Original Article

Magnetic Resonance Imaging (MRI) Evaluation of Sellar Region Tumors with Histopathological Correlation

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Abstract

MRI is a complex, rapidly evolving modality which has assumed an increasingly important role in the diagnosis of Sellar region tumors. It is now the preferred modality for the definitive evaluation and follow-up of the most sellar region tumors. Using different pulse sequence small lesion can be detected even without contrast. Gd-DTPA provides valuable information in MR imaging sellar region tumors, particularly in pre-operative evaluation. This study was conducted to elucidate the accuracy of MRI in pre-operative evaluation of sellar region tumors and its validity by determining sensitivity, specificity, positive and negative predictive value with histopathological correlation. This cross sectional observational study was carried out in the department of radiology and imaging in collaboration with department of Neurosurgery, Dhaka Medical college Hospital, Dhaka during the period of January 2008 to April 2009. MRI of brain was done on 42 patients referred for evaluation of sellar region tumors. The following result and observation were obtained. The age range of the patient was 20 to 80 years. The mean age (HSE) was 34.31(+2.80). Maximum patients were in age group 20-30 years and male-female ratio was 1.8:1. Most sellar region tumor located in the intrasellar with suprasellar extension. Out of 42 patients 37 (88%) patients were truly diagnosed by MRI as sellar region tumors. The sensitivity of MRI to diagnosed macro adenoma was 81.25%, specificity 80.76%, positive predictive value 72.2%, negative predictive value 87.5%, accuracy 80.95%. This study finds that MRI is a valid imaging modality in the diagnosis of pituitary adenoma and sellar region tumor.

Keywords: *MRI, sellar region tumors, pituitary adenoma.*

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INTRODUCTION

The key questions to be answered when a patient with a pituitary problem undergoes an evaluation by any imaging modality. These questions are: is there any lesion and if so, what type? How large is it? Dose it after visual pathway? Does it involve cavernous sinus? The answer to these questions is important because they affect the choice of therapy. At present high resolution high field MR imaging has become widely accepted as the most sensitive method for imaging of pituitary adenomas. Its' multi-planner imaging capability, lack of ionizing radiation, absence of beoe artifact and better soft tissue contrast has made it the investigation of choice in detecting sellar region tumors. Approximately 80% - 90% of micro adenomas are hypo intense to normal gard on TIWI, while 30%-50%are hyper intense on T2WI (Roddie and cel1997). Gd DTPA enhancement provides greater contrast between gland and relatively non enhancing tumor and increase the capaity of MRI for detection of micro adenoma.[31] Micro adenomas are usually obvious and are well shown on TIWI, which usually iso to hypo intense. On T2WI, the lesion is iso to hyper intense and adherences (enhances) uniformly with contrast media. Extension and relation to surrounding structures can be well assessed by MRI.[19]

A true positive rate of 81%-100% has been reported in MR imaging at 1.5 tesla in the detection of micro adenomas without using contrast media.[17,28]

Several other studies also suggest a higher rate of detection after gadolinium.[6,20]

Though the investigation is costly, early detection of tumor before involvement of parasellar structure especially cavernous sinus is very much beneficial for the patient, when resection is easier. Thus this study is intended to assess the efficacy of MRI in the evaluation of Sellar region tumor with histopathological correlation.

MATERIALS AND METHODS

This cross sectional observational study was carried out during January 2008 to April 2009 in the department of Radiology and Imaging, Dhaka medical Collage Hospital in collaboration with the department of Neurosurgery and Pathology of the same hospital. Total 52 patients who were clinically suspected having sellar region tumor included consecutively in this study among them 45 patients ranging from 20 - 80 years of age were selected purposively as respondents who were referred for MRI of pituitary gland with visual field defect, cranial nerve palsy, and/ or endocrinological suspicion of sellar region tumor. system. Subsequently MRI scan of brain was performed in all cases and data were collected in a predesigned structured data collection sheets (proforma). Those patients who were operated were continuously followed up after the surgery up to histopathological diagnosis was made.. Then the collected reports were correlated with findings of MRI. All this information's were collected in predesigned structured data collection sheets. After approval of research protocol from the department, ethical clearance was taken from Ethical Review Board of Dhaka medical Collage. Verbal and written informed consent from the patients was obtained. Information and records of patients were kept anonymously with maintaining confidentiality.

