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ORIGINAL RESEARCH PAPER

Radiology

# ASSESS UTILITY OF MRI IMAGING IN SELLAR AND PARASELLAR MASSES

**KEY WORDS:** Sellar masses, Parasellar lesions, MRI, Pituitary adenoma, Craniopharyngioma, Meningioma, Diagnostic accuracy, Histopathology comparison.

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ABSTRACT

**Background-** The sellar and juxtasellar regions are complex anatomical areas prone to various neoplastic and non-neoplastic lesions. Accurate diagnosis and appropriate therapeutic interventions require comprehensive imaging assessments. Magnetic Resonance Imaging (MRI) is a critical tool due to its superior soft-tissue contrast and high spatial resolution. **Methods-** This study was conducted at the Department of Radio Diagnosis, Sri Aurobindo Medical College & Post Graduate Institute, Indore. It involved 45 patients with clinically suspected sellar and parasellar masses. MRI scans were performed using a Siemens 1.5 T MAGNETOM® Symphony® with Tim technology. The imaging protocol included routine MR pulse sequences and gadolinium-enhanced images. Data were analyzed using descriptive statistics, with MRI findings compared against histopathological results. **Results-** The study found that pituitary adenomas were the most prevalent lesions, accounting for 66.6% of cases, followed by craniopharyngiomas (16.6%) and meningiomas (13.3%). MRI demonstrated high sensitivity and specificity in diagnosing these conditions, with substantial agreement with histopathology results. **Conclusion-** MRI is a reliable diagnostic tool for identifying sellar and parasellar masses, offering distinct imaging characteristics that aid in differentiating between various lesion types. Its ability to provide detailed anatomical visualization makes it indispensable for planning appropriate treatment strategies.

## INTRODUCTION:

The sellar and juxtasellar regions are anatomically intricate areas at the skull base, where diverse neoplastic and nonneoplastic lesions manifest. These conditions necessitate a comprehensive approach involving endocrinologic, ophthalmologic, and neurologic assessments, complemented by advanced neuroimaging techniques. Neoplasia, granulomatous and inflammatory lesions, infections such as bacterial abscesses, and developmental and vascular illnesses represent the various categories of potential lesions.Neoplastic lesions may be classified as benign or malignant, including pituitary adenomas, cystic lesions, germ cell tumours, gliomas, lymphomas, meningiomas, and metastatic tumours.The symptoms associated with these tumours vary and are contingent upon the involvement of particular anatomical landmarks. Clinical presentations may vary, including manifestations resulting from endocrine dysfunction or mass effect, which can lead to compressive symptoms such as headaches or vision disturbances. Comprehensive understanding of sellar and parasellar anatomies, coupled with the application and analysis of diverse imaging modalities, is essential for accurate diagnosis of sellar and parasellar lesions and for providing suitable therapeutic interventions, including surgery, radiotherapy, and primary or adjuvant medical treatment, such as endocrine deficit replacement.[3] Specific imaging characteristics of these lesions may yield critical insights for deciding between surgical and nonsurgical approaches, as well as the degree of resection required. Magnetic resonance imaging (MRI) is the preeminent imaging technique for characterising such lesions, owing to its superior soft-tissue contrast differentiation, the availability of advanced sequences that provide high spatial resolution, and the absence of ionising radiation, thereby facilitating precise visualisation of mass effects on adjacent soft tissues.[1, 4, 5] Nonetheless, there There is an absence of extensive population-based studies concerning the utilisation of MRI as a diagnostic instrument for sellar masses.[6]

In light of the aforementioned context, the current study aimed to assess the MRI imaging characteristics of sellar and juxtasellar tumours, correlating these findings with histopathology to determine the diagnostic accuracy of MRI.

## MATERIALS AND METHODS:

This study was conducted in the Department of Radio Diagnosis at Sri Aurobindo Medical College & Post Graduate Institute, Indore, following approval from the institutional research and ethical committee. The aim was to investigate patients with clinical suspicion of sellar and parasellar masses using magnetic resonance imaging (MRI).

