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A Study on Correlation of Magnetic Resonance Imaging (MRI) with Histopathological Findings in Evaluating Sellar Region Tumors

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ABSTRACT

Aims and objectives: To determine the diagnostic accuracy of Magnetic Resonance Imaging (MRI) in the detection of sellar region tumors and to study the correlation between MRI and histopatological findings in their evaluation.

Materials and methods: An analytical cross-sectional study was performed in the department of Radiology and imaging in collaboration with department of Neurosurgery and Pathology, ASRAM Medical college and Hospital, Eluru, during the period of May 2022 to March 2023. MRI of brain was performed using 1.5 Tesla MRI scanner, Seimens Magnetom Avento Syngo (MR D- 13) 16 channel machine on 35 patients referred for evaluation of sellar region tumors and the findings were correlated with histopathological results post-operatively.

Results: The mean age group of sellar region tumors was 32.4 (±1.85) years. Most common sellar region lesion diagnosed on MRI was pituitary macroadenoma comprising 37% of the total cases. Among the total MRI diagnosed 35 cases, 28 (80%) cases were confirmed histopathologically. The accuracy, sensitivity, specificity, and negative predictive value (NPV) of MRI in diagnosing sellar region tumors were in the range of 88.9- 94.3%, 80- 91.7%, 89.7-96.7%, and 95.5- 96.7%, respectively.

Conclusion: The sensitivity and specificity of MRI in diagnosing various types of sellar region tumors almost paralleled histopathological results (gold standard) and was found in between 82% to 91%. This research concludes that MRI is a useful imaging technique for the diagnosis of malignancies in the sellarregions and pituitary adenoma.

Key Words: *Sella, Macroadenoma, Microadenoma, Meningioma, Craniopharyngioma.*

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INTRODUCTION

The sellar and parasellar region is a complex anatomical area within the human skull situated at the basisphenoid and lodges the pituitary gland within a bony structure, the sella turcica[1]. The pituitary gland, often known as the hypophysis or "master gland," is essential for controlling the body's hormone levels. Several tumors may arise in this area and various pathologies involving the pituitary-hypothalamic axis can have significant effects on the nervous system, endocrinology, and clinical symptoms[2,3]. The “Big Five” include macroadenoma, meningioma, craniopharyngioma, aneurysm and astrocytoma. Hypothalamic-glioma, rathke's cleft cyst, germinoma, teratoma, metastasis, leukemic infiltration, lymphoma, and langerhans cell. Histicytosis are other few lesions in this region an appropriate treatment for sellar and suprasellar tumors with minimal complications requires accurate diagnosis[4]. Using histopathological correlation to determine sensitivity, specificity, positive and negative predictive values, and other metrics, several studies clarified the usefulness and accuracy of MRI in the pre-operative assessment of sellarregion tumors[5-8]. It was observed that morphologically, solid lesions were predominant in macroadenomas (85.7) and meningioma (100%) and mixed lesions are common in craniopharyngioma (83.3%) that were statistically significant ($p < 0.001$) when correlated to the histological diagnosis. The goal of imaging is to determine the location and characteristics of sellar mass precisely, delineate its relationship to, and involvement with surrounding structures that enables to narrow down the differential diagnosis and help direct patient management. Therefore, the study is intended to assess the efficacy of MRI in the evaluation of sellar region tumors with histopathological correlations.

Materials and Methods

An analytical cross-sectional study was performed in the department of Radiodiagnosis and imaging, ASRAM Medical college, Eluru in co-ordination with departments of Neurosurgery and Pathology of the same institute, during the period of May 2022 to March 2023. Total 35 patients of the age range 20 to 80 years, who were referred to the

department with clinical suspicion of sellar region tumors (vision disturbance, headache, cranial nerve palsy, endocrine disturbance) were included in the study. Patients with previously treated and post -operative history of sellar and juxtasellar tumors, with recurrence and claustrophobia individuals were excluded from the study.Proper procedure was followed while obtaining consent from respondents. All the 35 respondents underwent MRI imaging of brain and required data has been collected in appropriate data sheets, including the histopathological result after follow up and the results were correlated. All data was kept confidential.

