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RESEARCH ARTICLE

ROLE OF MRI IN EVALUATION OF SELLAR, PARASELLAR AND SUPRASELLAR LESION WITH HISTOPATHOLOGICAL CORRELATION

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ABSTRACT

Background: Anatomical complex areas seen in parasellar region includes e.g. orbits, cavernous sinus and its contents like ICA and the walls of the cavernous sinuses, suprasellar cistern, hypothalamus attach through the pituitary stalk and dural reflections forming diaphragm sellae. Wide diversity of anatomy and pathology includes tumors, cyst, vascular lesion, inflammation, infection and congenital lesions1. A number of diseases that affect the pituitary-hypothalamic axis can have profound clinical, endocrinological as well as neurological consequences. Aim of study was to evaluate MRI findings in Sellar, Parasellar and Suprasellar lesions and compare the results with histological findings and asses diagnostic accuracy of MRI in characterisation of these lesions. ***Methods***: We reviewed the records of 50 patients strong clinical complaints suggestive of Sellar, Parasellar and suprasellar lesions or previous CT was showing abnormality, were evaluated. Radiological appearances were correlated with intraoperative findings and post-operative histopathology. Results: Majority (66%) of patients in study belonged to the third and fourth decade. Most common mass lesion was pituitary macroadenoma comprising about 66% of total cases. We observed a very good diagnostic accuracy of 100% in diagnosing pituitary macroadenoma. MR was 75% accurate in diagnosing craniopharyngioma. MR have 100% efficiency in diagnosing meningioma. ***Conclusion***: MRI is the modality of choice for characterizing sellar and suprasellar lesions, morphology of lesions, nature of contrast material enhancement and extent of lesions. Hence MRI has very good diagnostic accuracy in characterisation of masses with good correlation to histopathology is the modality of choice for diagnosing sellar and suprasellar masses with high accuracy, sensitivity and specificity.

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INTRODUCTION

Anatomical complex areas seen in parasellar region includes e.g. orbits, cavernous sinus and its contents like ICA and the walls of the cavernous sinuses, suprasellar cistern, hypothalamus and dural reflections forming diaphragm sellae. Cavernous sinuses is the most important of all structures surrounding the sella turcica in parasellar region from the practical and clinical aspects. Wide diversity of pathology includes the tumors (pituitary adenoma/apoplexy, meningioma, hypothalamic glioma, Craniopharyngioma), cyst (rathke's cleft cyst), vascular lesions, inflammation, infection and congenital lesions. Various clinical features associated with sellar, parasellar and suprasellar region includes pituitary axis dysfunction, visual field defects, hydrocephalus, intracranial mass effect etc. depending on effect on sellar and parasellar structures. Accurate diagnosis before any intervention is essential as the treatment of choice will be different for each disorder, especially in the case of sellar and suprasellar tumours. In the most of parasellar tumours, a multimodal therapeutic approach is frequently necessary including surgery, radiotherapy, primary or adjuvant medical treatment and replacement of apparent endocrine deficits. Magnetic resonance imaging (MRI) is the imaging modality of choice for evaluating hypothalamic-pituitary related endocrine diseases. We studied the clinical and radiological characterstics of sellar, parasellar and suprasellar masses and correlated with histopathological findings.

Aims and objectives

- To characterise the Magnetic Resonance Imaging features that help in diagnosis of lesion.
- To study the role of gadolinium in characterization of sellar, parasellar and suprasellar lesions.
- To evaluate the diagnostic accuracy of MRI in detection & characterization of sellar and parasellar lesions with histopathalogical correlation as gold standard.

METHODS

50 patients with sellar, parasellar and suprasellar lession who had been operated in our institution from Oct 2015 to

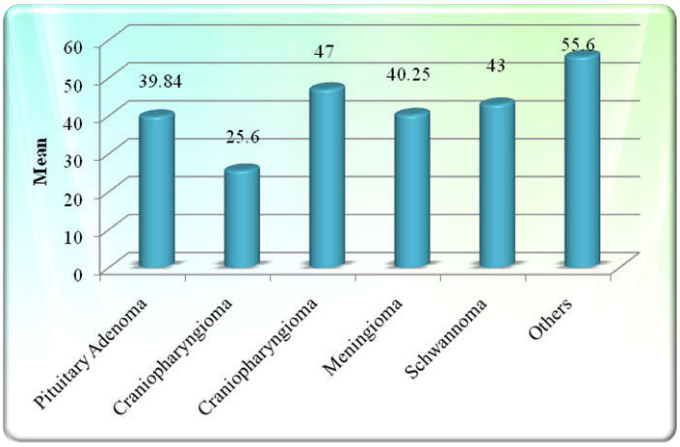
December 2017 were retrospectively studied and an analysis to assess the concordance of MRI with final histopathology report was taken as gold standard. Based on the MR imaging characteristics of the different Sellar, parasellar and suprasellar masses, compared to the intraoperative and histopathological findings, diagnostic accuracy of MRI was calculated. The radiological features taken into consideration were: Margins, Signal intensity, Contents, Mass effect, Bony changes, and Pattern of enhancement Hydrocephalus. Then patients were operated, biopsy material was sent for histopathological evaluation. Previously diagnosed patients, the patients having recurrence or the patients having no histopathology reports for sellar /suprasellar tumors were excluded from our study.

RESULTS

The observations of these 50 patients were compiled and studied comprising of 33 MR Imaging diagnoses of adenomas, 8-craniopharyngiomas and 4Juxta/parasellar meningiomas, Trigeminal schwanomma was seen in two patients, one case of parasellar aneurysm. There was one case which was reported as chordoma on MRI because of its extension upto clivus with bone destruction, with extension into base of skull and involvement of greater wing of sphenoid, encasing bilateral ICA but was diagnosed as pituitary adenoma with aggressive features on histopathology and she presented with raised level of growth hormone and signs of acromegaly clinically. There was one case of Arachnoid cyst who presented with complaints of visual disturbances and headace. MRI diagnosed a lesion in suprasellar region with CSF signal intensity on all sequences with peripheral enhancement after contrast. And was finally diagnosed as arachnoid cyst on histopathology. Sellar, parsellar and suprasellar lesions were most commonly present in the third and fourth decades of life. Females (52%) were more commonly affected as compared to males (48%).