### Study Population

Patients referred from various departments within the institute with a clinical suspicion of sellar and parasellar masses were included in the study. Written informed consent was obtained from all participants prior to their inclusion.

### Inclusion Criteria

- Patients undergoing MRI with a clinical suspicion of sellar and parasellar masses during the study period.

### Exclusion Criteria

- Patients unwilling to provide consent.
- Patients for whom MRI is contraindicated.

### Sample Size

The study aimed to include 45 patients. Based on an average of 3-4 cases per month at the institute, this sample size was achievable within 15 months.

### MRI Procedure

The MRI scans were performed using a Siemens 1.5 T MAGNETOM® Symphony® with Tim technology. The following routine MR pulse sequences were obtained:

- Sagittal-axial T1-weighted imaging (T1WI)
- Sagittal-axial T2-weighted imaging (T2WI)
- Coronal Short Tau Inversion Recovery (STIR)

Additionally, sagittal-axial T1 Fat-Suppressed (T1FS) images were acquired pre- and post-contrast after intravenous administration of gadolinium at a dose of 0.1 mmol/kg.

### Data Collection

The MRI images were analyzed by an experienced radiologist. Findings were recorded on a pre-structured proforma designed for the study. Descriptive statistics were used to identify characteristics of the collected data.

### Statistical Analysis

Data were entered into Microsoft Excel 2010 and presented in frequency tables. Descriptive statistics, including mean and standard deviation for quantitative variables, and frequency and percentage for categorical variables, were calculated. Visual representations such as pie or bar diagrams were used for quantitative variables. The Chi-square test was applied to assess associations between variables, with a p-value <0.05 considered statistically significant

**OBSERVATION AND RESULTS:**

**Table 1: Age Distribution**

| Age Distribution | No. of Patients |
|---|---|
| 1 - 10 yrs | 5 |
| 11 - 30 yrs | 12 |
| 31 - 50 yrs | 12 |
| 51 - 70 yrs | 10 |
| > 70 yrs | 6 |

The table illustrates the age distribution of 45 patients across different age groups. The largest number of patients (12) fall in the age ranges of both 11-30 years and 31-50 years, making these the most common age categories in the study. The second largest group includes 10 patients aged between 51-70 years. Patients under 10 years of age represent a smaller portion, with 5 individuals. Finally, the least represented group comprises those over 70 years, with 6 patients in this category. This distribution provides a clear overview of the diverse age groups affected by the condition under study.

**Table 2: Sex distribution of the study subjects**

| Sex | Number of Cases | Percentage of Cases |
|---|---|---|
| Males | 27 | 60% |
| Females | 18 | 40% |

The table outlines the sex distribution of 45 patients. Out of the total, 27 patients (60%) are male, while 18 patients (40%) are female. This indicates a higher prevalence of the condition in males compared to females within the study group, with a male-to-female ratio of 3:2. This sex distribution provides insights into the potential gender-related differences in the occurrence of the condition under investigation.

**Table 3: Types of lesions**

| Types of Lesions | No. of Cases |
|---|---|
| Pituitary Adenoma | 30 |
| Craniopharyngioma | 7 |
| Meningioma | 6 |
| Aneurysm | 2 |

The table highlights the different types of lesions observed among 45 patients. Pituitary adenoma is the most common lesion, occurring in 30 patients, representing a significant majority of the cases. Craniopharyngioma follows with 7 cases, while meningioma is seen in 6 patients. Aneurysm is the least common lesion type, identified in just 2 patients. This distribution underscores the predominance of pituitary adenomas within the study population, with craniopharyngioma, meningioma, and aneurysm occurring less frequently.

**Table 4: Type of Functioning Adenoma**

| | Type of Functioning Adenoma | No. Of Patients |
|---|---|---|
| 1 | Prolactinoma | 6 |
| 2 | ACTH Adenoma | 4 |
| 3 | GH Adenoma | 1 |
| 4 | Mixed | 1 |

The table describes the types of functioning adenomas found in 12 patients. Prolactinoma is the most common, accounting for 6 cases, followed by ACTH adenoma, which occurs in 4 patients. GH adenoma and mixed adenomas are less common, with only 1 patient affected by each. This data shows that prolactinomas are the predominant type of functioning adenoma, while ACTH adenomas are also relatively frequent. GH and mixed adenomas are rare in comparison.

