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Characterizing MRI Features of Sellar, Parasellar, and Suprasellar Lesions

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Abstract

Background: Sellar, parasellar, and suprasellar lesions encompass a wide spectrum of pathological entities, posing diagnostic challenges due to their complex anatomical location. Magnetic resonance imaging (MRI) plays a pivotal role in the evaluation of these lesions, providing detailed anatomical and pathological information.

Objective: This study aimed to characterize the MRI features of sellar, parasellar, and suprasellar lesions, describe their incidence and age/gender distribution, and assess the diagnostic accuracy of MRI in detecting these lesions.

Methods: A retrospective analysis was conducted on patients referred to the Department of Radiology with suspected or diagnosed sellar, parasellar, or suprasellar lesions. MRI examinations were performed using standard protocols, and findings were analyzed for characteristic features. Incidence, age, and gender distribution of lesions were documented, and diagnostic accuracy of MRI was assessed by comparing imaging findings with histopathological diagnoses.

Results: The study included a total of 39 patients with sellar, parasellar, or suprasellar lesions. Pituitary adenomas, particularly macroadenomas, were the most prevalent pathology, followed by craniopharyngiomas and meningiomas. Female predominance was observed, with a peak incidence in the 31 to 40 years age group. MRI demonstrated high sensitivity and specificity in diagnosing pituitary macroadenomas and craniopharyngiomas, with moderate sensitivity for meningiomas.

Conclusion: MRI is a valuable tool in the characterization and diagnosis of sellar, parasellar, and suprasellar lesions. The findings of this study provide insights into the MRI features, incidence, age/gender distribution, and diagnostic accuracy of these lesions, facilitating their timely diagnosis and appropriate management. Further research is warranted to validate these findings and explore the utility of advanced imaging techniques in improving diagnostic accuracy.

Keywords: MRI, sellar lesions, parasellar lesions, suprasellar lesions, pituitary adenoma, craniopharyngioma, meningioma, diagnostic accuracy.

Introduction

Sellar, parasellar, and suprasellar regions constitute a complex anatomical area within the cranial cavity, hosting a myriad of vital structures pivotal for neurological and endocrine function. This intricate region encompasses the sella turcica, a bony saddle-like structure cradling the pituitary gland, as well as surrounding structures such as the optic chiasm, cavernous sinuses, and hypothalamus. Lesions arising in these regions present a diagnostic challenge owing to their diverse etiology and the intricate relationships among neighboring structures [1-3].

The sellar region, centrally located within the cranial base, harbors the pituitary gland, also known as the hypophysis. This pea-sized gland, often referred to as the "master gland," plays a fundamental role in regulating various physiological processes through the secretion of hormones. Pathological conditions affecting the pituitary gland range from benign adenomas to rare malignant tumors, each posing unique diagnostic and therapeutic considerations. Pituitary adenomas, accounting for the majority of sellar lesions, arise from the adenohypophysis and can manifest with hormonal hypersecretion or mass effects, leading to a spectrum of clinical presentations [4-6].

Adjacent to the sella turcica lie the parasellar and suprasellar regions, extending beyond the confines of the sellar fossa. The parasellar region encompasses structures such as the cavernous sinuses, internal carotid arteries, and cranial nerves III, IV, V (V1 and V2 divisions), and VI. Pathological processes in this region often impinge upon these vital neurovascular structures, leading to characteristic clinical syndromes such as ophthalmoplegia, sensory deficits, and cavernous sinus syndrome. Craniopharyngiomas, arising from remnants of Rathke's pouch, represent a significant subset of lesions affecting the sellar and suprasellar regions. These benign but locally aggressive tumors commonly affect pediatric populations and pose unique challenges due to their proximity to critical structures and potential for hypothalamic dysfunction [5-9].

Suprasellar lesions extend superiorly from the sella turcica and may impinge upon the optic chiasm, optic nerves, and third ventricle. Meningiomas, originating from the meninges surrounding the brain and spinal cord, are among the common lesions affecting the suprasellar region. These tumors often present with characteristic imaging features, including dural tail sign and calcifications, aiding in their differentiation from other sellar and parasellar lesions [4-8].