Imaging technique and procedure:

MR imaging was obtained with 0.3 Tesla systems TIWI MR Sagittal, Coronal, and axial scan were obtained first using short TR (500-800ms) and short TE (14-20 ms). Coronal and axial T2WI image were taken using long TR (3500-4500ms) and long TE (80ms). After bolus intravenous injection of 10ml (4.69gm) contrast media namely Magnevist (Dimeglumine gadopentate) TIWI sagittal, coronal and axial scan were taken immediately. Slice thickness was 3-5mm with a field of view 20-23cm and pictures matrix was 256x256 or 192x256.

MRI diagnostic criteria:

MRI appearance pituitary microadenoma

TIWI: Isointense to hypo intense. (Osborn 1994)

T2WI: 30% -50% micro adenoma hyper intense (Kucharczyk et al., 1986).

Post contrast: (1) Focal mass that enhance less rapidly and less intensely than normal gland. (2) Delayed scan shows enhancement of mass lesion.

MRI appearance of pituitary macro adenoma:

MRI diagnosis: (Osborn 1994, Hagga 1994)

Size- more than 10mm

Shape- figure of eight (in coronal section)

- Displacement of optic chiasma upwards may be seen
- Compression on the 3rd ventricle resulting hydrocephalus
- Lateral extension may causes encasement of Cavernous sinus
- There may be erosion of sellar floor and may involve brain stem The tumor is –

TIWI- isointense to parent gland (but may be variable if there is hemorrhage,necrosis and cyst formation; T2WI- isointense-slightly hyperintenses.[19] Post contrast-delayed strong inhomogeneous enhancement.[20] Calcification is rare & reported in 1% to 2% cases.[30]

Sellar region meningioma:

MRI diagnosis: (Osborn 1994, Hagga 1994) Smooth well defined mass supra sellar ± in location

TIWI: iso to hypo intense suprasellar mass may be associated with calcification which is hypointense in both T1 WI and T2WI; T2WI: Iso to hypo to slightly hyper intense.

Post contrast: Intense homogenous contrast enhancement is noted but not intense as adjacent

pituitary and Cavernous hemangioma Duraltail: contrast enhance duramater is pathog nomic.

Craniopharyngioma:

MRI diagnosis: (Osborn 1994, Hagga 1994)

Of all sella region mass craniopharyngioma have the most heterogeneous MR imaging spectrum signal is highly variable the most common pattern is

TIWI: hypo intense to isointense to hyper intense (depending upon its content like high protein concentration and blood degradation product in free solution or both; T2WI: hyper intense to adjacent gland

Post contrast: Strong rim enhancement but Heterogeneous.

Focal calcification low signal rim or low signal globular area in both T1 and T2.

RESULT

The main objective of the study was to establish the diagnostic usefulness of MRI in detection of sellar region tumor. This cross sectional study was done on 42 purposively selected patients whose age range from 20-80 years.

Table-1 shows the age distribution of 42 patients. The mean age (±SD) was 34.31 (±2.80) years. 47.62%, 30.95%, 9.52%, 9.52% and 2.38% patients were in age group 20-30, 31-40, 41-50, 51-60 and 71-80 years respectively. No patient was found in age group 61-70 year.

Table I: Distribution of the respondent by age: (N=42)

Age group (Years)	Frequency (N-35)	Percentage (%)	Mean age ±SE
20-30	20	47.62	
31-40	13	30.95	
41-50	4	9.52	34.31
51-60	4	9.52	±2.80
61-70	0	0	
71-80	1	2.38	
Total	42	100	

Table- II shows the clinical feature of the patients with sellar region tumor. Headache was found in 85.71% of patient followed by vomiting 35.71%, visual disturbance 35%, secondary amenorrhea 47.6%, with galactorrhoea (23.80%), polyuria and polydipsia 11.9% and 7.1% present with acromegaly.

