{\text{True Positive}}{\text{True Positive + False Negative}}$	x 100
	$\frac{42}{42 + 1}$	x 100 = 97.7 %
Specificity	$\frac{\text{True Negative}}{\text{True Negative + False Positive}}$	x 100
	$\frac{11}{11 + 1}$	x 100 = 91.7 %
Diagnostic Accuracy	$\frac{\text{True Negative}}{\text{True Positive + True Negative + False Positive + False Negative}}$	x 100
	$\frac{42 + 11}{42 + 11 + 1 + 1}$	x 100 = 96.4 %

Table-VIII. Sensitivity, specificity and diagnostic accuracy of magnetic resonance imaging for acoustic neuroma

Positive Predictive Value	$\frac{\text{True Positive}}{\text{True Positive + False Positive}}$	x 100
	$\frac{42}{42 + 1}$	x 100 = 97.7 %
Negative Predictive Value	$\frac{\text{True Negative}}{\text{True Negative + False Positive}}$	x 100
	$\frac{11}{11 + 1}$	x 100 = 91.7 %

Table-IX. Positive predictive value and negative predictive value of magnetic resonance imaging for acoustic neuroma

Acoustic neuromas are mildly hyperintense on MR T2-weighted images and are isointense relative to the pons on MR T1-weighted images. Intense gadolinium-DTPA enhancement is exhibited by Meningiomas however Epidermoids do not enhance on MR.[18]

Acoustic neuromas are benign, slow-growing tumours that originate from schwann cells lining the vestibular nerves, most commonly the superior vestibular nerve[19] constituting the most common tumour of the CPA and the posterior fossa in adults, but one in five CPA tumours are not acoustic neuroma. For these sort of lesions different management strategies are required.[20,21] Early diagnosis and prompt surgical treatment is the most important and essential factor in the preservation of hearing loss after surgery; furthermore there is significant reduction in surgery related complications.[22,23] In this study, out of the 55 patients with clinical suspicion of acoustic neuroma, 43 patients

(78.2%) had acoustic neuroma and 12 patients (21.8%) had other CPA pathology. This is in agreement to literature findings which state that acoustic neuromas account for about 70-80% of CPA tumours.[2,24] Out of 12 non-acoustic pathologies, meningiomas and epidermoid cyst were 12.7% and 5.4% respectively which is again an agreement to previous study which stated that meningioma and epidermoid are second and third most common CPA pathology constituting 10-15% and 5% of CPA tumours.[24]

In this study age range of the patients is 10-70 which lies close to the literature in which age range was 26-80 year.[25] Similarly mean age of the patients in this study is 51.9 ±10.5 years which is close to the mean age documented in literature i.e 56.5 years.[26] The highest number of patients was aged between 51-60 years i.e. 25 (45.5%). This is in accordance to literature stating majority of the acoustic neuromas appear after 50 years of lif.[27] In this study, out of 55 patients 35 (63.6.0%) were females and 20 (36.4%) were males. This is also in accordance with the literature, which states that the acoustic neuroma is commoner in females with female to male ratio 3:2.[27]

Most of the acoustic neuromas in this study were better visualized after contrast enhancement. This fact is supported by a studywhich states that contrast enhanced T1-W MR image enhances the capacity to visualize the tumour margins and its intrameatal component.

In the present study, on comparison of results of MRI with histopathology taken as gold standard, out of 55 patients, 42 patients were true positive, 11 patients were true negative, while 1 patient was false positive and 1 patient was false negative. The overall sensitivity of MRI was 97.7%, specificity 91.7% and diagnostic accuracy 96.4% while the positive predictive value of MRI was 97.7% and its negative predictive value was 91.7%. These results are close to results of another study in which MRI was reported to have a sensitivity of 96%, specificity of 88.2%, diagnostic accuracy of 92.86, PPV 92.31 and NPV of 93.75.[28] Results of the present study are also supported by other studies.[11,29,30] This shows that the sensitivity, specificity and diagnostic accuracy of MRI is high enough to allow reliable diagnosis of acoustic neuroma, therefore, it is doubtlessly the best imaging modality for detection of acoustic neuromas.

CONCLUSION

Magnetic resonance imaging is a highly accurate, non-invasive, safe and convenient imaging modality for the evaluation of acoustic neuromas and is valuable for guiding surgical biopsies thereby decreasing unnecessary intervention. It allows detection of small tumours which is very useful in tumour characterization and plays an integral role in early detection, planning management and estimating patient's prognosis.

REFERENCES

1. Sanchez-Legaza E, Melendez Guerrero B, Sanchez Legaza B, Idelfonso Miranda J. **Acoustic neuroma shown as facial palsy.** An Otorrinolaringol Ibero Am 2007; 34: 565-72.

2. Wandong S, Meng L, Xingang L, Yuguang L, Shugan Z, Lei W et al. **Cystic acoustic neuroma.** J Clin Neurosci 2005; 12: 253-255.

3. Di Rienzo L, Artuso A, Lauriello M, Coen Tirelli G. **Pauci-symptomatic large epidermoid cyst of cerebellopontine angle: Case report.** Acta Otorhinolaryngol Ital 2004; 24: 92-6.

4. Haq RN, Chaudhary IA. **Schawanoma disguising as a solitary thyroid nodule.** Pak J Med Sci 2007; 23: 128-9.

5. Myrseth E, Pedersen P.H, Moller P and Lund-Johansen M. **Treatment of vestibular schwannomas. Why, when and how?** Acta Neurochir 2007; 149: 647-660.