Given the diverse etiology and overlapping clinical presentations of sellar, parasellar, and suprasellar lesions, accurate diagnosis and treatment planning necessitate a multimodal approach integrating clinical, radiological, and pathological findings. Magnetic resonance imaging (MRI) serves as the cornerstone in the evaluation of these lesions, offering unparalleled soft tissue contrast and multiplanar imaging capabilities. Understanding the characteristic MRI features of different sellar region lesions is essential for accurate diagnosis, prognostication, and therapeutic decision-making [6-10].

In this study, we aim to comprehensively characterize the MRI features of sellar, parasellar, and suprasellar lesions, delineating their imaging characteristics and clinical implications. Through a detailed analysis of imaging findings and comparison with existing literature, we endeavor to provide valuable insights that will enhance the diagnostic accuracy and therapeutic management of patients with sellar region pathology.

Material and methods

The study was conducted at a tertiary care center, specifically within the Department of Radiology at Krishna Institute of Medical Sciences and Hospital. Participants included patients who were referred to the Department of Radiology with suspected or diagnosed sellar or parasellar lesions.

Inclusion criteria comprised all cases showing clinical manifestations of sellar or parasellar lesions, with patients of all age groups being considered. Exclusion criteria involved cases where MRI was contraindicated.

This was an observational study conducted over a total period of 18 months. The study area was confined to the Department of Radiology at Krishna Institute of Medical Sciences & Hospital.

The sample size calculation was based on the estimation that around 10% of all intracranial tumors are sellar lesions. Using the formula N = Z^2 x P x Q/L^2, where Z represents the standard constant value at 95% CI, P denotes the prevalence of sellar lesions, Q signifies the complementary value of P, and L indicates the allowable error or precision rate, a minimum of 36 subjects were selected for the study.

The study included patients from both the inpatient and outpatient departments who presented with clinical features suggestive of sellar, parasellar, or suprasellar lesions. Additionally, patients previously diagnosed with sellar or parasellar lesions on CT SCAN and requiring further evaluation with MRI were also included. Moreover, patients exhibiting hormonal alterations indicative of pituitary pathology were considered for inclusion.

MRI examinations were carried out using a 1.5 Tesla SIEMENS MAGNETOM AVANTO scanner.

Results

Table 1 illustrates the distribution of sellar and parasellar lesions by age and gender. The data shows a varied distribution across different age groups, with the highest number of cases observed in the 31 to 40 years age group. Additionally, there is a predominance of female patients, comprising approximately 64% of the total cases.

Table 2 further delves into the distribution of specific pathologies within the sellar region, categorized by gender. The most common pathology observed is macroadenoma, with a higher prevalence in females compared to males. Craniopharyngioma and microadenoma also contribute significantly to the observed cases, with varying distributions across gender.

Table 3 provides insights into the location-wise distribution of sellar and parasellar lesions. It delineates the specific regions affected by each pathology, including sellar, sellar & suprasellar, and suprasellar locations. Macroadenoma is predominantly observed in the sellar and sellar & suprasellar regions, while craniopharyngioma exhibits a more balanced distribution across all locations. Other pathologies, such as cavernous sinus hemangioma and meningioma, are primarily localized in the suprasellar region. These findings offer valuable information regarding the anatomical localization of different sellar and parasellar lesions, aiding in diagnosis and treatment planning.

Table 4 presents specific MRI findings related to pituitary lesions, including the presence of cystic changes and blooming on GRE sequences. Craniopharyngiomas and macroadenomas exhibit the highest prevalence of cystic changes, while blooming on GRE sequences is particularly prominent in cases of craniopharyngioma and aneurysm. These findings highlight the diverse radiological characteristics of pituitary lesions, which can aid in their differential diagnosis and management.

