

# Magnetic Resonance Imaging in the Evaluation and Characterisation of Sellar and Juxtaseilar Lesions

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## ABSTRACT

### BACKGROUND

The sellar and juxtaseilar region is a complex area where varied pathologies can occur. Differentiation among various pathologies may not always be easy, since many of these lesions mimic pituitary adenomas on clinical presentation, endocrinologic and radiologic examinations. The study intends to describe the imaging characteristics of the spectrum of pathological conditions affecting these regions using magnetic resonance imaging (MRI).

### METHODS

The main source of data for the study were patients from hospitals attached to Bangalore Medical College and Research Institute, Bengaluru viz. Victoria Hospital, Bowring and Lady Curzon Hospital and Vani Vilas Hospital. Patients with suspected sellar and juxtaseilar pathology on clinical examination referred to the Department of Radiodiagnosis from November 2017 to May 2019 underwent MRI study using Siemens 1.5-T Magnetom Avanto MR system. Magnetic resonance imaging was done in all patients according to the pituitary protocol.

### RESULTS

Among the 50 patients, there were 16 males and 34 females. Most of the patients were in the third to fifth decade of life. The various abnormalities on MRI included neoplastic (68 %), malformative (8 %), vascular (6 %), granulomatous, infectious and inflammatory (18 %) lesions. Pituitary adenomas (46 %) were the most common lesions in sellar and juxtaseilar regions, followed by tuberculosis (10 %), craniopharyngioma (8 %), Rathke's cleft cyst (6 %), meningioma (6 %), internal carotid artery (ICA) aneurysm (4 %), epidermoid (2 %) and miscellaneous lesions.

### CONCLUSIONS

MR imaging characteristics were sufficiently distinct to allow various sellar and juxtaseilar pathologies to be differentiated from each other. The spectrum of MRI findings were related to neoplastic, malformative, infectious, inflammatory, granulomatous and vascular causes. Our study observed that MRI with appropriate imaging protocols is the essential imaging modality in evaluation of sellar and juxtaseilar lesions.

### KEYWORDS

Pituitary, Sellar, Juxtaseilar, Magnetic Resonance Imaging

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## BACKGROUND

The sellar and juxtaseilar region is an anatomically complex region where a varied number of pathologies can occur. Differentiation among various pathologies may not always be easy, since many of these lesions mimic pituitary adenomas on clinical presentation, endocrinologic and radiologic examinations. CT and MRI are the imaging modalities for imaging and characterising anatomy and pathologic processes of the sellar and juxtaseilar region.<sup>1</sup>

Patients with endocrinological abnormalities pertaining to hypothalamo-pituitary tract and or visual field abnormalities require diagnostic imaging to rule out sellar and juxtaseilar pathology. Because of the multiplanar images with superior tissue contrast differentiation, with no hazards of radiation and non-invasiveness, magnetic resonance imaging has virtually replaced other imaging techniques such as computed tomography and angiography as the modality of choice for evaluation of the sellar and juxtaseilar regions.<sup>2</sup>

Sella turcica and parasellar region being small and complex component of the central nervous system, varied spectrum of sellar and parasellar pathologies often present with similar symptoms demonstrating profound neuroendocrine manifestations treatable. Early diagnosis and accurate characterisation provide significant clinical benefit. Systematic approach and knowledge of the key anatomy and imaging features can help in narrowing down the differential diagnosis and sometimes to reach a specific diagnosis although definitive diagnosis requires histopathological correlation.<sup>3</sup>

Numerous lesions (around 30) arise from the pituitary gland and adjacent surrounding structures.<sup>4</sup> Pituitary adenomas account for 90 % of sellar and parasellar lesions while other lesions include non-neoplastic and neoplastic solid and cystic lesions, vascular lesions, granulomatous lesions, infective and inflammatory lesions.<sup>5</sup>

A correct diagnosis of such lesions thus implicates a multidisciplinary approach, requiring detailed endocrine, neuroimaging, and ophthalmological studies.<sup>6</sup> MRI is the imaging modality of choice for the evaluation of pituitary gland. Optimising the study requires performing thin sections targeting the pituitary fossa both the sagittal and coronal planes. T1 weighted sequences before and after intravenous contrast are the main stay of pituitary imaging. Coronal T2 weighted sequences can also give added information but are less sensitive in the detection of adenomas.<sup>7</sup>

### Objectives

The following study intends to describe the imaging characteristics of the spectrum of pathological conditions affecting the sellar and juxtaseilar regions.

