

Evaluation of Clinical and Magnetic Resonance Imaging Profile of Pituitary Macroadenoma: A Prospective Study

Kamini Gupta, Shivam Sahni, Kavita Saggar, Gaurav Vashisht

Department of Radiodiagnosis, Dayanand Medical College and Hospital, Ludhiana, Punjab, India

Abstract

Background: Pituitary macroadenoma is a common tumor of middle-aged people. Magnetic resonance imaging (MRI) is the investigation of choice for its evaluation. Various parameters regarding the extent, consistency, and contrast uptake can be studied and a noninvasive diagnosis is possible. **Aims and Objectives:** To study the MRI features and extent of pituitary macroadenomas. **Materials and Methods:** We studied clinical and MRI features of 33 patients of all age groups and both sexes with pituitary macroadenomas who presented to Dayanand Medical College and Hospital, Ludhiana from January 2014 to June 2015. MRI was carried out on MAGNETOM Avanto 18 Channel 1.5 Tesla Machine by Seimens India Ltd. The dedicated sellar protocol consisted of sagittal and coronal T1-weighted image (T1-WI) and T2-WI without intravenous contrast using thin slices (3 mm) and a field of view of <200 mm. **Results:** On analysis of the 33 cases, we observed that patients of pituitary macroadenoma showed an almost equal sex incidence and average age group of 50–60 years. The common presenting complaints were headache and decreased vision. Superior and inferior extent of the lesion was beyond the defined boundaries of sella in most cases, but the lateral extent was limited, resulting in characteristic “snowman-like” appearance. The imaging characteristics showed solid to predominantly solid consistency, appearing mostly heterogeneously hyperintense on T2-WI, and hypo to isointense on T1-WI with intense postcontrast enhancement. Hemorrhage is less common. Pituitary apoplexy is rare and can result in spontaneous resolution. **Conclusions:** We conclude that the knowledge of clinical and imaging profile of pituitary macroadenoma can help the radiologists to diagnose these sellar lesions, and hence their therapeutic approach can be defined timely.

Keywords: Apoplexy, cavernous sinus, macroadenoma, magnetic resonance imaging, optic chiasm

INTRODUCTION

Pituitary adenomas account for approximately 10% of all intracranial neoplasms and between one-third to one-half of sellar and parasellar masses. The majority of pituitary tumors are asymptomatic, discovered as “incidentalomas” in the course of investigation for other conditions. The most common pituitary adenomas are prolactinomas, comprising approximately 30% to 40% of all pituitary tumors.^[1] Prolactin-secreting and growth hormone-secreting adenohypophyseal cells are located more laterally within the normal pituitary gland and corticotropin-secreting, thyroid-stimulating hormone-secreting, and gonadotropin-secreting cells are located more medially. This inherent spatial organization of adenotrophs within the gland imparts a similar spatial distribution to the origin of hormone-secreting adenomas.^[2] Nonfunctioning adenomas are the second most common tumors, comprising 25% of pituitary adenomas. These tumors

often grow to a significant size and cause optic chiasm compression or other mass effect before they are detected.^[3] A slow-growing macroadenoma expands the bony sella and extends into the suprasellar cistern. Often, these lesions have a “figure of eight” or “snowmanlike” appearance because the rigid dura of the diaphragm sellae results in a waist to the mass.^[4] Macroadenoma may expand to involve adjacent structures; they often grow superiorly into the suprasellar cistern and compress the optic chiasm or nerves. Inferiorly, macroadenoma can extend into the sphenoid sinus, and posteriorly, they extend into the dorsum sellae. Laterally, they can invade the cavernous sinuses.^[5]

Address for correspondence: Dr. Kamini Gupta,
Department of Radiodiagnosis, Dayanand Medical College and Hospital,
Ludhiana - 141 001, Punjab, India.
E-mail: kamini.kshitij@gmail.com

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We in the present article studied the clinical presentation and magnetic resonance imaging (MRI) features of pituitary macroadenomas and delineated the common patterns and behavior of these tumors.

MATERIALS AND METHODS

This prospective study was conducted on patients suspected clinically or on other investigations to have sellar/parasellar lesions, referred from indoor/outdoor patient department to the Department of Radiodiagnosis at Dayanand Medical College, Ludhiana, for MRI from January 2014 to June 2015. The Institutional Ethical Committee accorded ethical clearance to this study.