Table 5 provides insights into the contrast enhancement patterns observed in sellar and parasellar lesions. Heterogeneous enhancement is predominant in craniopharyngiomas and macroadenomas, while microadenomas demonstrate homogeneous enhancement. Additionally, a notable proportion of cases, including partial empty sella and rathkes cyst, show no enhancement. These findings underscore the importance of contrast-enhanced MRI in characterizing sellar and parasellar lesions, which can assist in determining their histopathological nature and guiding therapeutic decisions.

Table 6 presents a comparison between MRI diagnoses and histopathological diagnoses of pituitary lesions, assessing the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of MRI. Macroadenomas and craniopharyngiomas demonstrate high sensitivity and specificity levels, indicating the accuracy of MRI in diagnosing these lesions. However, the sensitivity for meningiomas is comparatively lower, suggesting the need for additional diagnostic modalities in certain cases. These findings emphasize the diagnostic utility of MRI in evaluating pituitary lesions, while also highlighting the importance of histopathological confirmation for definitive diagnosis and management.

Discussion

Sellar, parasellar, and suprasellar lesions pose significant diagnostic and therapeutic challenges due to their complex anatomical location and diverse pathological entities. In this discussion, we will analyze the findings from our study regarding the characteristic MRI features, incidence, age and gender distribution, pathology, and diagnostic accuracy of these lesions, and contextualize them within the existing literature.

Characteristic MRI Features

Our study comprehensively delineates the MRI features of sellar, parasellar, and suprasellar lesions, providing valuable insights for accurate diagnosis and management. The characteristic MRI findings, including cystic changes, blooming on GRE sequences, and contrast enhancement patterns, exhibit considerable variability among different pathologies. For instance, craniopharyngiomas commonly demonstrate cystic changes and blooming on GRE sequences, while macroadenomas exhibit heterogeneous enhancement. These findings align with existing literature, emphasizing the importance of MRI in characterizing sellar region lesions [1,2].

Incidence and Age/Gender Distribution

The incidence of sellar, parasellar, and suprasellar lesions varies across different studies, with pituitary adenomas being the most prevalent pathology [3,4]. Our study corroborates this, with macroadenomas constituting the majority of cases. Interestingly, we observed a predominance of female patients, consistent with previous reports highlighting the hormonal influence on the development of pituitary adenomas [5,6]. Additionally, our findings reveal a peak incidence of sellar lesions in the 31 to 40 years age group, aligning with the literature suggesting a bimodal distribution with peaks in the third and sixth decades of life [7,8].

Pathology

The spectrum of sellar, parasellar, and suprasellar lesions encompasses various benign and malignant entities, each with distinct radiological and histopathological features. Pituitary adenomas, particularly macroadenomas, were the most common pathology in our study, consistent with their high prevalence in sellar region lesions [9]. Craniopharyngiomas, although relatively rare, constituted a significant proportion of cases, highlighting their clinical significance in sellar region pathology [10]. The observed distribution of other pathologies, such as meningiomas and epidermoid cysts, further underscores the diverse etiology of sellar lesions [11,12].

Diagnostic Accuracy

MRI serves as the cornerstone in the diagnosis of sellar, parasellar, and suprasellar lesions, offering superior soft tissue contrast and multiplanar imaging capabilities [13]. Our study demonstrates high sensitivity and specificity of MRI in diagnosing pituitary macroadenomas and craniopharyngiomas, consistent with previous reports [14,15]. However, the sensitivity for other pathologies, such as meningiomas, was relatively lower, emphasizing the need for histopathological confirmation in certain cases. These findings highlight the diagnostic utility of MRI in evaluating sellar region lesions while also acknowledging its limitations in certain scenarios.

Clinical Implications

Accurate characterization of sellar, parasellar, and suprasellar lesions is crucial for guiding appropriate therapeutic strategies. Our study provides valuable insights into the radiological features and distribution of these lesions, aiding in their differential diagnosis and treatment planning. For instance, the identification of cystic changes and blooming on GRE sequences can help differentiate craniopharyngiomas from other sellar lesions, guiding surgical management [16]. Additionally, understanding the age and gender distribution of specific pathologies can inform screening strategies and therapeutic decisions tailored to individual patients [17].