Table 1 Age Wise Distribution of the Lesion

Final diagnosis	N	Mean age (yrs)
Pituitary Adenoma	33	39.84
Craniopharyngioma	8	25.6
		47 Bimodal Age
Meningioma	4	40.25
Schwannoma	2	43
Others	3	55.6

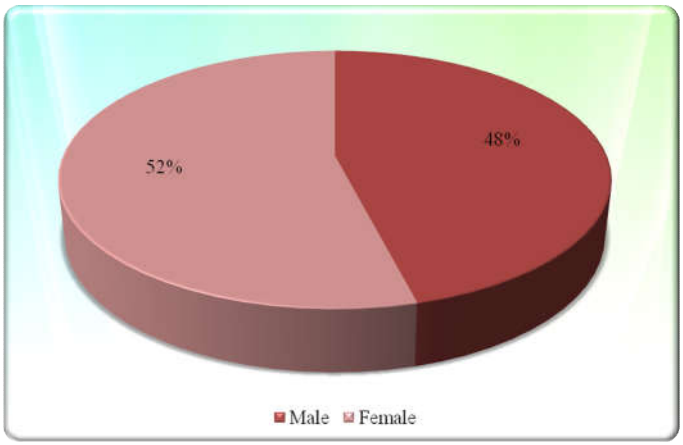


Graph 1. Age Wise Distribution of the Lesion

Significant difference was observed in age with the diagnosis. Mean age was 40 yrs in adenoma and meningioma, little higher in schwannoma, bimodal age peak in Craniopharyngioma (with a lower peak age at 25 and second peak at 47 yrs).

Table 2. Sex Distribution in sellar and parasellar pathologies

Sex	No. of cases (n=50)	Percentage
Male	24	48%
Female	26	52%

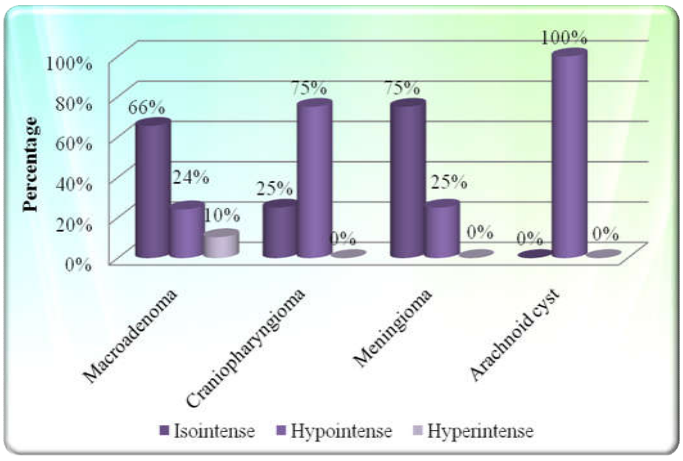


Graph 2. Sex Distribution in Sellar and Parasellar Pathologies

In the present study slight higher incidence of pathologies was found in females (52%). Male to female ratio was 0.92: 1.

Table 3. T1W Signal Intensity Characteristics

T1W signal intensity	Macroadenoma (n=29)	Craniopharyngioma (n=8)	Meningioma (n=4)	Arachnoid Cyst (n=1)
Isointense	19 (65.52%)	2 (25%)	3 (75%)	0
Hypointense	7 (24.14%)	6 (75%)	1 (25%)	1 (100%)
Hyperintense	3 (10.34%)	0	0	0

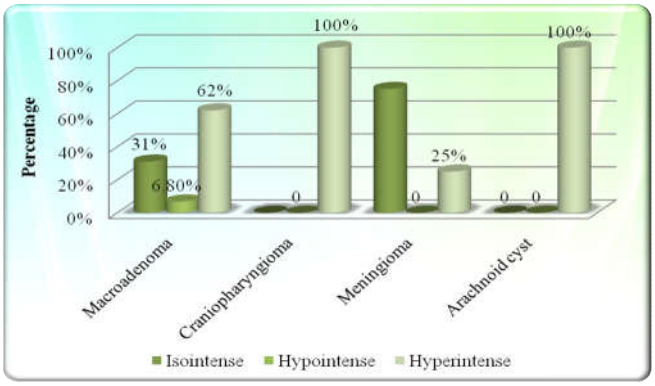


Graph 3. T1W Signal Intensity Characteristics

Table shows, T1W signal intensity characteristics of the lesions. Significant difference was observed in T1W signal intensity of the lesions. Isointensity to grey matter was observed significantly more in meningioma (75%) and macroadenoma (65.5%) as compared to craniopharyngioma (25%).

Table 4. T2W signal intensity characteristics

T2W signal intensity	Macroadenoma (n=29)	Craniopharyngioma (n=8)	Meningioma (n=4)	Arachnoid cyst (n=1)
Isointense	9 (31%)	0	3 (75%)	0
Hypointense	2 (6.8%)	0	0	0
Hyperintense	18 (62%)	8 (100%)	1(25%)	1 (100%)

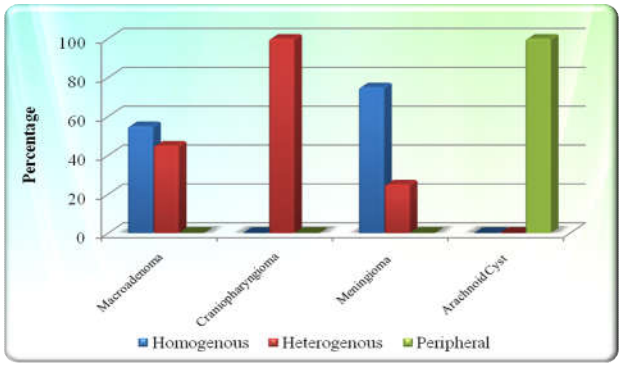


Graph 4. T2W Signal Intensity Characteristics

Table shows, T2W signal intensity characteristics of the lesion. Significant difference was observed in T2W signal intensity (iso and hyper intensity) of the lesions. Isointensity was observed significantly more in Meningioma (75%) and Macroadenoma (31%) as compared to Craniopharyngiom (0%). Case of Arachnoid cyst showed 100% hyperintense T2W signal intensity (Similar to CSF) No significant difference was observed in hypo intensity.