Imaging technique and procedure:

MR imaging was performed using 1.5 Tesla systems. Thin section (1-5 mm) multiplanar MR with small FOV (field of view) obtained before and after contrast administration, including dynamic and static sequences. Sequences obtained were T1W axial; T2W axial, coronal, sagittal, and flair sequences. DW-ADC, SW1 sequence, post-contrast axial, sagittal and Coronal. Dynamic contrast enhanced imaging was done when required. Contrast media used was 10 ml of Gadopentetate Dimeglumine (Gadoimage- 469 mg)[9].

MRI diagnostic criteria:

Pituitary microadenoma T1WI: Isointense to hypo intense. (Osborn 1994)[10]

T2WI: 30% -50% micro adenoma are hyper intense (Kucharczyk et al., 1986)[11]. Post contrast (DCE): Thin section coronal images discriminate between slowly enhancing microadenoma and rapid enhancing normal gland.

Pituitary macroadenoma (> 10 mm): (Osborn 1994)[10]

T1WI- isointense to parent gland, variable if there is hemorrhage, necrosis, and cyst formation; T2WI- isointense-slightly hyperintense. Post contrast-delayed strong inhomogeneous enhancement.

Mass effects include: Antero-superiorly-Displacement of optic chiasma, hydrocephalus (compression on the 3rd ventricle); laterally- encasement of Cavernous sinus. Erosion of sellar floor and involvement of brain stem may be observed.

Sellar region meningioma T1WI: (Osborn 1994)[10]

Iso to hypo intense; T2WI: Hypo to slightly hyper intense; Post contrast: Intense homogenous enhancement; and Duraltail is pathognomic.

Craniopharyngioma: (Osborn 1994)[10]

Solid-cystic lesion T1WI: Variable signal depending on its content (protein concentration and blood degradation products); T2WI/FLAIR: Hyper intense to adjacent gland; Post contrast: Strong nodular/rim enhancement.

Results and Discussion

This analytical cross-sectional study has been done on 35 respondents of age range 20-80 years using 1.5 T MRI with an aim to establish the diagnostic efficiency of MRI in detection of sellar region tumors. The mean age (±SD) was 32.45 (±1.85) years. Patients in the age groups of 20–30, 31–40, 41–50, 51–60, 61–70, and 71–80 years were represented by 45.7%, 31.4%, 8.5%, 8.5%, 2.8%, and 2.8%, respectively. The distribution of sellarregion tumors among 35 patients who had MRIs diagnosticwas shown in figure 1(a). Pituitary macroadenomas, microadenoma, meningioma and craniopharyngioma were the major constituents for the study consisting of 37% (13 patients), 23% (8 patients), 17% (6 patients), and 14% (5 patients) of the cases, respectively. 9% (3 patients) of the cases had no abnormal pathology and showed normal brain imaging findings. 32 patients were operated out of the total 35 and were followed up for histopathology result as shown in figure 1(b), which was positive for 28 cases. and are as follows: macroadenoma: 12(92%), microadenoma: 6(75%), meningioma:5(83%) and craniopharyngioma: 5(100%) For pituitary macroadenoma, out of 13 MRI diagnosed cases, 12 were confirmed by histopathology and 1 case was negative. Among 8 MRI diagnosed microadenoma cases, 2 were not confirmed by histopathological evaluation. 5 out of 6 MRI diagnosed meningioma cases were confirmed by histopathology whereas 1 case was not. All 5 cases of craniopharyngioma were confirmed histopathology. Therefore, there were 4 false positives.