Limitations and Future Directions

Our study has several limitations, including its retrospective design and single-center setting, which may limit the generalizability of findings. Furthermore, the relatively small sample size warrants caution in extrapolating results to broader populations. Future studies with larger cohorts and prospective designs are warranted to validate our findings and elucidate the diagnostic and therapeutic implications of sellar region lesions comprehensively. Additionally, the integration of advanced imaging techniques, such as diffusion-weighted imaging and spectroscopy, may further enhance the diagnostic accuracy of MRI in sellar region pathology.

Conclusion

In conclusion, our study provides valuable insights into the characteristic MRI features, incidence, age and gender distribution, pathology, and diagnostic accuracy of sellar, parasellar, and suprasellar lesions. The findings underscore the importance of MRI in the evaluation of these lesions and its role in guiding accurate diagnosis and treatment planning. Further research is warranted to validate our findings and explore the potential of advanced imaging techniques in enhancing the diagnostic accuracy of sellar region lesions. Ultimately, a multidisciplinary approach integrating clinical, radiological, and pathological findings is essential for optimal management of patients with sellar region pathology.

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Tables

Table 1: Age and Gender Distribution of Sellar and Parasellar Lesions

Age Group (years)	**Male Count**	**Female Count**	**Total Count**
11 to 20	2	1	3
21 to 30	4	4	8
31 to 40	5	6	11
41 to 50	4	3	7
51 to 60	3	2	5
61 to 70	2	2	4
70 above	1	0	1
Total	21	18	39

Table 2: Distribution of Pathologies in Sellar Region by Gender

MRI Diagnosis	Male Count	Female Count	Total Count
CAVERNOUS SINUS HEMANGIOMA	0	1	1
CRANIOPHARYNGIOMA	2	3	5
EPIDERMOID CYST	1	1	2
HYPOTHALAMIC CHIASMATIC GLIOMA	1	0	1
MACROADENOMA	6	7	13
MENINGIOMA	1	2	3
MICROADENOMA	0	6	6
PARTIAL EMPTY SELLA	1	3	4
RATHKES CYST	0	2	2
ANEURYSM	1	1	2
Total	13	25	38

Table 3: Location-wise Distribution of Sellar and Parasellar Lesions

MRI Diagnosis	Sellar	Sellar & Suprasellar	Suprasellar	Total
CAVERNOUS SINUS HEMANGIOMA	0	0	1	1
CRANIOPHARYNGIOMA	0	3	2	5
EPIDERMOID CYST	0	0	2	2
HYPOTHALAMIC CHIASMATIC GLIOMA	0	0	1	1
MACROADENOMA	2	11	0	13
MENINGIOMA	0	0	3	3
MICROADENOMA	6	0	0	6
PARTIAL EMPTY SELLA	4	0	0	4
RATHKES CYST	2	0	0	2
ANEURYSM	0	0	2	2
Total	14	14	11	39

Table 4: MRI Findings of Pituitary Lesions

MRI Diagnosis	Cystic Changes Present	Blooming on GRE Sequences
CRANIOPHARYNGIOMA	3	5
MACROADENOMA	4	6
MICROADENOMA	1	1
PARTIAL EMPTY SELLA	4	0
RATHKES CYST	2	0

Table 5: Contrast Enhancement Patterns of Sellar and Parasellar Lesions

MRI Diagnosis	Heterogenous	Homogenous	Nil
CRANIOPHARYNGIOMA	5	0	0

MACROADENOMA	9	4	0
MENINGIOMA	1	2	0
MICROADENOMA	0	6	0
PARTIAL EMPTY SELLA	0	0	4

Table 6: Comparison of MRI with Histopathological Diagnosis

Lesion	**Sensitivity**	**Specificity**	**Positive Predictive Value**	**Negative Predictive Value**
MACROADENOMA	91.67%	77.78%	84.62%	87.50%
CRANIOPHARYNGIOMA	100.00%	100.00%	100.00%	100.00%
MENINGIOMA	50.00%	94.12%	66.67%	88.89%