Table 5. Contrast Enhancement Pattern

Enhancement	Macroadenoma (n=29)	Craniopharyngioma (n=8)	Meningioma (n=4)	Arachnoid Cyst (n=1)
None	0	0	0	0
Homogenous	16 (55%)	0	3 (75%)	0
Heterogenous	13 (45%)	8 (100%)	1 (25%)	0
Peripheral	0	0	0	1 (100%)

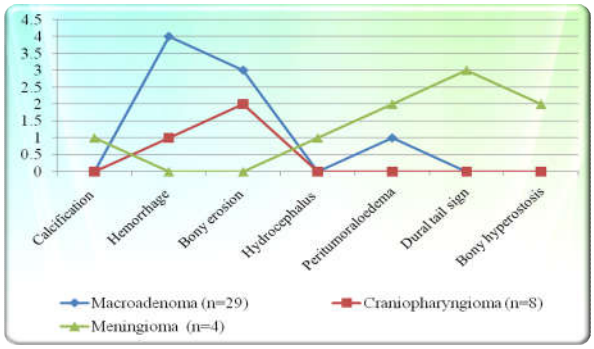


Graph 5. Contrast Enhancement Pattern

Table shows the contrast enhancement patterns of the lesions. Significant difference was observed in contrast enhancement pattern of the lesions. Heterogenous enhancement was observed significantly morein Craniopharyngioma (100%) because of its solid –cystic nature and (45%) as compared to Meningioma (25%). Homogenous type of contrast enhancement was observed in Meningioma (75%) and Macroadenoma (55%).

Table 6. Additional Features of the Lesions

Associated features	Macroadenoma (n=29)	Craniopharyngioma (n=8)	Meningioma (n=4)
Calcification	0	4(50%)	1(25%)
Hemorrhage	4(24%)	1(5%)	0
Bony erosion	3(17%)	2(12%)	0
Hydrocephalus	0	7(87%)	1(25%)
Peritumoraloedema	1(3.4%)	0	2(50%)
Dural tail sign	0	0	3(75%)
Bony hyperostosis	0	0	2(50%)

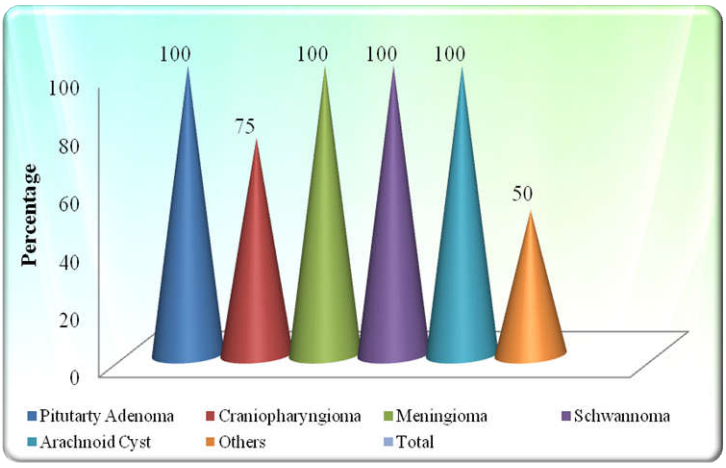


Graph 6. Additional Features of the Lesions

Table shows that calcification (50%), hydrocephalus (87%) was significantly more in Craniopharyngioma and dural tail sign (75%) and bony hyperostosis (50%) was significantly more in Meningioma.

Table 7. Concordant rate between MRI diagnosis and final diagnosis

MRI Diagnosis	Final Diagnosis								
	Meningioma	Schwannoma	Craniopharyngioma	A. cyst	Others	Pitutarty Adenoma	Total	Concordant Rate	(%)
Pitutarty Adenoma						33	33	33/33	100
Craniopharyngioma			6		1	1	8	6/8	75
Meningioma	4						4	4/4	100
Schwannoma		2					2	2/2	100
Arachnoid Cyst				1			1	1/1	100
Others					1	1	2	1/2	50
Total	4	2	6	1	2	35	50	47/50	