## METHODS

This was a cross-sectional study design with total of 50 patients. The main source of data were patients coming to

the hospitals attached to Bangalore Medical College and Research Institute, Bengaluru viz. Bowring and Lady Curzon Hospital, Victoria Hospital and Vani Vilas hospital for a period between November 2017 to May 2019. Patients suspected to have sellar and juxtaseilar pathology on clinical examination were included in the present study underwent MRI examination. Brief history, clinical examination and provisional clinical diagnosis was made before MRI examination. The procedure was communicated to the patients and the informed consent was taken in written format. Claustrophobic patients and patients with general contraindications to MRI such as pacemakers, aneurysmal clips, cochlear implants, metallic implants or metallic foreign bodies, etc. were excluded from the study.

### Technique of Examination

All magnetic resonance imaging examinations were performed on a 1.5-T Siemens Avanto Magnetom MRI machine. MRI was performed in all patients according to a standardised pituitary protocol with 5 mm thickness slices and 0.5 mm interslice gaps in the axial, coronal and sagittal plane with T1 & T2 weighting, along with fluid-attenuated inversion recovery (FLAIR) & diffusion-weighted magnetic resonance imaging (DWI) sequences. For DWI images B values of 0 and 1000 sec / mm<sup>2</sup> were used. A pituitary protocol MRI also includes axial, sagittal and coronal T1 fat saturated sequences with slice thickness of 3 mm and a 0.5 to 1 mm interslice gap. Post contrast fat saturated sagittal and coronal T1 sequences with a 3 mm slice thickness were also acquired. Spectroscopy was utilised in specific conditions if required. Gadopentetate dimeglumine was used as the paramagnetic contrast agent with dosage of 0.1 mg / kg.

### Statistical Analysis

The overall data was analysed for descriptive statistics for percentages and proportions using Statistical Package for the Social Sciences (SPSS) software version 20.0. Sensitivity and specificity of MRI was assessed whenever histopathological confirmation was available.

## RESULTS

Our study included total of 50 patients out of which 32 % cases were males and 68 % cases were females. Most of the patients were in the age group of 41 - 50 years (28 %) followed by 21 - 30 years age group (24.0 %).

Neoplastic lesions were the most common type of pathology in the sellar and juxtaseilar regions constituting 68 % of the cases followed by granulomatous, infections & inflammatory conditions, malformative and vascular lesions. Among neoplasms pituitary adenomas constituted majority of the cases, followed by craniopharyngiomas and meningiomas.

Tuberculosis constituted majority of cases among granulomatous, infections & inflammatory conditions. Pituitary adenomas were more common in females (60.9 %)

more common in 41 - 50 years of age group and least common in 11 - 20 years age group. Macroadenomas (91.3 %) were more common than microadenomas. Majority of the macroadenomas produced chiasmal syndrome (65.2 %) and rest with symptoms of hypopituitarism and acromegaly. 13 cases had cavernous sinus invasion, 61.9 % cases of macroadenomas, out of which, 42.9 % had bilateral involvement.

Out of 50 cases, total of 15 cases (24 %) showed cystic areas within. Among the cystic lesions, craniopharyngioma were the most common, followed by Rathke's cleft cysts and macroadenoma with cystic changes.

12 out of 50 cases (24 %) showed foci of blooming on susceptibility weighted imaging which indicates haemorrhage / calcification. Macroadenoma constituted the most cases which showed blooming on susceptibility weighted imaging (SWI) (41.67 %).

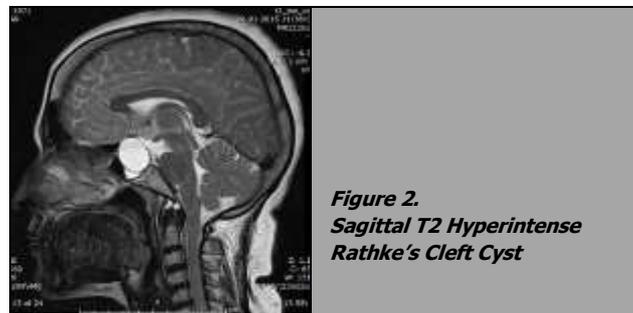
8 out of 50 cases (16 %) showed restricted diffusion on diffusion weighted imaging which included 2 cases of macroadenoma and one each case of tuberculosis, fungal sinusitis, cavernous sinus thrombosis, petrous apex cholesteatoma, thrombosed ICA aneurysm and epidermoid.