6. Wippold FJ, Lubner M, Perrin RJ, Lammle M, Perry A. **Neuropathology for neuroradiologist. Antoni A and B tissue patterns.** Am J Neuroradiol 2007; 28: 1633-1638.

7. Kwan TL, Tang KW, Pak KK, Cheung JY. **Screening for vestibular schwannoma by magnetic resonance imaging: Analysis of 1821 patients.** Hong Kong Med J 2004; 10: 38-43.

8. Curtin HD, Hirsch WL Jr. **Imaging of acoustic neuroma 1992.** Neurosurg Clin N Am 2008; 19: 175-205.

9. Zafar AM, Zuberi LM, Khan AH, Ahsan AH. **Utility of MRI in assessment of pituitary iron overload.** J Pak Med

Assoc 2007; 57: 475-7.

10. Merhemic Z, Kadanic Z, Niksic M, Humackic A, Muftic E, Suleimanpasic G. **MRI as the method of choice in cerebellopontine angle tumors.** Med Arh 2004; 58: 114-6.

11. Stuckey SL, Harris AJ, Mannolini SM. **Detection of acoustic schwannoma: Use of constructive interference in the steady state three dimensional MR.** AJNR Am J Neuroradiol 1996; 17: 1219-25.

12. Bloomer CW, Ackerman A, Bhatia RG. **Imaging for spine tumors and new applications.** Top Magn Reson Imaging 2006; 17: 69-87.

13. Fortnum H, O'Neill C, Taylor R, Lenthall R, Nikolopoulos T, Lightfoot G, et al. **The role of magnetic resonance imaging in the identification of suspected acoustic neuroma: A systematic review of clinical and cost effectiveness and natural history.** Health Technol Assess 2009; 13: 1-154.

14. Wright A, Bradford R. **Management of acoustic neuroma.** BMJ 1995; 3: 1141-4.

15. Armington WG, Harnsberger HR, Smoker WRD, Osborn AG. **Normal and diseased acoustic pathway: evaluation with MR imaging.** Radiology 1988; 167: 509-515.

16. Mikhael MA, Ciric IS, Wolff AP. **MR diagnosis of acoustic neuromas.** J Comput Assist Tomogr 1987; 11: 232-235.

17. Duvoisin B, Fernandes J, Doyon D, Denys A, Sterkers JM, Bobin S, **MR findings in 92 acoustic neuromas.** Eur J Radiol 1991; 13: 96-102.

18. Weber AL. **Magnetic resonance imaging and computed tomography of the internal auditory canal and cerebellopontine angle.** Isr J Med Sci 1992; 28: 173-82.

19. Martinez Del Pero M, Lloyd SK, Moffat DA. **Hearing improvement in a growing vestibular schwannoma.** Skull Base 2009; 19: 159-62.

20. Sarrazin J, Hélie O, Cordoliani Y. **Cerebellopontine angle tumors in adults.** J Radiol 2000; 81: 675-90.

21. Springborg JB, Poulsgaard L, Thomsen J. **Nonvestibular schwannoma tumors in the cerebellopontine angle: A structured approach and management guidelines.** Skull Base 2008; 18: 217-227.

22. Shelton C, Brackmann DE, House WF, Hitselberger WE. **Acoustic tumor surgery: Prognostic factors of hearing conservation.** Arch Otolaryngol He ad Neck Surg 1989; 115: 1213-1216.

23. Moffat DA, Ha rdy D G. **Early diagnosis and surgical management of acoustic neuroma: Is it cost effective?** J R Soc Med 1989; 82: 329-332.

24. Fink JR. **Imaging of cerebellopontine angle masses: Self-assessment module.** AJR Am J Roentgenol 2010; 195: 15-21.

25. Bhadelia RA, Tedesco KL, Hwang S, Erbay SH, Lee PH, Shao W, Heilman C. **Increased cochlear fluid-attenuated inversion recovery signal in patients with vestibular schwannoma.** AJNR Am J Neuroradiol 2008; 294: 720-3.

26. Brooker JE, Fletcher JM, Dally MJ, Briggs RJ, Cousins VC, Smee RI, et al. **Quality of life among acoustic neuroma patients managed by microsurgery, radiation, or observation.** Otol Neurotol. 2010; 31: 977-84.

27. Swensson RC, Swensson RP, Pizzini FE, Boldorini PR, Jorge Júnior JJ. **An uncommon presentation of an VIII nerve tumor.** Braz J Otorhinolaryngol 2008; 74: 628-31.

28. Haque S, Hossain A, Quddus MA, Jahan MU. **Role of MRI in the evaluation of acoustic schwannoma and its comparison to histopathological findings.** Bangladesh Med Res Counc Bull 2011; 37: 92-96.

29. Maurer J. **The role of brain stem evoked potentials in acoustic neuroma screening and diagnosis.** Laryngorhinootologie 2008; 87: 585-96.

30. Thamburaj K, Radhakrishnan VV, Thomas B, Nair S, Menon G. **Intratumoral microhemorrhages on T2*-weighted gradient-echo imaging helps differentiate vestibular schwannoma from meningioma.** AJNR Am J Neuroradiol 2008; 29: 552-7.

Never give up on **anybody**.
Miracles happen **everyday**.

"Unknown"

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author-s Full Name	Contribution to the paper	Author=s Signature
1	Nazish Hameed	Data collection	
2	Muhammad Tahir		
3	Noureen Jahangir		
4	Hassan Bukhari		
5	Hira Bukhari		