**Table 5: Comparison of MRI Diagnosis with Histopathology Diagnosis for Pituitary Adenoma, Craniopharyngioma, and Meningioma (n=18)**

| MRI Diagnosis | Pituitary Adenoma | Adamantinomatous Type of Craniopharyngioma | Meningiotheliomatous Meningioma | Total |
|---|---|---|---|---|
| Macroadenoma | 13 | 1 | 1 | 15 |
| Craniopharyngioma | 1 | 6 | 0 | 7 |
| Meningioma | 1 | 0 | 4 | 5 |
| Total | 15 | 7 | 5 | 27 |

This table compares MRI findings with histopathological diagnoses for 18 study subjects, showing how MRI diagnoses align with different types of lesions.

- Macroadenoma was diagnosed in 15 cases through MRI, with 13 confirmed as pituitary adenomas, 1 as craniopharyngioma, and 1 as meningioma based on histopathology.
- Craniopharyngioma was identified in 7 cases via MRI, with 6 confirmed as adamantinomatous craniopharyngiomas.
- Meningioma was seen in 5 cases by MRI, and 4 were confirmed as meningiomas.

**Table 6 (a): MRI diagnosis Vs HPE of the pituitary adenomas**

| | | Histopathology | | |
|---|---|---|---|---|
| | | **Pituitary Adenoma** | **Non-Pituitary adenoma** | **Total** |
| MRI | Macroadenoma | 13 | 4 | **17** |
| | Non Macroadenoma | 4 | 7 | **11** |
| | **Total** | **17** | **11** | **28** |

The table compares MRI diagnosis with histopathology findings for pituitary adenomas in 28 patients. Out of 17 cases diagnosed as macroadenomas by MRI, 13 were confirmed as pituitary adenomas, while 4 were found to be non-pituitary adenomas. Conversely, of the 11 cases diagnosed as non-macroadenomas by MRI, 4 were confirmed as pituitary adenomas, and 7 were non-pituitary adenomas. Overall, MRI identified 17 pituitary adenomas, while histopathology revealed 11 non-pituitary adenomas, making a total of 28 cases examined. This comparison illustrates the diagnostic challenges and the importance of histopathology for accurate confirmation of adenomas.

**Table 6 (b): Comparison of MRI diagnosis of Macro adenoma with Histopathology diagnosis of the study subjects (n=17)**

| | |
|---|---|
| Sensitivity | 81.8% |
| Specificity | 71.4% |
| Positive predictive value | 81.8% |
| Negative predictive value | 71.4% |
| Per cent agreement | 77.8% |
| Kappa value | 0.532 |
| P value | 0.024 |

This table summarizes the diagnostic performance of MRI in identifying macroadenomas, based on a study of 17 subjects. The sensitivity of MRI for detecting macroadenomas is 81.8%, indicating a high ability to correctly identify patients with the condition. The specificity is 71.4%, reflecting a moderate ability to correctly identify patients without the condition. The positive predictive value is also 81.8%, suggesting that a significant proportion of patients diagnosed with macroadenomas via MRI indeed have the condition confirmed by histopathology. Conversely, the negative predictive value is 71.4%, indicating that some patients without macroadenomas may be misclassified. The overall percent agreement between MRI and histopathology is 77.8%, demonstrating a fair level of concordance. The Kappa value of 0.532 suggests moderate agreement beyond chance, while the p-value of 0.024 indicates statistical significance, reinforcing the reliability of MRI in diagnosing macroadenomas.