19 out of the 50 cases (38 %) demonstrated erosion / expansion of the sella, macroadenoma constituted 14 out of the 19 cases (73.7 %). 5 cases (10 %) showed destruction of sphenoid sinus walls, 2 of them were nasopharyngeal carcinoma. 2 cases (4 %) showed erosion of skull base. One case of nasopharyngeal carcinoma showed erosion of pterygoid plates and one case of cholesteatoma showed erosion of petrous temporal bone.

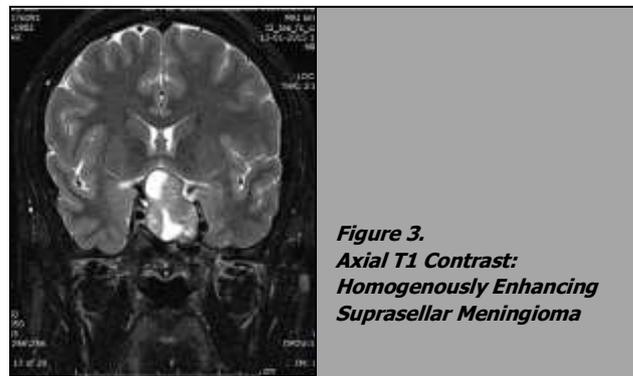
Most of the sellar and juxtaseilar lesions (44 %) showed heterogeneous enhancement. 4 cases (8 %) were non-enhancing, which included microadenoma, sphenoid sinus mucocoele and epidermoid. 3 cases (6 %) of tuberculosis showed meningeal enhancement. All 3 cases of meningioma showed homogeneous enhancement. Ring / rim enhancing lesions included tuberculoma and Rathke cleft cysts. Out of the 50 cases, holoprosencephaly (HPE) diagnosis was available for 31 of the cases.

Pathology	MRI Diagnosis	HPE Diagnosis
Meningioma	3	3
Macroadenoma	15	13
Craniopharyngioma	4	3
Rathke's cleft cyst	3	3
Fungal sinusitis	1	1
Sphenoid sinus mucocoele	1	1
Epidermoid	1	1
Nasopharyngeal carcinoma	2	2
Juvenile nasopharyngeal angiofibroma	1	1
<b>Total</b>	<b>31</b>	<b>28</b>

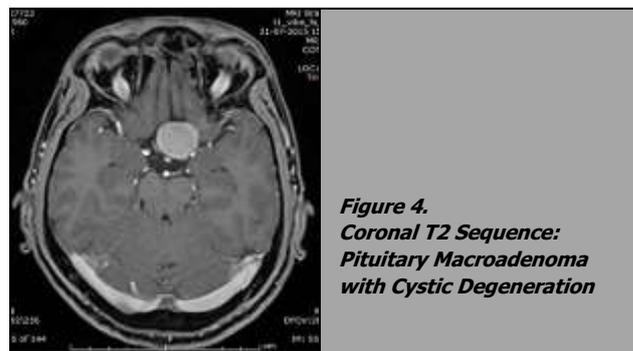
**Table 1. MRI Diagnosis vs. HPE Diagnosis**



**Figure 2.**  
*Sagittal T2 Hyperintense Rathke's Cleft Cyst*



**Figure 3.**  
*Axial T1 Contrast: Homogeneously Enhancing Suprasellar Meningioma*



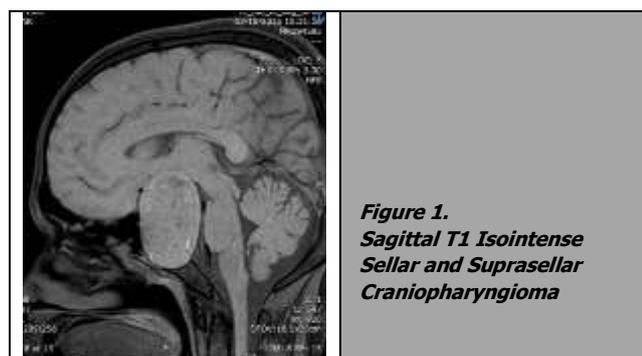
**Figure 4.**  
*Coronal T2 Sequence: Pituitary Macroadenoma with Cystic Degeneration*

