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Role of MRI in the evaluation of acoustic schwannoma and its comparison to histopathological findings

Haque S[1], Hossain A[2], Quddus MA[2], Jahan MU[3]

[1]National Institute of Cancer Research & Hospital, Dhaka, [2]Department of Radiology, Dhaka Medical College, Dhaka, [3]Department of Radiology & Imaging, Bangabandhu Sheikh Mujib Medical University, Dhaka.

Abstract

Magnetic Resonance Imaging (MRI) has been the primary imaging modality and has revolutionized the imaging of brain tumors. MRI can display accurate multi planer imaging without interfering of adjacent structures specially for posterior fossa mass lesion. MRI is the imaging modality of choice for cerebollo-pontine (CP) angle Schwannoma. The study was performed to determine, the diagnostic accuracy of MRI in the evaluation of intracranial extra axial CP angle Schwannoma. MRI scan of brain was done on 42 consecutively selected patients referred for the evaluation of CP Acoustic Schwannoma. The age range from 21-60 years and the mean age was 42.85(±9.5) years. Highest incidence of cerebollo-pontine angle (CPA) mass were found 42.86% in 41-50 age group of patients. Male and Female ratio was 1.083:1. The most common presenting feature of the patients with CP angle Acoustic Schwannoma were headache 90.48%. Acoustic Schwannoma is T_1 hypointense 100%, T_2 hyper intense 84.61% and heterogeneously hyper intense 92.30% in FLAIR image. After giving contrast agents, homogeneous enhancement 57.69% and heterogeneous 42.31% cases of Acoustic Schwannoma. Overall 61.54% Acoustic Schwannoma strong contrast enhancement was observed. Dural tail was observed in 26.92% cases. Perilesional edema was observed 38.46% cases. Mass effect was observed in 76.92%. After complete MRI evaluation 61.9% had Acoustic Schwannoma. Histopathologicaly proved cases showed out of all patients Acoustic Schwannoma 59.52%. The overall sensitivity of MRI to diagnose Acoustic Schwannoma were found, Sensitivity- 96%, Specificity- 88.2%, PPV-92.31%, NPV-93.75% and Acceuracy 92.86%. Test is significant with $p<0.0001$ level. It is conceivable that MRI is a highly accurate, sensitive and Gadolinium enhanced MRI is more sensitive in detection of acoustic Schwannoma. MR imaging is the study of choice for the examination of the patient of cerebellopontine angle Schwannoma because of its high sensitivity specially after use of contrast material.

Introduction

Intra-cranial tumors are the most devastating illness in human being. In the developed world, cerebral tumors account for 2% all death at all ages[1]. The incidence of Primary intracranial cerebollo-pontine (CP) angle Schwannoma account approximately 8-10% of all neoplasms. The most common cerebollo-pontine angle (CPA) mass is Acoustic Schwannoma. Among the CPA masses, vestibular Schwannoma accounts 75% of the lesions[2]. With the advent of Computed Tomography (CT) and Magnetic Resonance Imaging (MRI) there is revolutionary change in the detection of intracranial tumor[3]. Now the availability and cost effectiveness with greater accuracy and fewer false negative cases, MRI has become the prime modality of investigation to detect intracranial tumors specially Acoustic Schwannoma. In MRI, multi planner imaging, cross sectional anatomical detail sagittal coronal axial reformat with contrast and FLAIR images plays excellent role and remains as a major imaging technique for detection and localization of CPA Acoustic Schwannoma[2]. Modern 1.5 Tesla or above high resolution MRI with Diffusion Weighted image and Perfusion Weighted image and gradient Echo, FLAIR images will localize and characterize the vast majority of cerebello-pontine angle Acoustic Schwannoma[4].

This study assess the effectiveness of MRI for the evaluation of CPA Acoustic Schwannoma and its comparison with histopathological findings. It also elucidate the accuracy, sensitivity, specificity of MRI in detection of acoustic Schwannoma.