**Table 7(a): MRI Vs HPE in craniopharyngiomas**

| | | Histopathology | | |
|---|---|---|---|---|
| | | **Adamantinomatous type of Craniopharyngioma** | **Non-Adamantinomatous type of Craniopharyngioma** | **Total** |
| MRI | Craniopharyngioma | 4 | 1 | **6** |
| | Non-Craniopharyngioma | 2 | 18 | **20** |
| | **Total** | **6** | **20** | **26** |

This table presents a comparison between MRI diagnosis and histopathological findings for craniopharyngiomas among 26 patients. Of the 6 cases diagnosed as craniopharyngiomas by MRI, 4 were confirmed as adamantinomatous types, and 1 was identified as a non-adamantinomatous type. Additionally, 20 cases were diagnosed as non-craniopharyngiomas, which included 2 misclassified cases. This data highlights the diagnostic performance of MRI in identifying craniopharyngiomas, revealing its limitations, particularly in distinguishing between different types and confirming the presence of non-craniopharyngiomas. The results indicate the necessity of histopathological evaluation for accurate diagnosis and classification of craniopharyngiomas.

**Table 7(b): Comparison of MRI diagnosis of Craniopharyngioma with Histopathology diagnosis of the study subjects (n=26)**

| | |
|---|---|
| Sensitivity | 75% |
| Specificity | 92.8% |
| Positive predictive value | 75% |
| Negative predictive value | 92.8% |
| Per cent agreement | 88.9% |
| Kappa value | 0.679 |
| P value | 0.004 |

This table summarizes the diagnostic performance of MRI in identifying craniopharyngiomas based on a study of 26 subjects. The sensitivity of MRI for detecting craniopharyngiomas is 75%, indicating a solid ability to accurately identify patients with the condition. The specificity is notably high at 92.8%, suggesting that MRI is effective at correctly identifying patients without craniopharyngiomas. The positive predictive value is also 75%, indicating that a significant proportion of those diagnosed with craniopharyngiomas via MRI are confirmed by histopathology. The negative predictive value of 92.8% signifies a low rate of false negatives, enhancing confidence in negative results. The overall percent agreement between MRI and histopathology is 88.9%, demonstrating strong concordance. The Kappa value of 0.679 indicates substantial agreement beyond chance, while the p-value of 0.004 signifies statistical significance, reinforcing the reliability of MRI in diagnosing craniopharyngiomas.

**Table 8(a): MRI vs HPE in diagnosing meningioma**

| | | Histopathology | | |
|---|---|---|---|---|
| | | **Meningiotheliomatous Meningioma** | **Non-Meningiotheliomatous Meningioma** | **Total** |
| MRI | Meningioma | 3 | 2 | **5** |
| | Non-Meningioma | 2 | 21 | **23** |
| | **Total** | **5** | **23** | **28** |

This table compares MRI diagnosis with histopathological findings for meningiomas among 28 patients. Of the 5 cases diagnosed as meningiomas by MRI, 3 were confirmed as meningiotheliomatous meningiomas, while 2 were classified as non-meningiotheliomatous types. Additionally, 23 cases were identified as non-meningiomas on MRI, which included 2 misclassified cases. This data illustrates the effectiveness of MRI in identifying meningiomas, highlighting some limitations in accurately distinguishing between the various types of meningiomas and confirming the absence of the condition. The results emphasize the importance of histopathological evaluation for definitive diagnosis and classification of meningiomas.

**Table 8(b): Comparison of MRI diagnosis of Meningioma with Histopathology diagnosis of the study subjects (n=28)**

| | |
|---|---|
| Sensitivity | 66.7% |
| Specificity | 93.3% |
| Positive predictive value | 66.7% |
| Negative predictive value | 93.3% |
| Per cent agreement | 88.9% |
| Kappa value | 0.600 |
| P value | 0.011 |

This table outlines the diagnostic performance of MRI in identifying meningiomas based on a study of 28 subjects. The sensitivity of MRI for detecting meningiomas is 66.7%, indicating a moderate ability to accurately identify patients with the condition. The specificity is high at 93.3%, reflecting a strong capability to correctly identify patients without meningiomas. The positive predictive value is also 66.7%, suggesting that a significant proportion of those diagnosed with meningiomas via MRI are confirmed by histopathology. Conversely, the negative predictive value is 93.3%, highlighting a low rate of false negatives, which enhances confidence in negative results. The overall percent agreement between MRI and histopathology is 88.9%, demonstrating a strong level of concordance. The Kappa value of 0.600 indicates moderate agreement beyond chance, while the p-value of 0.011 signifies statistical significance, reinforcing the reliability of MRI in diagnosing meningiomas.