Out of 15 MRI diagnosis of macroadenoma, 2 of the cases turned out to be craniopharyngioma with sensitivity of 86.67 %, specificity of 87.5 %, positive predictive value of 86.67 % and negative predictive value of 87.1 %.

Out of the 4 MRI diagnosis of craniopharyngioma, 1 case turned out to be macroadenoma with sensitivity of 75 %, specificity of 96.3 %, positive predictive value of 75 % and negative predictive value of 96.3 %.

**DISCUSSION**

Our study included total of 50 patients belonging to all the age groups with majority of the patients (about 54 %) belonged to the third to fifth decade of life. This was similar to Banna et al.<sup>8</sup> who encountered maximum number of patients in third and fourth decades of life However Reich et al.<sup>9</sup> reported a high incidence of patients (15 out of 20) above the age of 40 years which was probably related to fact that most of their patients had aneurysm, meningiomas and metastases, whereas only five patients had pituitary adenoma and craniopharyngiomas. There was a female preponderance in the present study which correlated with



**Figure 1.**  
*Sagittal T1 Isointense Sellar and Suprasellar Craniopharyngioma*

Banna et al. experience in contrast to Reich et al. who reported a male preponderance.

The most common lesion detected in our study was pituitary adenoma (21 macroadenomas and 2 micro adenomas) and proportion of macroadenoma to micro adenoma was 10.5:1 which was in accordance with Johnsen et al. who found the total proportion of macro to microadenomas as 2.5:1. Out of 21 cases of macroadenoma, 14 cases caused sellar expansion and 13 cases had cavernous sinus invasion (61.9 %). Bilateral involvement of cavernous sinus was seen in 9 out of 13 cases (42.9 %). Total encasement of the internal carotid artery was the most specific sign for the detection of cavernous sinus invasion.

Suprasellar craniopharyngiomas constituted 8 % of total patients, in the age group of 11 to 33 with male predominance which was similar to study by Johnsen et al. who noted 7.6 % cases of craniopharyngiomas with average age being 34 years with male predominance.

The presence of calcification was noted in 2 (50 %) cases. In a study by Pusey et al.<sup>10</sup> which compared CT and MRI in assessment of craniopharyngiomas, they found that, CT was superior to MR in demonstrating calcifications within the tumours. MR failed to demonstrate areas of calcification in three of 14 cases in which calcification was demonstrated by CT. Johnsen et al. also concluded that, CT provides superior demonstration of tumoral calcification and, hence, may permit a more specific diagnosis when this common characteristic is demonstrated. Although all were primarily suprasellar in location, all cases of craniopharyngiomas in our study showed intrasellar extension. Bony sellar wall erosion was seen in one case. The sellar expansion was not as large as in pituitary adenomas. Karnaze et al.<sup>11</sup> showed bony sellar wall erosion in 44 % of cases of craniopharyngiomas. Donovan et al.<sup>12</sup> further stated that, if mass was centred in the sella with significant sellar expansion and bony erosion, the possibility of pituitary adenoma was more. Our study also supported this hypothesis.

Meningiomas in sellar region may arise from tuberculum sellae, diaphragma sellae, clinoid processes, optic nerve sheaths and wings of sphenoid. Meningiomas in parasellar region may extend into the sellar region. Johnsen et al. reported higher incidence of meningiomas in female patients (10 out of 14) similar to our series which showed 2 out of 3 patients to be females. In our study, we found all cases to be isointense on T1 W and T2 W images which is consistent to study by Taylor et al.<sup>13</sup> who found that 91 % of meningiomas were isointense on T1 and 55 % were isointense on T2 W. Dural tail sign or the meningeal sign was commonly associated with meningiomas but was not entirely specific. In our study, 2 out of 3 cases showed dural tail sign.