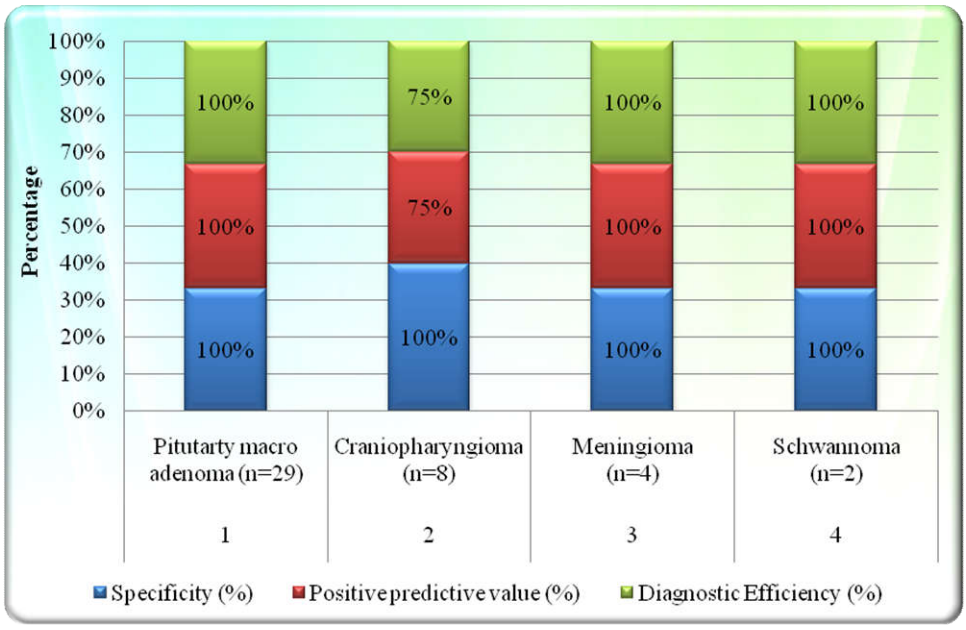


Graph 7. Concordant rate between MRI diagnosis and final diagnosis

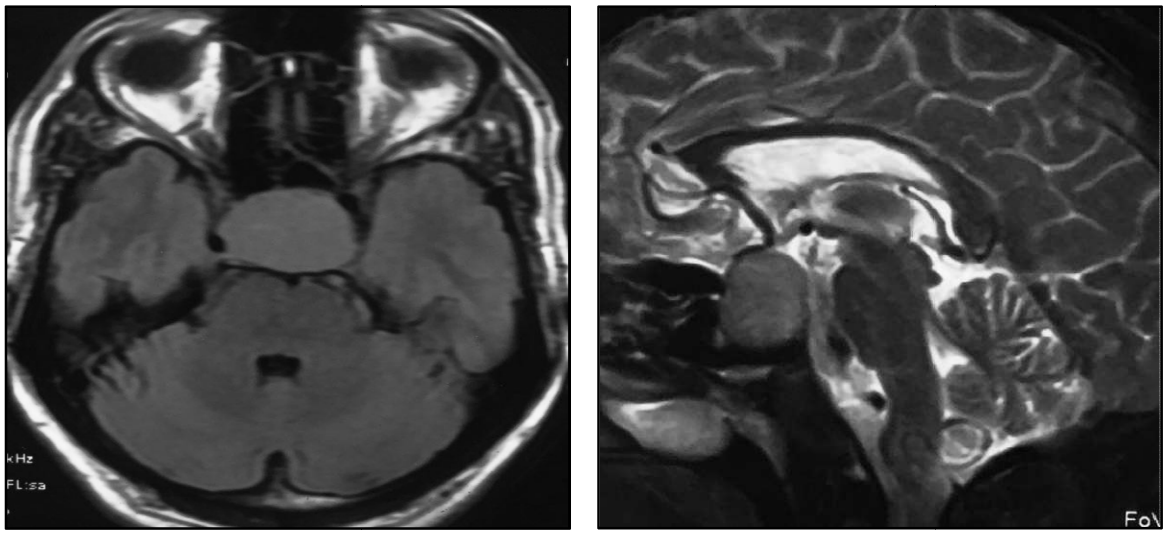
Out of 33 cases identified as Pituitary Adenoma on MRI all were confirmed as pituitary adenoma by finaldiagnosis, so concordant rate was 100%. Simillarly concordant rate for Craniopharyngioma was 6/8(75%), Meningioma was 4/4 (100%), Arachnoid cyst and Schwannoma was 100%.

Table 8 Diagnostic accuracy of MRI in diagnosis of various lesions against gold standard

S. No.	Criterion	Specificity (%)	Positive predictive value (%)	Diagnostic Efficiency (%)
1	Pitutarty macro adenoma (n=29)	100%	100%	100%
2	Craniopharyngioma (n=8)	100%	75%	75%
3	Meningioma (n=4)	100%	100%	100%
4	Schwannoma (n=2)	100%	100%	100%

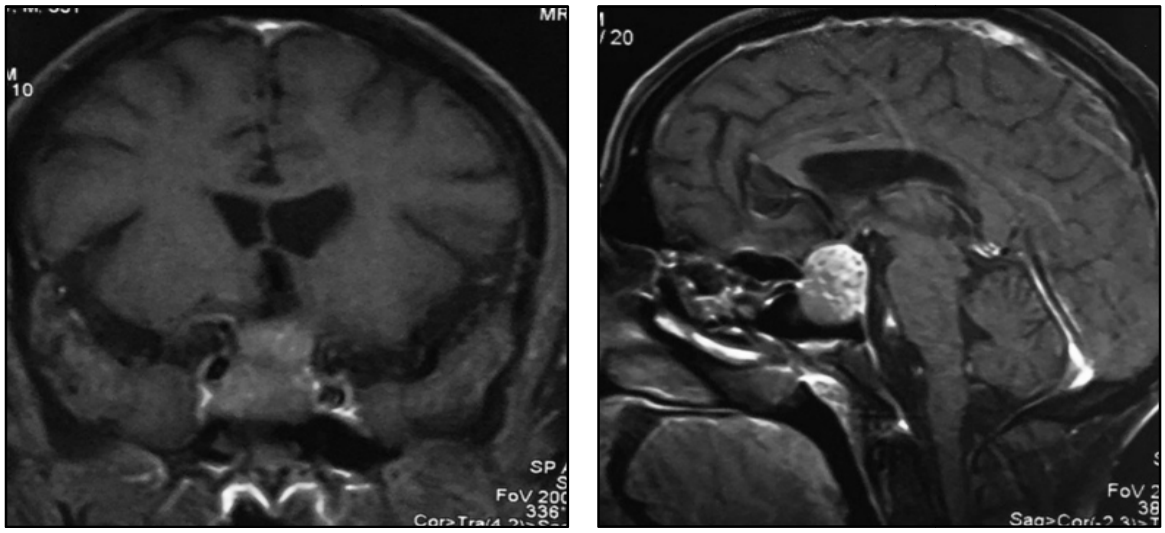


Graph 8. Diagnostic accuracy of MRI in diagnosis of various lesions against gold standard



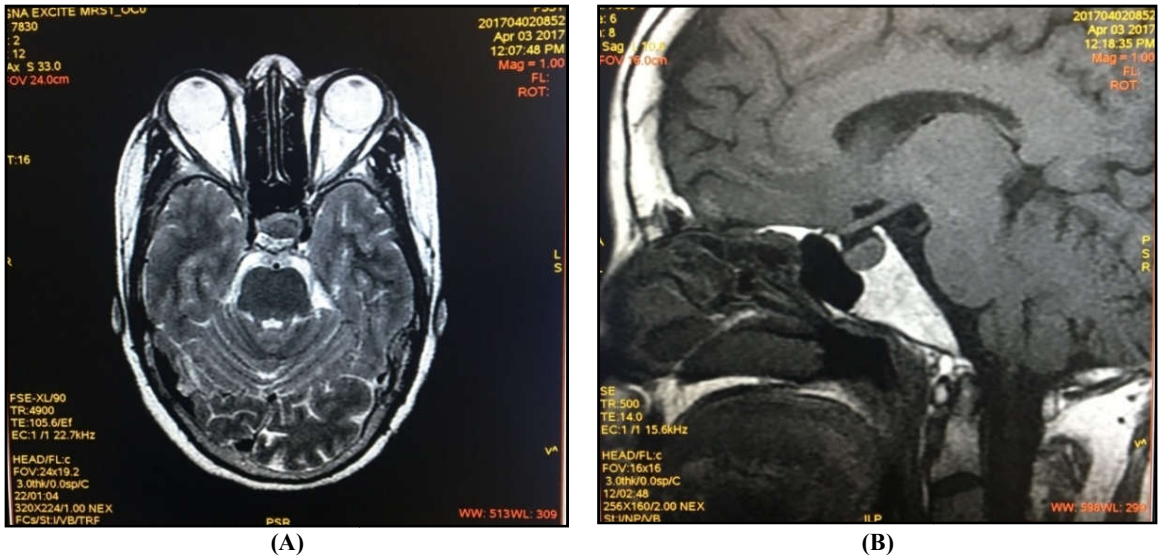
(A) **(B)**

Pituitary Macroadenoma- A) T1W axial and B) T2W sagittal images showing, isointense lobulated soft tissue mass occupying sella.