Table II: Distribution of respondent according to clinical feature (Multiple responses)

Clinical feature	Frequency	Percentage
Headache	36	85.71
Vomiting	15	35.71
Visual disturbance	15	35.71
Secondary Amenorrhea	20	47.6
Galactorrhoea	10	23.80
Polyuria, polydipsia	5	11.90
Convulsion	5	11.90
Acromegaly	3	7.1

Table III shows location of sellar region tumor according to MRI findings.

Among 42 sample about half of the tumors were (20) in intracellar with supjrasellar Extension, 12 were Intrasellar and 7 were suprasellar.

Table III: Location of sellar region tumor according to MRI findings:

Intrasellar.	12
Suprasellar.	7
Intrasellar with supjrasellar Extension	20
Intrasellar with supjrasellar and Para sellar Extension	3
Total	42

Table IV shows that 28 tumors were truly diagnosed by MRI as pituitary adenoma, 18 of which were macro adenoma and rest 10 cases were micro adenoma within other 14 cases 6 were diagnosed as meningioma, 6 were diagnosed as craniopharyngioma and rest 2 were normal on MRI examination though they are clinically suspected and were referred for MRI].

Table IV: Distribution of respondents MRI Signal intensity

Name of the tumor	Imaging Sequence	Hypointense	Hypointense	Isointense	intensity	Total %
Macro adenoma	TIWI	3 (17%)	2 (11%)	11 (61%)	2 (11%)	100
	TIWI	0	12 (67%)	4 (22%)	0	100
Micro adenoma	TIWI	6 (60%)	0	4 (40%)	0	100
	TIWI	2 (20%)	3 (30%)	5 (50%)	0	100
Meningioma	TIWI	3 (50%)	0	3 (50%)	0	100
	TIWI	3 (50%)	0	3 (50%)	0	100
Craniopharyngioma	TIWI	3 (50%)	1 (17%)	2 (33%)	0	100
	TIWI	0	4 (67%)	0	2 (33%)	100

Table V shows the distribution of sellar region tumor according to contrast enhancement pattern; out of 40 diagnosed MRI positive sellar region tumors, all 10 micro adenoma (100%) did not show early contrast enhancement. Out of 18 macro adenomas 12 enhances homogenously and 06 enhances heterogeneously and 05 meningioma shows strong uniform homogenous enhancement and 01shows heterogenous nhancement, 04 caniopharyngioma shows ring enhancement and 02 shows heterogenous enhancement.

Table V: Distribution of sellar region tumor according to contrast enhancement pattern

Tumor	Enhancement pattern		Ring
	homogenous	heterogeneous	
Macro adenoma	12 (delayed)	6 (delayed)	
Micro adenoma	6 (delayed)	4 (delayed)	
Meningioma	5	1	
Craniopharyngioma		2	4
Normal pituitary gland	2 (early)		

Table VI shows the distribution of sellar region tumor according to MRI diagnosis; among 42 patients who underwent MRI examination, 18 patients (42.85%) diagnosed as pituitary macro adenoma and 10 (23.8%) pituitary micro adenoma; 06 (14.3%) as meningioma, others 06 (14.3%) were craniopharyngioma, where 02 (4.8%) clinically suspected patients were diagnose as normal in MRI.

Table VI: Distribution of sellar region tumor according to MRI diagnosis N=42

MRI diagnosis	Frequency	Percentage
Macro adenoma	18	42.9
Micro adenoma	10	23.8
Meningioma	6	14.10
Craniopharyngioma	6	14.3
Normal	2	4.8
Total	42	100%

Table VII shows the distribution of sellar region tumor according to histopathological diagnosis in compare with MRI diagnosed cases; out of total 42 patients 40 patients were operated and histopathological examination was done. Histopathologically 16 (40.0%), 8 (20%), 7 (17.5%) and6 (15.0%) patients were diagnosed as macro adenoma, micro adenoma, meningioma and craniopharyngioma respectively. Among the MRI diagnosed 40 cases total 37 (93.0%) cases were confirmed histopatho- logically.