Consent was obtained from each patient, and relevant detailed history was elicited from all patients. Before starting the MRI study, the procedure was explained to the patient in his/her vernacular language to allay the fear and anxiety and written informed consent was taken. The length of the study varied from 15 to 30 min, during which the patient was in direct contact with technologist/doctor by two-way intercom system.

The confirmation of the diagnosis was done surgically/histopathologically wherever possible. In case, no surgery/biopsy was undertaken/indicated, clinical follow up was done.

MRI in all patients included in this study was carried out on MAGNETOM Avanto 18 Channel 1.5 Tesla TIM MR Machine by Seimens India Ltd, in our department.

The patient was positioned in the supine position. Head was secured in a head coil. The patient was instructed to maintain the correct position and to hold still during the examination.

Localizer was taken in coronal, axial, and sagittal plane after making proper positioning of the patient. The MRI brain protocol consisted of the following sequences:

- In the axial plane:
 - Turbo spin echo (TSE) T2-weighted sequence (repetition time [TR]/echo time [TE]/number of excitations (n) = 4050 ms/101 ms/3)
 - Spin echo T1-weighted sequence (TR/TE/ n = 652 ms/17 ms/1)
 - Diffusion-weighted imaging was performed using echo planar imaging sequence with the following parameters: TR/TE = 3500 ms/109 ms (minimum), field of view = 23 cm × 23 cm, number of excitations = 3, slice thickness = 5 mm, inter-slice gap = 1.5 mm, and matrix size = 128 × 128. Diffusion sensitizing gradients were applied along the three orthogonal directions with diffusion sensitivity of $b = 0$, $b = 500$, and $b = 1000$ s/mm².

The dedicated MRI sellar protocol consisted of sagittal and coronal T1-weighted images (T1-WI), followed by sagittal and coronal T2-WI performed without intravenous contrast. Coronal T1-WI were obtained using thin slices (3 mm) and a field of view of <200 mm. In case of contrast administration,

post contrast sagittal and coronal T1-WI using 3 mm slices was done.

Patients having no sellar/parasellar lesion on MRI, and patients having known aneurysmal clippings and/or other metallic prosthesis *in situ* were excluded from the study.

The data were recorded in a pro forma and were analyzed using descriptive statistics.

RESULTS

Out of total 33 pituitary macroadenoma patients, most of the patients in our study were between the age group of 50–60 years (30.3%). There was a slight female predominance in younger age groups, with most of the male patients belonging to older age groups (75% of male patients were more than 50 years old).

The most common symptoms at presentation were headache (22 subjects, 75%) and vision loss (14 patients) which in most cases presented concurrently. Syncope was present in six, altered sensorium in five, three patients each presented with seizures and fever, and two presented with neuropathy.

In our study, the macroadenoma cases presented with a wide range of volumes, from 1.2 ml to 125 ml. 24.3% cases had volume <2 ml and 15.1% cases had volume more than 32 ml. Most of the cases, however, were between the range of 2 and 16 ml (51.5%).

On MRI, majority macroadenomas extended superiorly and inferiorly, with 72.7% extending superiorly either compressing the chiasm or the 3rd ventricle. Inferiorly, 60.6% of patients had the presence of sellar floor depression. On the other hand, more than half had no significant parasellar extension, 51.5% were confined within the lateral walls of bilateral cavernous internal carotid arteries (ICAs). Nearly, 33.33% had lateral extent beyond the lateral wall of one-sided cavernous ICA, and only 15.15% had lateral extent beyond bilateral cavernous ICA [Table 1].

On analysis of the imaging characteristics, we observed that the lesions in our study were either solid or predominantly solid (45.4% and 51.5% respectively). Only one predominantly cystic macroadenoma was seen in our study. Most of the lesions were heterogenous on T2-WI (63.6%) and hypo/isointense on T1-WI. On gradient-echo (GRE) images, 45.45% patients showed blooming suggestive of hemorrhage. Increased diffusivity was noted in 36.3% cases [Table 2].

Contrast study was performed in 21 patients only. The most common reason for not getting the contrast study done was deranged renal functions.