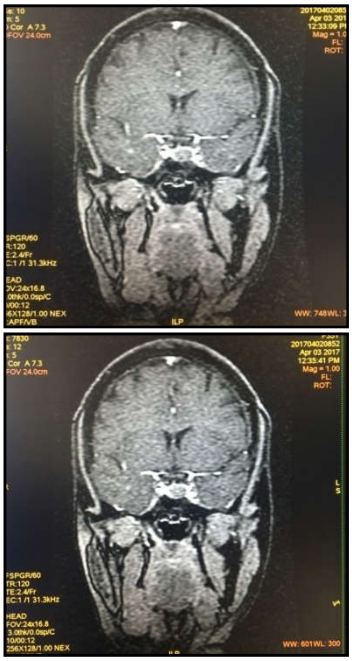
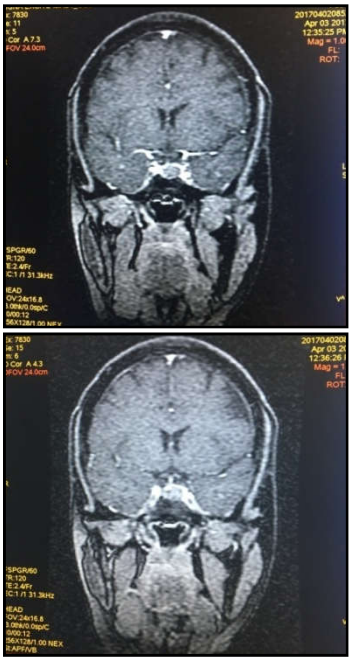
(C) **(D)**

Pituitary Macroadenoma- C) T1W contrast coronal and D) T1W contrast sagittal images showing, heterogenously enhancing soft tissue mass "(figure of eight)" causing widening of sella turcica and partial encasement of internal carotid artery

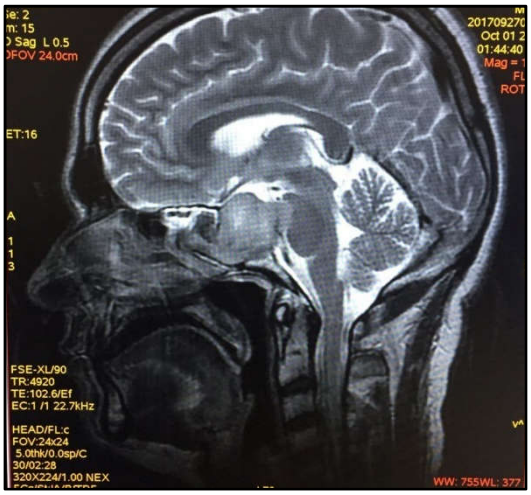


(A) **(B)**

Pituitary Microadenoma: (A & B) Precontrast T2 axial & T1 W sagittal images showing hypointense focal lesion in left half of anterior pituitary

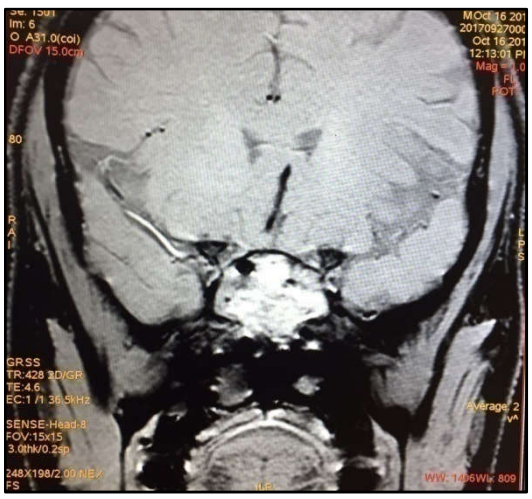
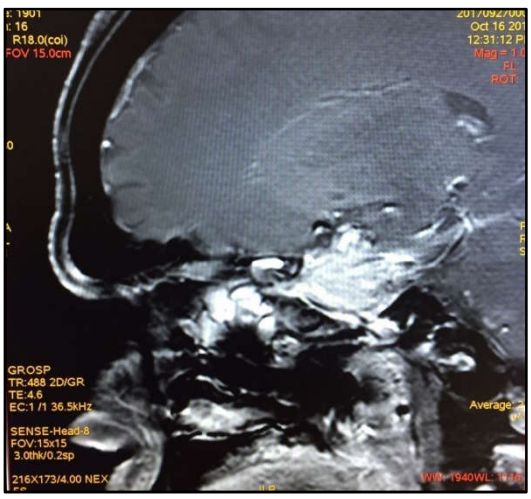



Dynamic post contrast T1W coronal image show much less enhancement of the lesion as compared to intensely enhancing normal gland. Dynamic post contrast T1W coronal image showing progressive enhancement of the lesion. These findings are s/o **pituitary microadenoma**

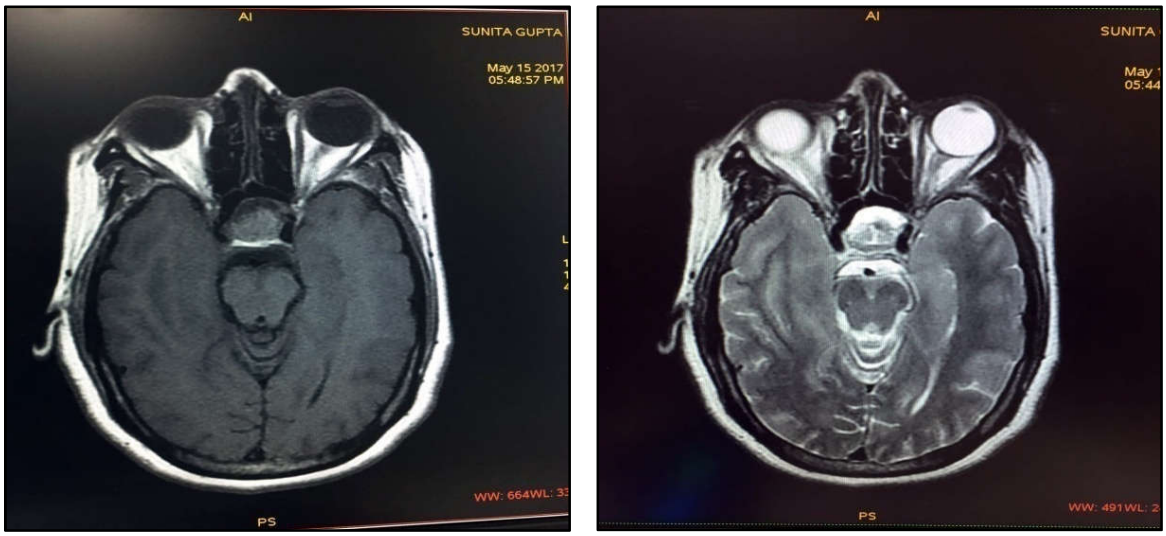
(A) **(B)**

Pituitary Macroadenoma (Invasive)- A) T1W axial B) T2 sagittal images shows solid cystic lesion, hypo intense on T1 and Iso on T2 in sellar and suprasellar region with foci of hemorrhage. Anteriorly the lesion is extending into right posterior ethmoid air cells with retained secretions. Posteriorly the lesion is invading clivus with loss of T1W hyperintensity and is projecting into prepontine cistern within impingement on pons. Superiorly causing displacement of optic chiasma. Inferiorly extending into sphenoid sinuses.