Here, MRI diagnosed 18 patients who were as macro adenoma 2 of them not confirm by histopathology, likely 10 of micro adenoma 8 were diagnosed histopathologically, where all 6 meningioma and craniopharyngioma were histopathologically confirm as same tumor; but 1 case which was MRI negative but histopathologically positive as meningioma. As, 37 patients were histopathologically positive from 40 MRI positive patients of sellar region tumor of which 4 MRI positive were histopathologically negative and 1 MRI negative was histopathologically positive, then 4 cases were false positive and 1 case was false negative.

Table VII: Distribution of histopathologically confirmed cases in compare with MRI diagnosed cases

	MRI diagnosed cases		Histopathologically confirmed cases	
	Frequency	Percentage	Frequency	Percentage
Macro adenoma	18	45.0	16	40.0
Micro adenoma	10	25.0	8	20.0
Meningioma	6	15.0	7	17.5
Craniophryngioma	6	15.0	6	15.0
Total	**40**	**100%**	**37**	**93%**

Table VIII shows the distribution of sellar region tumor according to their size; among 40 MRI positives and the range of size was 6mm - 54mm. Maximum number (50%) of tumors were in size ranges 0mm-10mm 25% and 21mm-30mm 25%.

Table VIII: Size distribution of the tumor MRI:

Size	Frequency	Percentage
0-10	10	25
12-20	5	12.5
21-30	10	25
31-40	5	12.5
41-50	6	15
51-60	4	10
Total	**40**	**100**

Table IX shows the distribution of MRI findings by histopathological findings for pituitary micro adenoma among the cases 7 were diagnosed as microadenoma and confirm by histopathological evaluation as true positive. Other 3 cases were diagnosed as micro adenoma, but histopathological were negative and included as false positive. Rest 32 cases of other than microadenoma one was confirm as pituitary micro adenoma and remaining 31 were other than pituitary microadenoma by histopathology and those were included as false negative and true negative respectively.

Table IX: Distribution of respondents of MRI findings by histopathological findings for pituitary micro adenoma:

MRI	Histopathology		Total
	Positive(+)	Negative(-)	
Positive (+)	7 (TP)	3 (FP)	10
Negative (-)	1 (FN)	31 (TN)	32
Total	8	34	42

Table X shows the Sensitivity, Specificity, Accuracy, Positive and Negative Predictive Values of the MRI in the diagnosis of Pituitary micro adenoma. Sensitivity of MRI diagnosis to micro adenoma was 87.5%, specificity 91.17%; positive predictive values are 70%, negative predictive values 91.17% and accuracy 90.47%.

Table X: Sensitivity, specificity, accuracy, positive and negative predictive values and accuracy of the MRI in the diagnosis of Pituitary micro adenoma

Sensitivity	87.5%
Specificity	91.17%
Positive predictive Values	70.0%
Negative predictive Values	91.17%
Accuracy	90.47%

Table XI shows the distribution of MRI findings by histopathological findings for pituitary macro adenoma where 13 MRI diagnosed macroadenoma cases were confirmed by histopathological

findings and included as true positive. Other 5 diagnosed cases were not confirmed by histopathologically and included as false positive. Another 24 cases other than macro adenoma by MRI diagnosis, from those cases 3 were confirmed as macro adenoma and 21 were other than macro adenoma by histopathology and included as false negative and true negative respectively.

Table: XI. Distribution of the respondent's MRI findings by histological findings for pituitary macro adenoma

MRI	Histopathology		Total
	Positive (+)	Negative (-)	
Positive (+)	13 (TP)	5 (FP)	18
Negative (-)	3 (FN)	21 (TN)	24
Total	16	26	42

Table: XII shows the sensitivity, specificity, accuracy, positive and negative predictive values of the MRI in the diagnosis of pituitary macro adenoma, where sensitivity of MRI diagnosis to micro adenoma was 81.25%, specificity 80.76%, positive predictive values72.20%, negative predictive values 80.95% and accuracy was 80.95%.

Table: XII. Sensitivity, specificity, positive and negative predictive values and accuracy of the MRI in the diagnosis of pituitary macro adenoma.