Out of 21 patients, most common enhancement pattern was homogenous (8 [38%] patients). Other patterns were heterogenous and heterogenous with peripheral enhancement (7 [33.3%] and 5 [23.8%] respectively). One

Table 1: Extent of pituitary macroadenoma

Extent of the lesion	Number of subjects (%)
Superior extent	
Below optic chiasm	9 (27.3)
Compressing optic chiasm	12 (36.3)
Compressing 3 rd ventricle	12 (36.3)
Total	33 (100)
Inferior extent	
Absence of sellar floor depression	13 (39.3)
Presence of sellar floor depression	20 (60.6)
Total	33 (100)
Lateral extent	
Within lateral walls of bilateral cavernous ICA	17 (51.5)
Beyond lateral wall of unilateral cavernous ICA	11 (33.3)
Beyond lateral walls of bilateral cavernous ICA	5 (15.1)
Total	33 (100)

ICA: Internal carotid artery

Table 2: Magnetic resonance imaging characteristics of pituitary macroadenoma

Imaging characteristics	Number of subjects (%)
Consistency	
Solid	15 (45.4)
Predominantly solid	17 (51.5)
Predominantly cystic	1 (3.1)
Cystic	0
Total	33 (100)
T2 character	
Hyperintense	9 (27.3)
Hypo/isointense	3 (9.1)
Heterogeneous	21 (63.6)
Total	33 (100)
T1 character	
Hyperintense	5 (15.1)
Hypo/isointense	16 (48.5)
Heterogeneous	12 (36.3)
Total	33 (100)
GRE images	
Blooming	15 (45.4)
No blooming	18 (54.5)
Total	33 (100)
DW images	
Increased diffusivity	12 (36.3)
Decreased diffusivity	21 (63.6)
Total	33 (100)

GRE: Gradient-echo, DW: Diffusion-weighted

case of predominantly cystic macroadenoma showed thick peripheral enhancement.

Follow-up

All cases were followed up, with 16 cases getting operated and the diagnosis confirmed on histopathology. Out of the 17 cases that had medical follow-up, 10 were followed up only clinically, and 7 with both clinical and imaging follow-up.

DISCUSSION

Our statistics follow the demographic parameters seen in the meta-analysis of 8276 cases by McDowell *et al.*^[6] which revealed an increase in the age-related incidence of macroadenoma till the age of 80, with the absolute number of cases in the age grouping showing an almost similar pattern.

Even with an approximately equal sex incidence, the analysis of both age and sex distribution together showed that 75% of male patients belonged to more than 50 years age group, with 70.6% of female patients were below 50 years age.

These parameters are also consistent with the data of McDowell *et al.*^[6] and Hemminki *et al.*,^[7] both studies showing female rates were higher among younger persons, and male rates were higher among older persons.

The common presenting complaints of macroadenoma subjects in our study were headache and decreased vision, present in 75% and 42% subjects, respectively. Cranial neuropathy was present in two patients.

This is consistent with the study of adenomatous lesions by Chen *et al.*,^[8] which showed headache and chiasmopathy in 62% and 60% patients, with extraocular muscle weakness in 14% cases.

The analysis of volume of macroadenoma in our study gave a wide range, with maximum incidence seen in the range of 2–16 ml. On analysis of relation of sex to the volume of lesion in our study, a specific pattern was observed with female subjects showing smaller volume at presentation as compared to male subjects. Sixty-five percent of female subjects had volumes <4 ml, and 81% of male subjects had volumes more than 4 ml.

This pattern is consistent with the study by Delgrange *et al.*,^[9] where at the time of diagnosis, macroadenomas were larger in men than in women. This preponderance of large tumors in males has been generally attributed to a longer delay in diagnosis.

On analysis of the extent of pituitary macroadenoma in our study, we observed that superior and inferior extent of the lesion was beyond the defined boundaries of sella in most cases, but the lateral extent was limited. These findings conform to the “snowman-like” or “figure-of-8” appearance of macroadenoma [Figure 1].

In a study of 38 cases of macroadenoma by Choi *et al.*,^[10] the findings are consistent with our study. Thirty-two cases had superior extent with compression over chiasm or 3rd ventricle, 17 patients had sellar floor depression, and >75% cases were limited laterally within lateral walls of the right and left cavernous ICAs.

One of the lesions in our study was a 47-year-old female patient with a large volume lesion, measuring 29.2 ml, having invasion of clivus inferiorly on imaging. Histopathology after surgery confirmed the lesion to be a pituitary macroadenoma [Figure 2].