Materials and Methods

This cross sectional prospective observational study was carried out on consecutively selected 47 patients ranging from 21-60 years of age referred for MRI scan of brain with a clinical suspicion of

CP angle mass in the Department of Radiology and Imaging Dhaka Medical College Hospital (DMCH), Dhaka in collaboration with the department of Neurosurgery and Pathology of same Hospital from July 2008 to March 2010. At first all the patients were evaluated by detail history and clinical examination with special emphasis on nervous system. Subsequently MRI scan of brain was performed in all cases. Patients who were operated continuously followed after the surgery up to histo-pathological diagnosis were made. The histopathological reports were collected thus, were compared with MRI findings. All these information's were collected in pre-designed structured data collection sheets. Inclusion criteria was suspected cases of cerebello-pontine angle masses referred to the department of Radiology and Imaging DMCH from Out Patient Department (OPD) or Indoor. Patients who were unfit for surgery or nor willing to undergo surgery also Patients in whom histopathological report were unavailable, were excluded from the study.

Result

The main objective of the study was to establish the diagnostic usefulness of MRI in detection of CP Angle Schwannoma.

A total number of 42 patients who were clinically suspected, having CP angle cistern mass were included consecutively in this study. The age range was from 21-60 years. The highest incidence of CPA masses was found in 42.86% was found in the age between 41-50 years age group and followed by 51-60 years of age group 23.81% and 21.43% in 31-40 years age group and 11.90% at the age 21-30 years age group.

Table I: Age distribution of the respondents (n=42)

Age group (years)	Frequency	Percent
21-30	5	11.90
31-40	9	21.43
41-50	18	42.86
51-60	10	23.81
Total	42	100.00
Mean±SD	42.85±9.50	

Out of 42 respondents (22) 52% was male and (20) 48% was female. Male and female ratio is 1.0833.

Table II: Sex distribution of the respondents (n=42)

Sex	Frequency	Percent
Male	22	52%
Female	20	48%
Total	42	100%
Mean±SD	21.0±0.21	

The most common presenting feature associated with CPA tumor was headache which was observed in 38 patients (90.48%). Another common symptom was tinnitus 80.95%, Vertigo 61.90% and 52.38% complained of hearing loss than followed by disequilibrium 40.48% and facial weakness 21.43%.

Table III: Distribution of the respondents by clinical feature (n=42)

Clinical feature	Frequency	Percent
Tinnitus	34	80.95
Hearing loss	22	52.38
Disequilibrium	17	40.48
Vertigo	26	61.90
Facial weakness	9	21.43
Headache	38	90.48
Exopthalmus	5	11.90
Wide gait	7	16.67

Table IV: MRI features of Acoustic Schwannoma (n=26)

MRI findings	Characteristics	No of cases	Percent
Signal intensity	T_1WI- Hypointense	26	100%
	T_2WI- Hyper intense	22	84.61%
	FLAIR: heterogenously hyper intense	24	92.30%
Contrast	Homogeneous	15	57.69%
Enhancement	Heterogeneous	11	42.30%
Enhancement	Strong	16	61.53%
Character	Moderate	10	38.46%
Mass effect		20	76.92%
Perilesional oedema		10	38.46%
Dural tail		7	26.92%
Involvement of internal acoustic canal		19	73.07%

Table-IV shows the different MRI features of Acoustic schwannoma. Out of all tumors 100% were hypointense in T1W1 and 84.61% hyper intense in T2W1 and 92.30% tumors were heterogeneously hyper intense in FLAIR image

After giving contrast agents, homogeneous enhancement was observed in 57.69% cases and heterogeneous in 42.30%. Enhancement was strong in 61.53% and moderate enhancement in 38.46% cases. 76.92% had mass effect, perilesional edema 38.46% cases. Dural tail was observed in 26.92% and involvement of Internal Acoustic Canal (IAC) in 73.07% cases. Out of 42 patients 21(50%) tumor was mixed in nature, 18(42.86%) solid and 3 (7.14%) was cystic in nature. Out of all cases 24 was diagnosed as AS by MRI and Confirmed by histopatholigical evaluation they were true positive. 2 case was diagnosed as Acoustic Schwannoma (AS) by MRI, but not confirmed by histopathological findings. They were false positive. Of 16 cases of other than Acoustic Schwannoma which were confirmed by MRI, 1

was confirmed as Acoustic Schwannoma and 15 were other than AS by histopathology. They were false negative and true negative respectively.