(C) **(D)**

Pituitary Macroadenoma (Invasive)- C) T1W contrast coronal and D) T1W C sagittal images shows heterogenous enhancement with extension into cavernous sinuses.

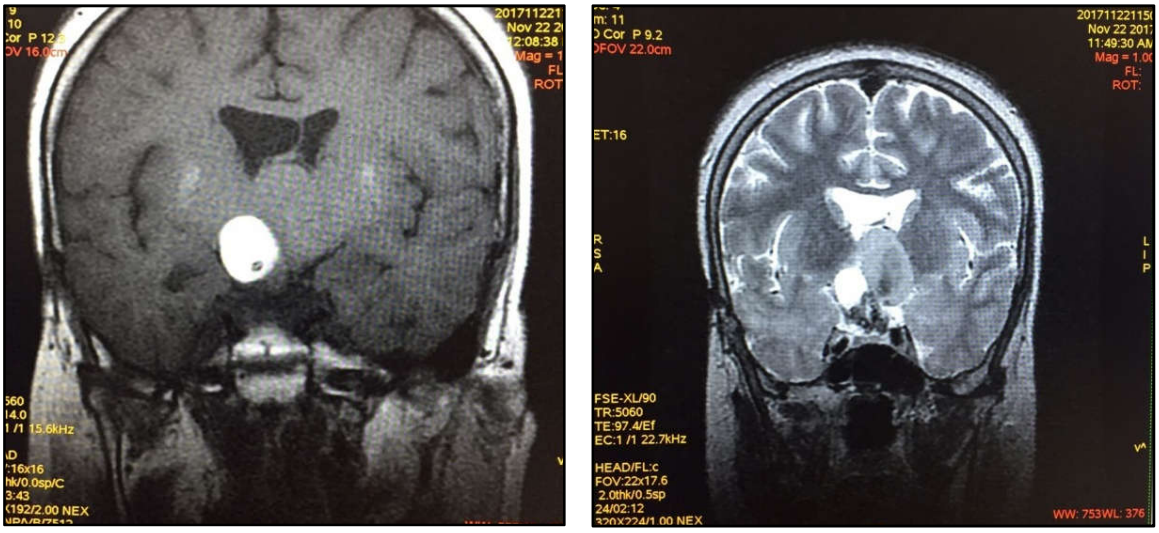


(A) **(B)**

Pituitary Macroadenoma with Apoplexy- A) T1W axial and B) T2W axial images showing well defined mass lesion seen in sella appearing hyper intense on T1W images suggestive of haemorrhage and necrosis within it.

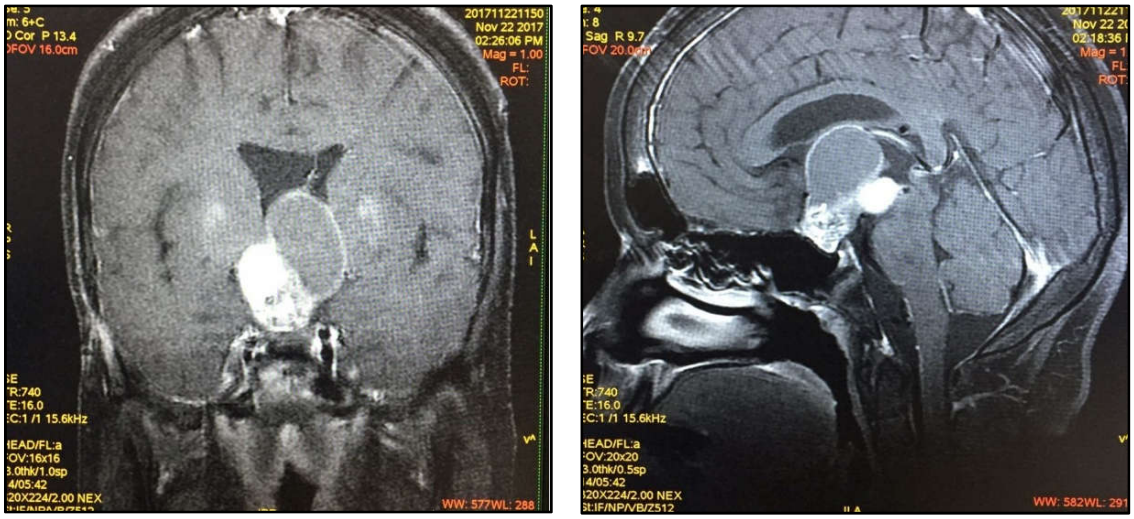
(C)

Pituitary Macroadenoma with Apoplexy- C) T1W contrast coronal image showing heterogenous enhancement of sellar mass.