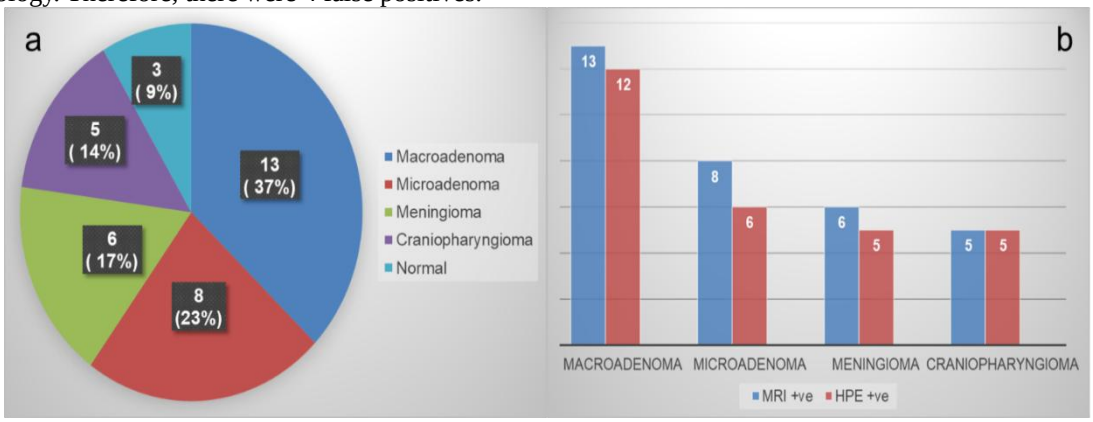

Figure 1(a) distribution of sellar region tumor according to MRI diagnosis and 1(b) shows the distribution of histopathologically confirmed cases in comparison with MRI diagnosed cases.

Table 1 Results of MRI based diagnosis as true or false positive and true or false negative

Histopathological Diagnosis	MRI Results			
	True +	True -	False +	False -
Pituitary macroadenoma (n=13)	11	21	2	1
Pituitary microadenoma (n=6)	5	26	3	1
Meningioma (n=5)	4	28	2	1
Craniopharyngioma (n=5)	4	29	1	1

Macroadenoma:

Table 1 displays 12 cases of macroadenoma identified by MRI were included as true positives after histological results were verified. Histopathology did not confirm two of the cases, hence they were listed as false positives. The remaining 22 cases, of which 1 was diagnosed as a macroadenoma by histology and included as a false negative or a true negative, respectively, in addition to the macroadenoma by MRI (figure 2). The results of the MRI's sensitivity, specificity, accuracy, positive, and negative predictive values in the diagnosis of pituitary macroadenoma were as follows: the sensitivity of the MRI to detect macroadenoma was 91.67%, specificity was 91.30%, positive and negative predictive values were 84.62% and 95.45%, with accuracy of 91.43% as shown in table 2. Compared with Yiasmeen et al., whose study showed 81.2% sensitivity, 80.7% specificity, positive predictive values 72.2%, negative predictive values 87.5% with 80.9% accuracy.