## DISCUSSION:

The sellar / parasellar and suprasellar regions are anatomically intricate areas that host various pathological lesions, both neoplastic and non-neoplastic. These conditions necessitate a comprehensive approach involving endocrinological, ophthalmic, and neurological assessments, supplemented by advanced neuroimaging techniques. The study comprised 45 patients with a clinical diagnosis of pituitary adenomas, suspected pituitary adenomas, intracranial space-occupying lesions, and those evaluated to exclude cerebral sinus venous thrombosis (CSVT). Sellar and parasellar cancers were evaluated based on clinical observations, laboratory assessments, and magnetic resonance imaging. Tissue diagnosis (biopsy) was performed post-surgery in viable cases, and results were provided accordingly. MRI is the premier imaging technique for characterising such lesions, owing to its superior soft tissue contrast differentiation, the availability of advanced sequences that provide high spatial resolution, and the absence of ionising radiation, thereby facilitating precise visualisation of mass effects on adjacent soft tissues. Pituitary adenoma: In our analysis, the predominant tumour was pituitary adenomas, specifically macroadenomas, which accounted for approximately 46.6% of the cases, while microadenomas comprised 20%, together totalling 66.6%. Craniopharyngiomas constituted 16.6%, while meningiomas accounted for 13.3% of all sellar and parasellar tumours. The The proportion of pituitary adenomas in our study was comparable to that observed in Awatif A's study (65.45%).[7] Batra V et al. observed that females constitute 60% of the cases of pituitary adenoma in their investigation. Banna et al. [9] observed a similar conclusion in their investigation, indicating a female predominance. However, Awatif et al. reported a male predominance in pituitary adenomas. The proportions of boys and females with pituitary adenoma in our study were comparable to those reported by Awatif et al.[7] Macroadenomas constituted 70% of pituitary adenomas observed in imaging studies, while microadenomas accounted for 30%. The findings were more aligned with those of Sweta Da Silva Pereira et al,[10] which reported a macroadenoma prevalence of 62.5%.

The normal pituitary parenchyma exhibits homogeneous augmentation at 60-80 milliseconds post-contrast injection. The peak picture contrast occurs at approximately one minute and subsequently diminishes progressively. Nonetheless, an adenoma may exhibit enhancement prior to pituitary tissue owing to direct artery perfusion. In this investigation, we observed that the majority of macroadenomas exhibited homogeneous enhancement on contrast MRI, but a few cases displayed heterogeneous enhancement due to haemorrhage. The results aligned with those of a study conducted by Batra et al. and Hui et al.[11] Batra et al. [8] observed that 70% of macroadenomas exhibited homogeneous contrast enhancement. Hui et al. reported that 71% of macroadenomas exhibited homogeneous enhancement. Sweta Da Silva Pereira et al. observed that 60.4% of the macroadenomas were homogeneous.