In a study of 390 cases by Chen *et al.*,^[11] they observed that clival invasion was a rare complication, seen in 8.2% cases. Multivariate analysis in their study revealed female sex to be the most important risk factor for clival invasion, followed by larger tumor volume.

The largest lesion of our study measured 125 ml in volume, with the lesion involving the paranasal sinuses and the nasal cavity inferiorly [Figure 3].

A few case reports of pituitary macroadenoma invading the nasal cavity are found. Jankiewicz-Wika *et al.*^[12] reported a case of pituitary adenoma penetrating the sphenoidal sinus and nasal cavity in a patient with recurrent nasal polyp.

The analysis of consistency gave us two major patterns—solid and predominantly solid macroadenoma and one case of predominantly cystic macroadenoma.

Ram *et al.*^[13] studied consistency of 21 cases of macroadenoma by intraoperative aspiration of sellar contents and found the presence of cystic component in 57% cases, which was similar to our incidence of 54.5%.

On the evaluation of the imaging characteristics of macroadenoma, we found variable T2 and T1 characters of the lesions, appearing mostly heterogeneously hyperintense on T2-WI and hypo to isointense on T1-WI. Blooming on GRE images—suggestive of hemorrhage was present in 15 subjects.

In a study of 88 cases of macroadenoma by Kim *et al.*,^[14] hemorrhage was detected in 36% cases. In another study of 83 cases by Nishi *et al.*,^[15] hemorrhage was detected in 31% cases. Our study had a slightly higher incidence of hemorrhage in macroadenoma, seen in 45% cases.

The analysis of post contrast images was done in 21 patients only. The lesions did show intense enhancement in most cases (20 of 21 cases), with patterns ranging from homogenous in 8, to heterogenous alone in 7, and heterogenous enhancement of solid portion with thin peripheral enhancement of the cystic portion.

One patient showed thick peripheral enhancement. This was a female patient, 60 years old, and presented with headache and sudden vision loss. The lesion showed a predominantly cystic consistency and showed blooming on GRE. The case was not operated, and the patient kept on conservative management despite the presence of vision loss. The imaging follow-up was done after 2 months, and it did not show any residual lesion, just a partially empty sella and resolution of vision loss [Figure 4].

On reviewing case reports with similar presentation, a study by Armstrong *et al.*^[16] had a patient with apoplexy due to infarction of a large pituitary macroadenoma and conservative treatment with steroids resulted in the reversal of symptoms and involution of the adenoma. Liu *et al.*^[17] also published a case report of patient with sudden clinical deterioration, where MRI showed a sellar mass appearing hyperintense on

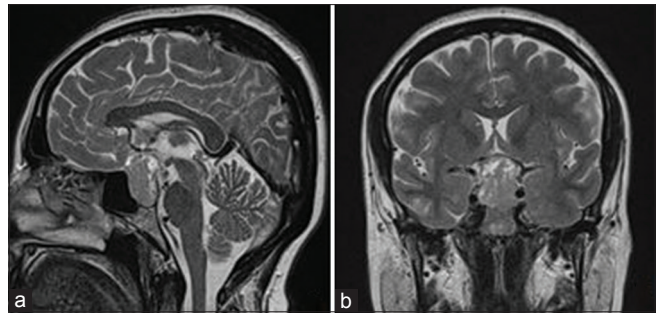


Figure 1: A 41-year-old female with vision loss. Sagittal T2-weighted (a) and coronal T2-weighted (b) images reveal a hyperintense mass in sellar and suprasellar location, giving a “figure-of-8” appearance

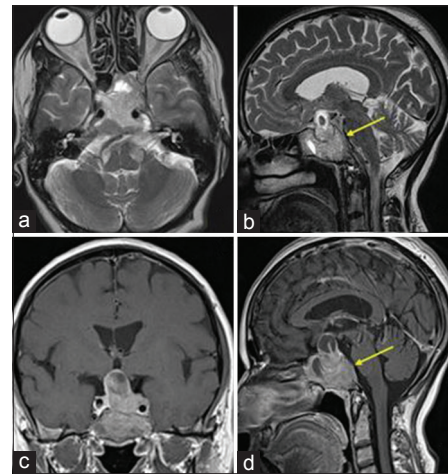


Figure 2: A 47-year-old female with headache and vision loss. T2-weighted axial (a) and sagittal (b); T1 postcontrast coronal (c) and sagittal (d) images show a heterogeneously enhancing sellar mass with inferior clival invasion (arrow) and left parasellar extension