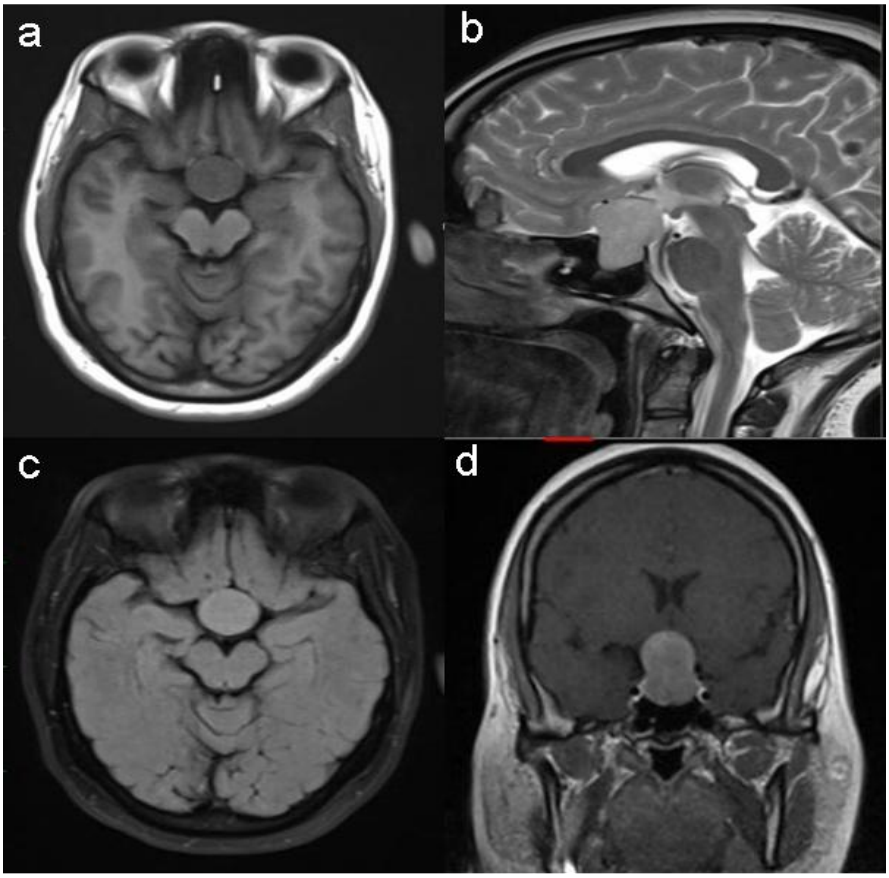

Figure 2: Pituitary macroadenoma

A case of 32-year-old female presented with complaints of temporal side visual loss in right eye and headachefor one month. Figure 2(a) shows a well-definedsellar region mass that is iso intense on T1. The mass is hyperintense on T2/Flair (figure 2 b and c) and shows figure of 8 appearance (figure 2 b and d) and intense contrast enhancement (figure d). Widening of sella turcica, stretching and superior displacement ofoptic nerve, optic chiasma seen.

Table 2 The sensitivity, specificity, accuracy, positive and negative predictive values of MRI based results

Diagnosis	MRI Results (%)				
	Sensitivity	Specificity	Accuracy	PPV	NPV
Pituitary macroadenoma (n=13)	91.8	91.3	91.4	85	96
Pituitary microadenoma (n=6)	83.3	89.7	88.9	63	96
Meningioma (n=5)	80	93.3	91.4	67	97
Craniopharyngioma (n=5)	80	96.8	94.3	80	97

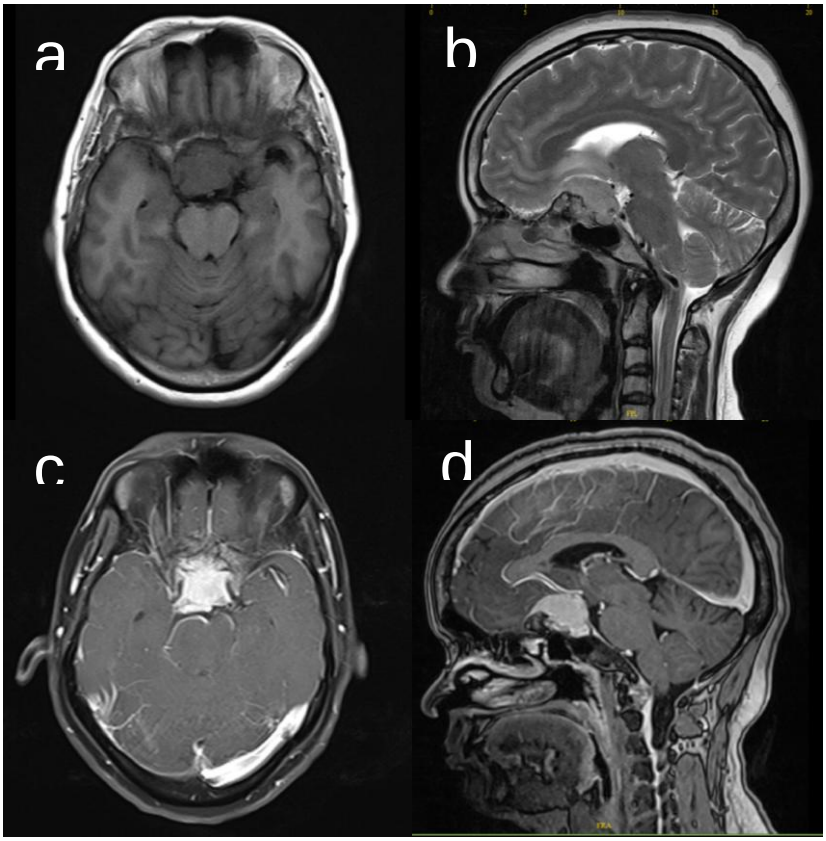

Figure 3: Meningioma

A case of 45-year-old female presented with complaints of headache and gradual loss of vision since 3 years. There is relatively defined T1, T2, and Flair isointense lesion in the sellar region compressing infundibulum and pituitary gland(figure 3 a and b).and showing intense homogenous contrast enhancement (figure 3c, d).Dural tail sign,(figure 3d), mass effect over mid brain, stretching of A1 and A2 segments of ACA, involvement of optic chiasma bilaterallyis seen.