Sensitivity	81.25%
Specificity	80.76%
Positive predictive Values	72.20%
Negative predictive Values	87.5%
Accuracy	80.95%

Table XIII shows the distribution of MRI findings by histopathological findings for Supra sellar meningioma where 5 from 6 MRI diagnosed meningiomas were confirmed as true positive and l case was not confirm that is false positive by histopathologically. From 36 cases other than meningioma, 2 cases were diagnosed histopathologically as meningioma, which are false negative and other 34 cases other than meningioma also confirm by histopathology and included as true negative.

Table: XIII. Distribution of the respondent's MRI findings by histological findings for Supra sellar meningioma:

MRI	Histopathology		Total
	Positive (+)	Negative(-)	
Positive(+)	5 (TP)	1(FP)	6
Negative(-)	2(FN)	34(TN)	36
Total	7	35	42

Table: XIV shows the sensitivity, specificity, accuracy, positive and negative predictive values of the MRI in the diagnosis of supra sellar region meningioma, where sensitivity of meningioma in MRI was 74.42%, specificity 97%, positive predictive values 83.33%, negative predictive values 94.44% and accuracy 92.85%.

Table: XIV. Sensitivity, specificity, positive predictive values, negative predictive values and accuracy of the MRI in the diagnosis of supra sellar region meningioma

Sensitivity	71.42%
Specificity	97.12%
Positive predictive Values	83.33%
negative predictive Values	94.44%
accuracy	92.85%

Table XV shows the distribution of MRI findings by histopathological findings for craniophary- ngioma where 5 MRI diagnosed craniophary- ngioma were confirmed by histopathologically as true positive and 1 case was not confirmed which included as false positive. From 36 cases other than craniopharyngioma 1cases was confirmed histopathologically as craniopharyngioma and 35 were other than craniopharyngioma and included as false negative and true negative respectively.

Table: XV. Distribution of the respondents of MRI findings by histological findings for craniopharyngioma:

MRI	Histopathology		Total
	Positive (+)	Negative(-)	
Positive(+)	5 (TP)	1(FP)	6
Negative(-)	1(FN)	35(TN)	36
	6	36	42

Table: XVI shows the sensitivity, specificity, accuracy, positive and negative predictive values and accuracy of MRI in the diagnosis of craniopharyngioma. Sensitivity of MRI to diagnose craniopharyngioma was 83.3%, specificity 97.22%, positive predictive values 83.3%, negative predictive values 97.2% and accuracy is 95.2%.

Table: XVI. Sensitivity, specificity, positive predictive values, negative predictive values and accuracy of MRI in the diagnosis of craniopharyngioma:

Sensitivity	83.3%
Specificity	97.22%
Positive predictive Values	83.3%
negative predictive Values	97.22%
accuracy	95.2%

DISCUSSION

Among sellar region tumor pituitary adenomas are common benign epithelial tumors that arise from adenohypophysis and constitute 10% to 15% of all intracranial tumors (olson and wells, 1997). The clinical presentation and classification depends primarily on whether they are functioning (non-secratory) from radiological perspective, it is the best to classify adenoma on the basis of their size, and those less than 10 mm in diameter being considered as micro adenoma and greater than 10 mm are macro adenoma.

This cross sectional study was carried out by 0.3T MRI with 3-5mm slice thickness. The study included 42 patients, age ranging from 20 to 80 years. MRI of the sellar region was performed in all cases and 28 cases were diagnosed as pituitary adenoma among them 18 were macrodome and 10 were micro adenoma by this imaging modalities. MRI failed detect 2 micro adenoma though they had strong clinical and hormonal evidenced of pituitary adenomas and 2 macro adenomas even of their presence of mass effect .They are histologically detect as other sellar region tumor than pituitary adenoma. One of the diagnosed macro adenoma histopathologically diagnosed as meningioma so 6 MRI suspected sellar region meningioma confirm by histopathology and there is also 1 case (MRI false positive of macro adenoma) diagnosed histologically as meningioma. With this imaging technique the normal anterior pituitary gland was found to be homogenous internal signal intensity, isointense to cerebral white matter on both T1WI and T2WI (photograph la,b). TIWI sequences were found as the most sensitive in demonstrating internal signal intensity changes within the gland containing adenoma. Within 10 cases 6(60%) were TIWI hypointense and 4(40%) were TIWI isointense which strongly correlate with the findings.[18] After gadolinium the hypointense area was visible as more hypointense due to relative nonenhancement of tumor.