Table V: MRI findings and Histopathological findings of schwannoma: (n=42)

Test Result MRI Diagnosis	True state of patients Histological diagnosis		Total
	True schwannoma	False schwannoma	
Positive	True Positive (TP) 24	False Positive (FP) 2	Patients with positive test (TP + FP) 26
Negative	False Negative (FN) 1	True Negative (TN) 15	Patients with Negative test (FN + TN) 16
Total	All patients with true schwannoma (TP+FN) 25	False schwannoma (FP+TN) 17	All Patient studied (TP+FP+FN+TN) 42

Sensitivity of MRI diagnosis for schwannoma was 96%, specificity 88.24%, positive predicative value 92.31%, negative predicative value 93.75% and accuracy 92.86%. Chi-square test results χ^2 =31.695 with 3 degree of freedom. The two tailed p value is less than 0.0001 by conventional criteria this p value is considered to be extremely statistically significant.

Discussion

The diagnostic approach to neurological problems has undergone significant change with the introduction of Magnetic Resonance Imaging MRI has proven to be an excellent technique for visualization of the posterior fossa and CP Angle tumor.Magnetic Resonance Images can be acquired with equal clarity in any orientation, axial, sagittal, coronal, image, artifacts from bone are absent with MRI. MRI is the imaging modality of the choice for CPA and internal auditory canal masses[5]. MRI should be used complementarily in CPA diagnostics[5].

Gadolinium di-ethylene tri amino penta acetic acid (Gd-DTPA) enhanced MRI imaging improves the reliability of CPA mass diagnosis. Schwannomas are more contrast enhancing than Meningiomas. Big Schwannomas presented mostly heterogeneous enhancement caused by the cystic degeneration, necrosis and hemorrhage[5]. MRI imaging is the study of choice for the examination of patients with suspected Schwannoma, because of its high sensitivity, especially after the use of contrast material[3]. A large variety of unusual lesion can be encountered in the CPA and should be differentiated from acoustic neuroma and meningioma. Signal intensity at MRI imaging enhancement, shape and margins, extent, mass effect is helpful in establishing the diagnosis[6,12.] This study was carried out with an aim to establish the usefulness of MRI in detection of acoustic Schwannoma and to compare the post operative histopathological diagnosis of CPA Schwannoma with the MRI along with its validity tests by calculating sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) respectively of MRI.

In this study the mean age of the patient was 42.85±9.25 years of age range from 21-60 years. Highest incidence of CPA mass was 42.86% found in 41-50 years age group followed by 23.81% in 51-60 years age group.

Regarding the Acoustic schwannoma Mulkens et al. (1993) worked with 81 patients of Acoustic Schwannoma in which the mean age was 54 years[3]. The age range of the present study which is almost similar that of the study of Mulkens et al[3]. Similarly Osborn (1994) has mentioned the peak occurrence of Acoustic Schwannoma between 40–60 years[13].

In our series out of all respondents 52% were male and 48% were female. According to Osborn[13] (1994) it has a slightly female preponderance (1.5:1-2:1) which contradicts to our study, where we found that ratio of male and female was almost equal[2,9].

Symptoms and signs of brain tumor can result from the focal effects of the tumor on neighboring areas. The symptoms of CPA masses arise from compression of local structures within as at the boundaries of the region, compression of fibres of cochlear nerve may result in sensory hearing loss[1]. The most common presenting symptoms headache 90%, tinnitus 80%. 26 cases of AN- hearing loss may be sudden, and tinnitus was found in 56% cases. Clinical presentation of CPA masses were found tinnitus, hearing loss, disequilibrium and visual disturbances. In the present study the most common presenting symptom was headache, sensory hearing loss, tinnitus and visual disturbances which is almost same with the previous study[1,5,12].