Meningioma:

Of the instances of suprasellar meningioma, 4 were verified as true positives, while 2 cases were false positives based on histology. As indicated in table 1, out of 29 cases other than meningioma, 1 case had a false negative histological diagnosis of meningioma, while the other 28 cases are included as true negatives. Table 2 presents the sensitivity, specificity, accuracy, positive and negative predictive values, and accuracy of MRI in the diagnosis of suprasellar region meningioma (figure 3). The results indicate that the sensitivity of meningioma in MRI was 80%, specificity was 93.33%, positive predictive values were 66.67%, negative predictive values were 96.55%, and accuracy was 91.43%. Batra et al., reported 80% sensitivity, 96% specificity, positive predictive values 80%, negative predictive values 96% and 93.1% accuracy which is in accordance with the present study.

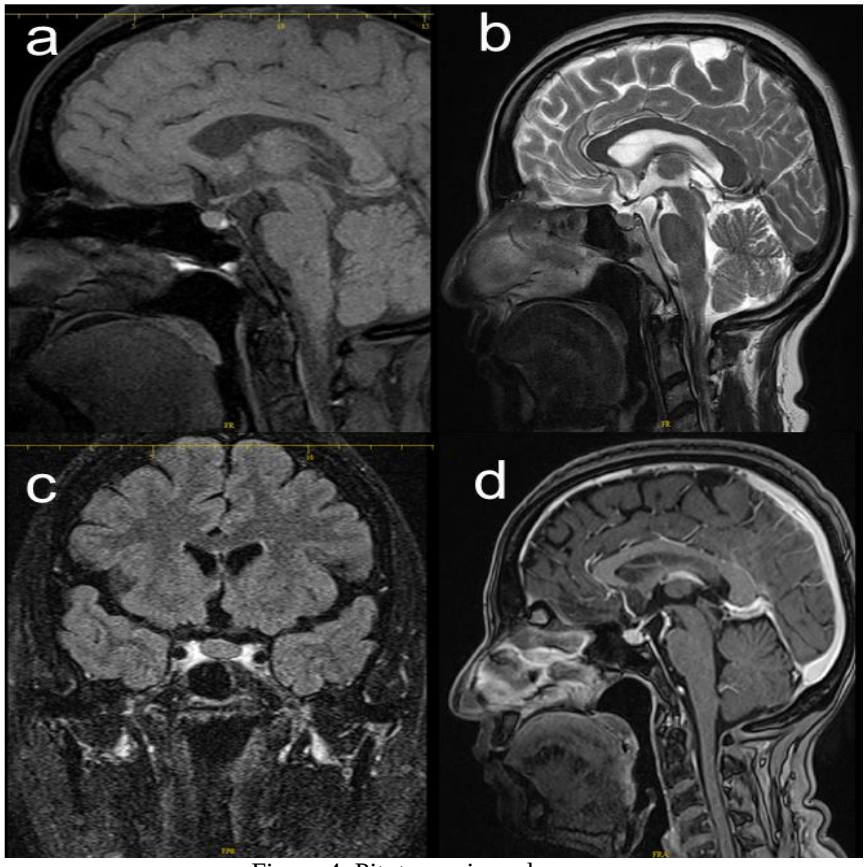

Figure 4: Pitutary microadenoma

A case of 46-year-old female presented with milk secretion from both breasts since 15 days. MRI imaging shows small rounded lesion in the pituitary fossa(figure 4 a,b) posterior bright spot seen(figure 4a).Postcontrast, there is delayed enhancement of lesion compared to normal gland(figure 4d) infundibulum is in mdline and no involvement of cavernous sinus.