There was one epidermoid cyst in our study which showed cerebrospinal fluid (CSF) signals on spin echo T1 & T2 sequences. However, Kallmes et al.<sup>14</sup> who found that epidermoid tumours show heterogeneous signal intensity with more hyperintense signal on T1, hyperintense on proton density (PD) and iso or hyperintense on T2 weighted images compared to CSF. They suggested that the "isointense epidermoid tumour," with signal-intensity characteristics identical to those of CSF on all three spin echo

pulse sequences was relatively unusual. Epidermoid cyst showed incomplete suppression on FLAIR and bright signal on diffusion which was similar to study by Hakyemez et al.<sup>15</sup> who found that FLAIR & DWI sequences were clearly superior to conventional T1 and T2 W images for differentiation from arachnoid cysts. Epidermoid cysts were hyperintense on FLAIR and diffusion with mean ADC value was more than arachnoid cysts but higher than cerebral cortical white matter.

Single case of lymphocytic hypophysitis was reported in our study. The patient was a peripartum female who presented with symptoms of headache, lactational failure and visual loss. MR demonstrated diffuse enlargement of anterior lobe, widening of pituitary stalk and loss of bright spot of posterior pituitary. Y. Nakata et al.<sup>16</sup> retrospectively reviewed the MR imaging findings in 20 patients and concluded that MR findings such as loss of posterior pituitary bright spot, thickened stalk, pituitary asymmetry, homogenous enhancement and parasellar T2 dark sign can contribute to distinguishing pituitary adenoma from lymphocytic hypophysitis.

There were 3 cases of Rathke cleft cyst in our study. Two of them were females and one patient was male. They presented with visual symptoms and headache. MRI revealed cystic lesions in sellar and suprasellar region iso to hyperintense on both T1 W and T2 W images. Rim enhancement was noted on postcontrast study. Johnsen et al. found two cases in their study both of them were young girls who presented with headache and seizures.

In our study, we reported 5 cases of suprasellar tuberculoma, who presented with convulsions, headache and visual disturbances. 4 of the patients were females and one patient was male. There were multiple conglomerated ring enhancing lesions seen in the optic chiasma, tuber cinereum, pituitary stalk and suprasellar cisterns. Most were isointense on T1 WI and few were hypointense. On T2 W images they were predominantly hypointense with few being hyperintense. One of the patients had lesions which showed restriction on DWI. Another patient had an active calcified tuberculoma, which showed blooming on SWI sequence. Most of the lesions showed ring enhancement on post contrast study with meningeal enhancement. Arunkumar MJ et al.<sup>17</sup> in their reported cases of intrasellar tuberculomas, found that most have headache as the presenting complaint in addition to visual disturbances with female preponderance and male: female ratio of 1:2.25. Four cases (4 out of 13, 30.8 %) had purely an intrasellar location, while the remaining (9 out of 13, 69.2 %) had an intrasellar mass with suprasellar extension. Faizuddin Ahmed et al.<sup>18</sup> have suggested that, tuberculosis should be considered in the differential diagnosis of sellar lesions, especially if associated with contrast enhancement and thickening of sphenoid sinus mucosa or pituitary stalk, in patients from tuberculosis endemic areas.

We reported 2 cases of aneurysm of the cavernous part of internal carotid arteries. Both patients were females who presented with headache and visual symptoms. In 5 reported cases of Johnsen et al. 3 were from cavernous part and 2 from the supraclinoid portion of ICA. In our study, we also reported two cases of nasopharyngeal carcinoma, one

case each of juvenile nasopharyngeal angiofibroma, aspergillosis, sphenoid sinus mucocoele, petrous apex cholesteatoma, cavernous sinus thrombosis due to preseptal cellulitis and metastasis from breast carcinoma all had secondary involvement of the sella and the juxtaseilar regions.

### CONCLUSIONS

MR imaging characteristics were sufficiently distinct to allow various sellar and juxta sellar pathologies to be differentiated from each other. The spectrum of MRI findings was related to neoplastic, malformative, infectious, inflammatory, granulomatous and vascular causes. Our study observed that MRI with appropriate imaging protocols plays an essential role in evaluation & characterisation of sellar and juxtaseilar lesions.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.

Financial or other competing interests: None.

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