The coronal section aids in evaluating the suprasellar extension of lesions. Sagittal pictures were employed to identify the lesion's location. T2-weighted, diffusion-weighted imaging, and apparent diffusion coefficient imaging facilitate the evaluation of lesion consistency; soft lesions exhibit hyperintensity on T2-weighted images, while hard lesions display hypointensity on T2-weighted images, with softer lesions correlating to elevated ADC values. The optimal pulse sequence for superior tissue contrast and anatomical visualisation in this location is typically recognised as T1-weighted imaging, as it facilitates the characterisation of lesion components effectively. Signal intensity in T2-weighted images varies due to haemorrhage, cystic characteristics, or necrosis. In our investigation, 10 macroadenomas exhibited isointensity on both T1 and T2 sequences, 3 cases demonstrated isointensity on T1 but hyperintensity on T2, and 2 cases were hypointense on both T1 and T2 sequences. Hui et al. [11] had comparable results, with 85% of T1 being isointense yet hyperintense on T2 signals. Batra V et al.[8] and Johnsen et al.[12] reported analogous results, with 82% isointense and 18% hyperintense T1 signals. Sweta Da Silva et al. reported that 60.3% of macroadenomas exhibited isointensity on both T1-weighted and T2-weighted imaging. In 7.5% of instances, it exhibited hypointensity on T1 and hyperintensity on T2. Up to 10% of macroadenomas infiltrate cavernous sinuses and are physiologically aggressive, increasing surgical morbidity and death. Coronal pre- and post-contrast T1 weighted images are considered for cavernous sinus invasion. Since it had 100% positive predictive value, Cottier et al.[13] evaluated 67% internal carotid artery encasement by the tumour. Other features include carotid sulcus venous compartment obliteration and tumour extension beyond the lateral intercarotid line. Our study used asymmetry of cavernous sinuses, ICA encasement >45%, adenoma lateral to ICA, and lateral wall bulging to define cavernous sinus invasion. Among the macroadenomas examined, five instances had cystic alterations, four cases demonstrated invasion of the cavernous sinus, three cases displayed encasement of the cavernous portion of the internal carotid artery, one case revealed clival invasion, one case indicated sphenoid sinus invasion, and only six cases were microadenomas confined to the sellar region. Meningiomas originate from arachnoid cap cells in the leptomeninges, which are derived from mesenchyme and neural crest. They are predominantly dural-based and frequently located along dural reflections. In the front skull, it may originate from the sphenoid wings, tuberculum sellae, limbus sphenoidal, and the chiasmatic and olfactory grooves. On MRI, they are often well-circumscribed, iso- to hypointense on T2, and exhibit pronounced contrast enhancement. While not definitive, the presence of a dural tail may indicate a meningioma if: (a) the tail is thick, proximal to the tumour, and tapers peripherally, (b) it exhibits more enhancement than the tumour, and (c) it is observable in two consecutive sections across multiple planes. The majority of the three cases (12% of sellar and parasellar tumours) identified in the current investigation were located in parasellar regions and consisted of sphenoid meningiomas exhibiting meningiotheliomatous patterns, extending into the suprasellar area and sella; all were classified as grade I according to the WHO categorisation system. One instance exhibited internal calcifications. All instances of meningiomas exhibited uniform enlargement. Two cases had classical traits such as a dural tail. Hyperostosis was absent in all cases. In each instance, pituitary function was normal. Patients exhibited cephalalgia and visual impairments.

Craniopharyngiomas exhibit no gender predominance, characterised by a bimodal age distribution with peak incidence occurring in children and adults aged 5 to 14. and 50 to 74 years, respectively. In our analysis, the majority of instances pertain to the paediatric age range under 14 years, with only one case involving a 33-year-old individual. In our study, they represent 20% of all sellar/parasellar lesions exhibiting adamantinomatous histological patterns and clinically manifested with vision disturbances and elevated intracranial pressure. In the present investigation, all craniopharyngiomas were situated in the suprasellar cistern, spreading into the sella and parasellar regions. Enhanced characterisation of lesions in craniopharyngiomas was observed on MRI. All instances exhibit solid and cystic components with calcified foci enhancing the solid region of the lesion and the perimeter of the cyst. Two cases exhibited recurrence within a one-year period.

## CONCLUSION:

The MR imaging characteristics of the four most common lesions were sufficiently unique to differentiate them from one another and from the majority of other entities. Additional imaging criteria, including post-contrast enhancement, the existence of cystic components, extracellular and intrasellar localisation, and clinical symptoms, facilitate further differentiation among the various disorders. Magnetic resonance imaging's superior resolution and multiplanar capabilities optimally illustrate the extent of sellar and parasellar lesions.

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