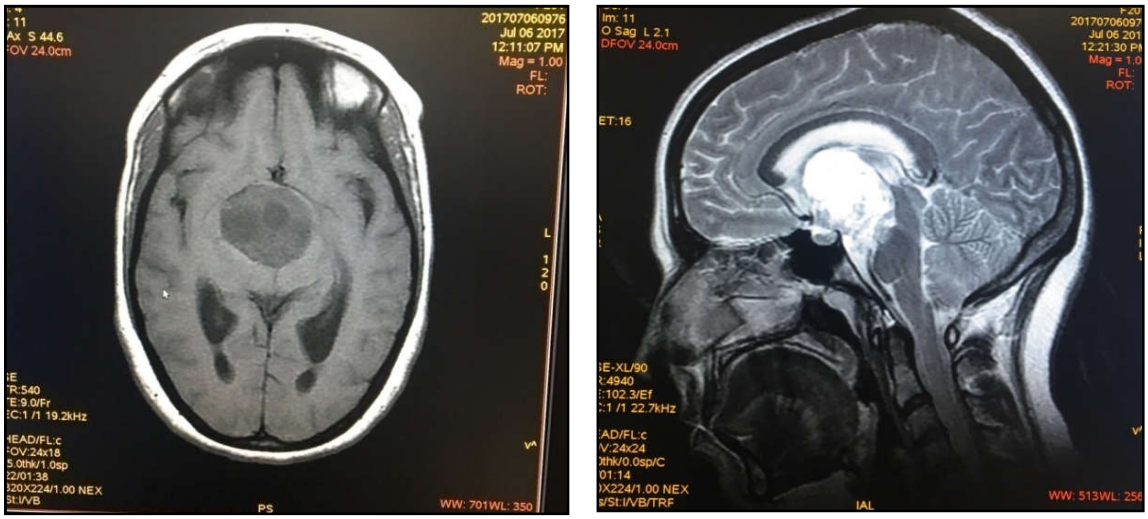
(A) **(B)**

Craniopharyngioma: A) T1W coronal and B) T2W coronal images showing large solid cystic lesion in suprasaller region.



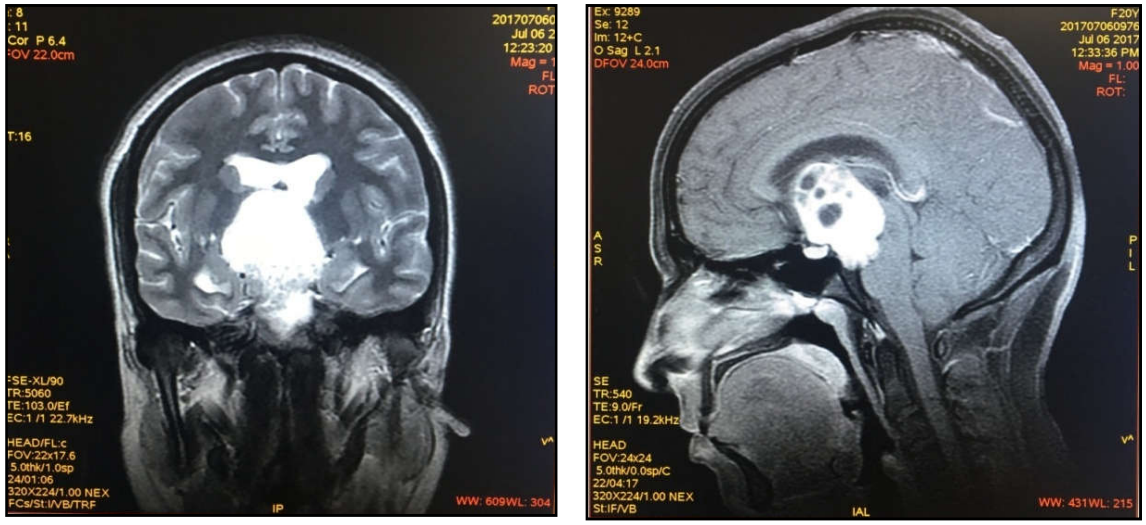
(C) **(D)**

Craniopharyngioma: C) T1W coronal and D) sagittal images show pheripheral enhancement on post constrast images. Solid component show mixed signal intensity on T1 and T2 images and heterogenous enhancement on contrast.



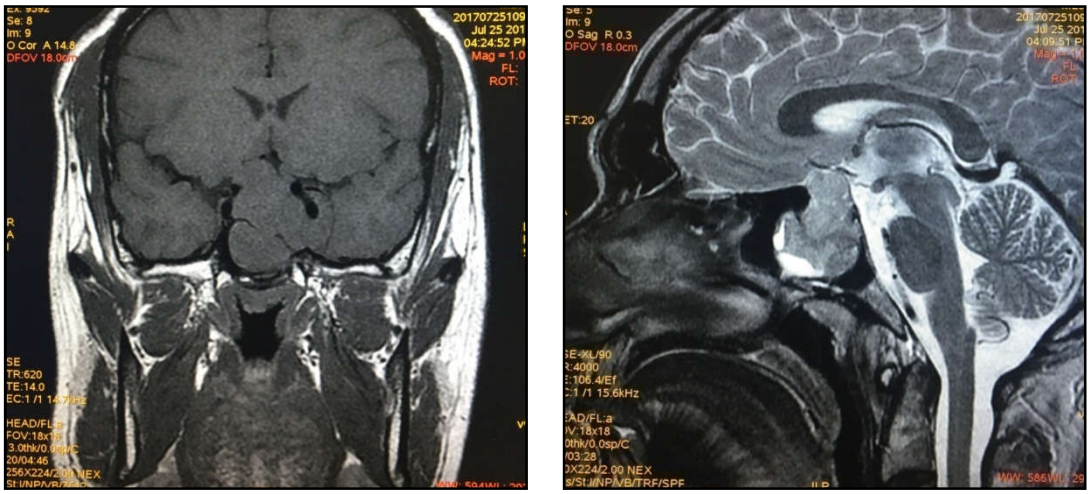
(A) **(B)**

Meningioma-: A) T1W axial and B) T2W sagittal images showing well defined mass in suprasellar region appearing hypointense on T1W & heterogeneously hyperintense on T2W causing indentation & widening of cerebral peduncles.