Microadenoma:

Of the eight cases of microadenoma detected by MRI (figure 4), Table 1 demonstrates that three were found to be normal and five were confirmed as true positives by histological investigation. 26 of the other 27 instances were not pituitary microadenomas, they were classified as true negatives and one was false negative, respectively. Table 2 displays the accuracy of the MRI diagnosis in the current study, which was 88.87%, with sensitivity of 83.33% and specificity of 89.66%, positive, and negative predictive values were 62.50% and 96.30%.Whereas,Yiasmeen et al., reported 87.3% sensitivity, 91.2% specificity, positive predictive values 70%, negative predictive values 91.2% and 90.5% of accuracy.

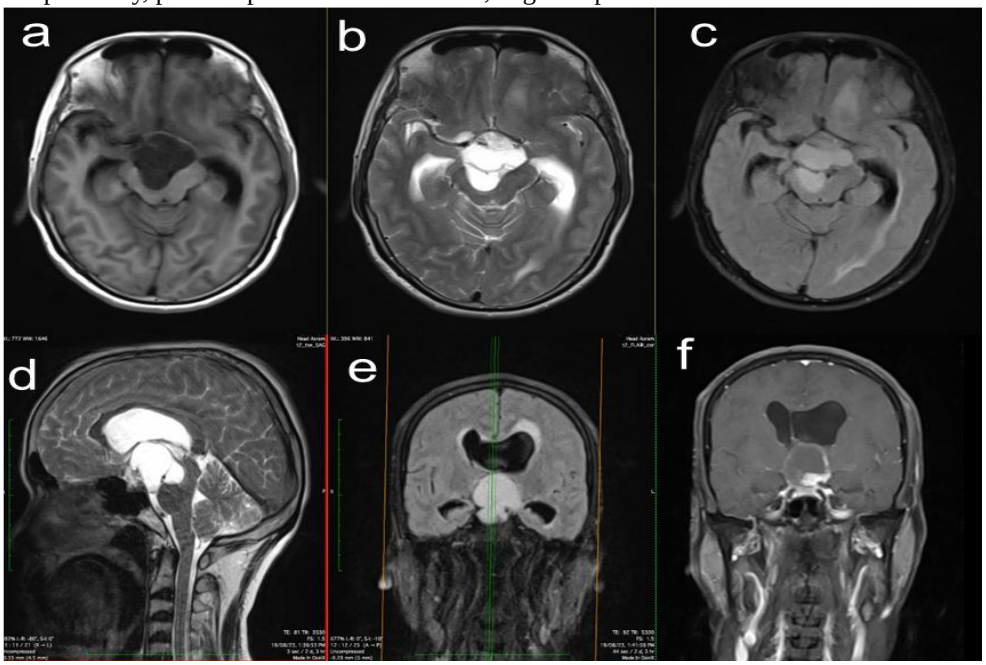

Figure 5: Craniopharyngioma

A case of 44 year old male presented with headache, and blurring vision. Mixed solid cystic lesion is seen in suprasellar region that is hypointense on T1(figure 5a), hyperintense on T2/Flair(figure 5 b, and c) there is intense enhancement of solid component and peripheral enhancement of cystic part.(figure 5f) Hydrocephalus due to mass effect of 3rd ventricle superiorly is seen(figure 5d, and e)

Craniopharyngioma:

In the present study, 4 MRI diagnosed craniopharyngioma were confirmed histopathologically as true positive and 1 case was false positive (Table 1). Out of 30 cases that were not related to craniopharyngioma, 1 case had a histological confirmation of being a craniopharyngioma, while the remaining 29 cases were not related to craniopharyngioma and were classified as false negative and true negative, respectively (figure 5). MRI showed 80% sensitivity, 96.67% specificity, 80% positive predictive values, 96.67% negative predictive values, and 94.29% accuracy in diagnosing craniopharyngioma. Batra et al., reported 85.7% sensitivity, 95.4% specificity, positive predictive values 85.7%, negative predictive values 95.4% and 93.1% accuracy. Yiasmeen et al., whose study showed 83.3% sensitivity, 97.2% specificity, positive predictive values 83.3%, negative predictive values 97.2% with 95.2% accuracy which is in accordance with the present study.

CONCLUSION:

The sensitivity and specificity of MRI in diagnosing various types of sellar region tumors almost paralleled histopathological results (gold standard) and was found in between 82% to 91%. This study finds that MRI is a valid imaging modality in the diagnosis of pituitary adenoma and sellar region tumors.

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