On T2WI, 50% of micro adenomas are isointense and 30% are hyperintense and 20% are hypointense. So, T2WI imaging methods was less sensitive as suggested[22] and 61% macro adenoma were isointense on T1WI and 22% were mixed intensity and on T2WI, 67% macro adenoma were hyperintense and 22% were isointense and 11% were isointensity 11% were mixed intensity. Contrast enhancement were noted in all cases but delayed and variable like 23 cases were homogenous, 13 were heterogeneous and 4 were ring enhancement. Contrast enhancements were noted in 95% of sellar region tumor these findings are similar to the result.[20]

In 2 cases hyper intensity was noted in both TIWI andT2WI and was diagnosed as haemorrhagic pituitary adenoma (photograph 7a, b). These patient present with acute onset of headache and blurring of vision which can be correlated with pituitary apoplexy syndrome.[27]

In three cases there was focal hypo-intensity on TIWI (photograph 8a,) which were hyper intense on T2WI and non-enhancing after contrast (photograph 5a, 8b). The signal intensity changes are characteristic of cystic degeneration within the tumor. Infundibular deviation was noted in 30 cases and also in 2 micro adenoma and 22 macro adenoma (photograph7b). Cavernous sinus invasion was noted in six cases (17%) cases. In two of them there were definit sign of cavernous sinous invasion like carotid artery encasement.[34]

Compression of optic chiasma noted in 30(71%) of sellar region (photograph 6a b). All of these patients had visual problem and in one patient there was complete loss of vision. Third nerve palsy was reported in 3(8.6%) and 15 patients (35.7%) had indentation of third ventricle (photograph 5b) and hydrocephalus noted in 4 cases (9.5%) (photograph 8b). Two of these patients had severe headache and vomiting and two had headache and convulsion. Thirteen patient of meningioma arise from tuberculum sella (Sutton etat.,1998) which may extened in to the sella and may simulate pituitary adenoma.[23] In the present series sensitivity of MRI to diagnose pituitary micro adenoma was 87.5%, specificity was 91.1%, positive predictive value was 70.0%, and negative predictive value was 91.17%, accuracy 90.47%.

In the present series the sensitivity of MRI to diagnosis macro adenoma was 81.25%, specificity was 80.76%, positive predictive value was72.20%, negative predictive value was 87.5% and accuracy was 80.95%.

In the present series the sensitivity of MRI diagnosis of sellar region meningioma was 74.42%, specificity was 97%, positive predictive value was 83.33%, negative predictive value was 94.44% and accuracy was 92.85%

In the present series the sensitivity of MRI diagnosed craniopharyngioma was 83.3%, specificity was 97.22%, positive predictive value was 83.3%, Negative predictive value 97.22% and accuracy 95.2%. Kulkarni et al. in 1988 showed 83% MR sensitivity of micro adenoma and 100% for macro adenoma.[18] demonstrated 91% and 100% sensitivity for micro adenoma and macro adenoma respectively. In this study MR sensitivity of macro adenoma was 81.25% and micro adenoma was 87.5%. The possible cause of lower sensitivity in this study was higher slice thickness (5mm) and 0.3T MRI machine.

CONCLUSIONS

The sensitivity and specificity of MRI for the diagnosis of various types of pituitary adenoma and as well as sellar region tumor were closely related with histopathological results (gold slandered) and were found in between 81% to 97%; only one exception of sensitivity of suprasellar meningioma which was 71.4%. MRI can be accepted as the most reliable imaging modality in the diagnosis of pituitary adenoma and as well as sellar region tumor. It can therefore be concluded that MRI scan is reliable modality in the evaluation of sellar region tumor. More importantly, MR scans can demonstrate the precise effect of the tumor mass on the adjacent structures, particularly those of the visual system and cavernous sinuses.

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