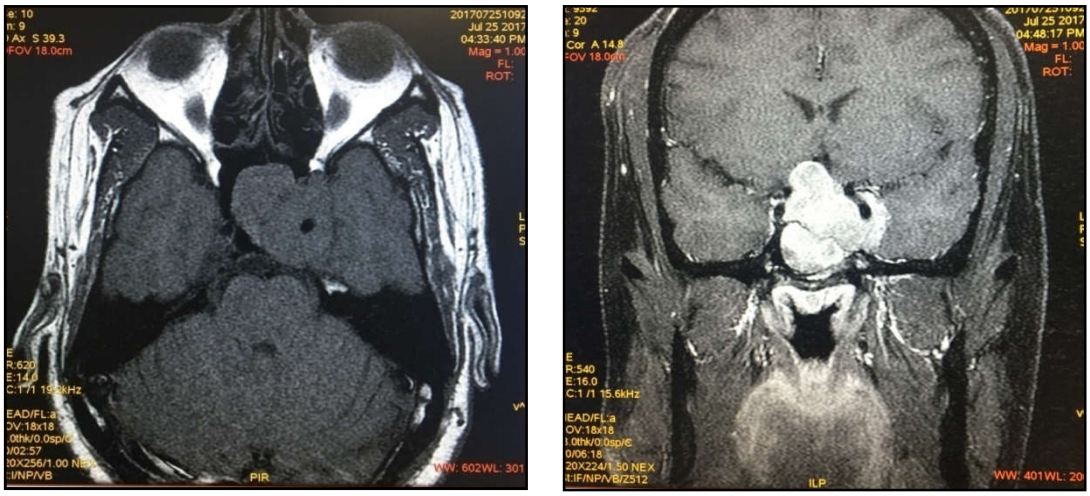
(C) **(D)**

Meningioma-: C) T2W coronal images showing well defined mass in suprasellar region appearing heterogeneously hyperintense on T2 causing compression & displacement of optic chiasma, hypothalamus & foramen of Monro with dilatation of bilateral lateral ventricle. (D) T1 W contrast sagittal image shows intense heterogeneous enhancement with multiple non enhancing cystic areas.



(A) **(B)**

Pituitary Macroadenoma: A) T1W coronal and B) T2W sagittal images showing a lesion in sellar and suprasellar region isointense on T1W, hetrogeneously hypertintense on T2W images, with superior splaying & displacement of optic chiasma s/o macroadenoma.



(C) **(D)**

Pituitary Macroadenoma: (C) T1W axial image showing a pituitary macroadenoma with extension into carvernous sinus, encasement of left ICA anteriorly reaching upto posterior aspect of left orbitial apex (D) Post gadolinium T1W coronal image show heterogenous enhancement.

DISCUSSION

The diagnosis of sellar and suprasellar lesions still remains the most difficult even after decades of advances, because of its complex anatomy and diverse pathology. Lesion morphology, signal intensity, and contrast enhancement pattern are taken into consideration when differentiating masses with MRI. The aim of this retrospective study was to describe MR imaging characteristics of the lessions of the sellar and suprasellar region; to correlate the MRI findings with histopathological findings and to assess the diagnostic accuracy of MRI in differentiation of sellar suprasellar lesions. 50 patients having strong clinical suspicion (based on symptomology) of sellar, parasellar and suprasellar lesions or previous CT showing abnormality were evaluated. In our present study, most commonly mass lesions were encountered in third and fourth decade. Females predominates present study constituting 52 % of the total study population. These observations are in concordance with study done by Banna et al.98 who reported maximum number of patients in fourth decade, and with female preponderance in their retrospective study. The most common lesion reported in our study was pituitary adenoma (33 out of 50) which was similar to studies of Benjamin *et al.* (1985) and Johnsen *et al.* (1991).

Pituitary macro adenomas

In present study, on MRI there were 29 patients of pituitary macroadenomas out of the total 50 cases. On T1W images 19 cases (65%) macroadenomas were isointense to grey matter, 7 were hypointense and 3 were hyperintense. The hyperintensity on T1WI in 3 cases was seen to be due to presence of hemorrhage in macroadenoma. After the contrast administration, 16 cases (55%) showed homogeneous enhancement. Our findings were similar to results of Johnsen et al. (1991) reported homogenous enhancement in 46% cases. Patients underwent surgery and histopathological correlation was obtained. Of the 29 radiologically diagnosed macroadenomas, all cases onhistopathologically turned out to be the same. So, we observed a very good diagnostic accuracy of MRI for diagnosis of the pituitary adenomas. In our study MRI have a 100% diagnostic efficiency.

Craniopharyngioma

In the present study, there were 8 patients of craniopharyngiomas which constituted 16% of total patients. Bimodal age distribution was seen. All cases were mixed solid cystic in appearance. In solid-cystic cases cystic component was iso to hyperintense on T1W and T2W images. Solid

component was iso to hypointense on T1W and isointense on T2W images. Solid lesions showed mixed signal intensity on T1W and T2W images and calcification was seen in 4 cases. On post contrast study, cystic component showed peripheral enhancement and solid portion showed heterogeneous enhancement. Our findings were similar to the results of Johnson *et al.* (1991) they analysed 60% of the cases were mixed in appearance. Out of the 8 radiologically diagnosed craniopharyngiomas, 6 cases on histopathologically turned out to be correct 2 were misdiagnosed.One cases was misdiagnosed as macroadenoma and other one was pilocytic astrocytoma because of the overlapping morphological characteristics on MRI. In present study MRI have a 75 % diagnostic efficiency for craniopharyngioma.

Meningiomas

There were 4 cases of meningiomas which constituted 8 % of total cases on MRI. Isointensity on T1W- and T2 W images is specific signal intensity feature of meningiomas. In the present study, we found 3 cases (75%) meningiomas to be isointense on T1W and T2W images. Taylor *et al.* (1992) analysed 91% of meningioma were isointense on T1 and 55% were isointense on T2W. Whereas 70% of macroadenomas appear isointense on T1W, while only 40% of macroadenomas showed isointensity on T2W. This led to finding that T2W signal intensity may be an important point to differentiate between the adenoma and meningioma. After contrast administration the tumours showed marked, homogeneous enhancement which was in accordance with Donovan J et al who analysed homogeneous enhancement in 94% of sellar meningiomas [5.] In present study hyperostosis was present in 1 (25%) cases of meningiomas. Taylor *et al.* (1992) observed hyperostosis in 34% of cases of meningiomas involving the sella. Hyperostosis remains highly specific for meningioma. Dural tail enhancement or the meningeal sign is commonly associated with meningiomas but is not specific. In our present study 75% cases showed dural tail sign. No other tumour showed this sign. Johnsen et al also showed presence of dural tail sign in 57% cases of meningiomaand in no other lesion. Of the 4 radiologically diagnosed meningiomas, all cases turned out to be the same on histopathologically.

In our study MRI have a 100% diagnostic efficiency for Sellar and parasellar and suprasellar meningioma.

Chordoma

In present study one case was reported as chordoma on MRI because of its extension upto clivus with bone destruction, with extension into base of skull and involvement of greater wing of sphenoid, encasing bilateral ICA but was diagnosed as pituitary adenoma with aggressive features on histopathology.

Conclusion

MRI is the modality of choice for characterizing sellar and suprasellar lesions, depending on morphology of lesions, nature of contrast material enhancement and extent of lesions Hence, finally to conclude, the MR imaging characteristics of the three most common lesions were sufficient to allow them to be differentiated from each other and from most other entities. Overall MRI has very good diagnostic accuracy in the characterization of masses with good correlation to histopathology.

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