In the present series Acoustic-Schwannoma was hypointense in T_1 WI in all cases (100%) and hyper intense in T_2WI 22(84%). In FLAIR heterogeneously hyper intense 24(92%) cases contrast enhancement was homogeneous in 15 (57%) cases and heterogeneous in 11(43%) cases.

Pattern of enhancement was strong in 16(61%) cases and moderate was 10 (39%) cases. Mulkens et al[3,4] (1993) has found 35% of tumors was iso intense to brain, 63% were hypointense in T1W1

and after contrast all tumors showed intense enhancement[3,7]. It was homogeneous in 67% and inhomogeneous 10% and heterogeneous with areas of cystic degeneration in 22%. Osborn (1994) has mentioned that 70%-75% tumors specially Acoustic Schwannoma were hypointense to brain and 25% was iso intense, tumors were hyper intense in T^2 WI[13]. Almost homogeneous enhancement 67% and mildly inhomogeneous 10% cases and heterogeneous in 22% which show similar result with the present study[2].

In the present series it was observed that mass effects were present in 20(76%) cases of Schwannoma. MR imaging has rapidly supplemented other imaging techniques in the diagnosis of these tumors, especially after the development of paramagnetic contrast agents. The use of contrast material improves the sensitivity of MR imaging by selectively increasing the level of contrast enhancement in all acoustic schwannomas[7,8]. The capillaries of these extra-axial tumors do not exhibit a blood brain barrier and theirs degree of enhancement is greater that of any other intra-cranial tumor[3]. 39% of Acoustic schwannoma T_2 weighted images mild to moderate peritumoral edema was visible.

Mulkens et al. (1993) showed 13(37%) of the 35 T_2 WI- mild of moderate peritumoral edema was visible in AN which is compatible with present study[3].

Dural tail was found in 7 out of 26(26%) schwannoma. It is an important sign in the differential diagnosis of tumor centered at the meatus of the internal auditory canal and or with an "acute angle" with the petrous bone is more likely to be an acoustic schwannoma. In our study we found that 19 out of 26(73%) Acoustic Schwannoma has an involvement to internal acoustic canal. The angle formed between the tumor border and petrous bone was acute in 81% which is quite similar with present study. From the result of present study as well as the findings obtained by other study[4], it is conceivable that MRI is a highly accurate and sensitive and Gadolinium enhanced MRI is more sensitive in detection of Acoustic Schwannoma[8,9]. MRI imaging is the study of choice for the examination of patients with suspected CPA masses because of its high sensitivity specially after use of contrast material.

Sensitivity of MRI diagnosis for schwannomas was 96.00%, specificity 88.24%, positive predicative value 92.31%, negative predicative value 93.75% and accuracy 92.86%. Mulkens et al.(1993) have found sensitivity for Schwannoma 98.00% accuracy 83.33%, PPV 92.77%[3]. This results are strongly comparable with that of results of present study.

Swieszewska: et al. (2006) found overall sensitivity specificity and accuracy of cerebello pontine angle masses were 86.52%, 80.00% and 84.87% respectively[5]. In the present study the results were found to be comparable with this results mentioned above[5].

From the results of present study as well as the findings obtained by Smirniotopoulos, Yue and Rusbing (1993), it is conceivable that MRI is a highly accurate and sensitive modality in the evaluation of cerebello pontine angle Schwannoma[4]. So MR Imaging is the study of Choice for examination of patients with suspected CP Angle Schwannoma.

Conclusion: MRI findings of the present study correlated well the histo pathological results. It can therefore be concluded that MRI is useful modality and study of choice in the diagnosis of CPA Schwannoma because of its high sensitivity and specificity specially after the use of contrast. MRI thus can be regarded as an important imaging modality in the diagnosis of cerebello pontine Angle Acoustic Schwannoma[1,3,5].

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