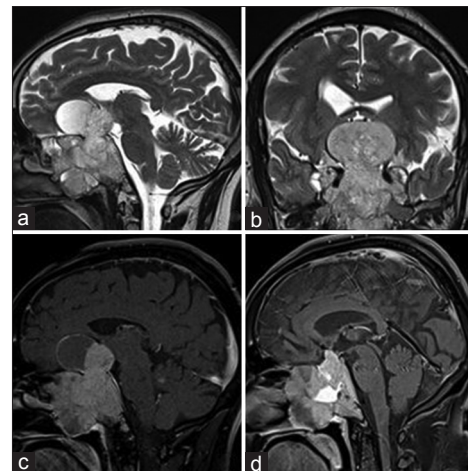


Figure 3: A 37-year-old male with headache, vision loss, and neuropathy. T2-weighted sagittal (a) coronal (b) and sagittal T1 postcontrast images of initial (c) and postoperative (d) scans show a large intensely enhancing solid-cystic sellar and suprasellar mass with bilateral parasellar extensions and extension into paranasal sinuses and nasal cavity. The postoperative images show the residual mass in the sinuses and nasal cavity

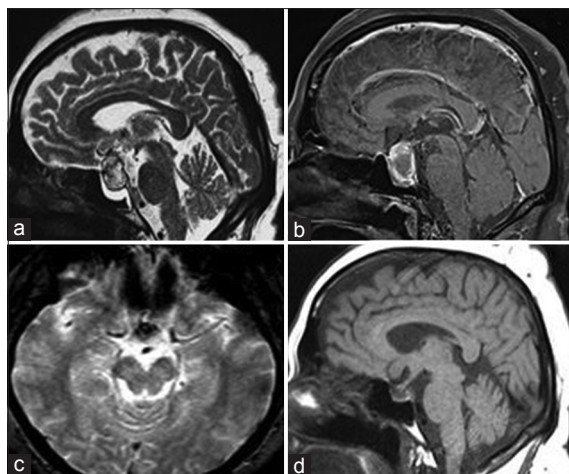


Figure 4: A 60-year-old female with headache and vision loss. Sagittal T2-weighted (a), T1-weighted postcontrast, (b) and axial gradient echo, (c) images of initial scan show a heterogeneous peripherally enhancing sellar mass with blooming on gradient echo-suggestive of cystic pituitary macroadenoma with hemorrhagic necrosis-pituitary apoplexy sagittal T1-weighted, (d) images of the follow-up imaging after 2 months of conservative management shows a partially empty sella with no enhancing mass

both T1 and T2-WI-suggestive of hemorrhage, and peripheral enhancement on post contrast images. The follow-up MRI after 3 months showed complete resolution of the lesion, prompting an explanation of apoplexy in macroadenoma with spontaneous resolution, similar to our case.

CONCLUSIONS

On analysis of the 33 cases of pituitary macroadenoma in our study, we observed that pituitary macroadenoma showed an almost equal sex incidence and the maximum number of patients belonged to the age group of 50–60 years. Male patients were of a higher age group and presented with large volume lesions as compared to female patients. The common presenting complaints were headache and decreased vision, present in 75% and 42% subjects, respectively. Superior and inferior extent of the lesion was beyond the defined boundaries of sella in most cases, but the lateral extent was limited, resulting in characteristic “snowman-like” or “figure-of-8” appearance of macroadenoma. The imaging characteristics of macroadenoma showed solid to predominantly solid consistency, appearing mostly heterogeneously hyperintense on T2-WI and hypo to isointense on T1-WI. Hemorrhage was present in 45.45% subjects. Post contrast images showed intense enhancement in most cases. Pituitary apoplexy is a rare complication, with the lesion showing cystic consistency with peripheral enhancement on post contrast images, because of hemorrhagic necrosis. Spontaneous resolution can be seen in these cases.

Thus most of the pituitary macroadenomas show similar clinical presentation and imaging features. A careful evaluation

by the clinician supplemented by the radiologist’s opinion can avoid unnecessary interventions and lead to early diagnosis.

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Conflicts of interest

There are no conflicts of interest.

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