Original Article

A Study of Pituitary Macroadenoma Transnasal Endoscopic Excision

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How to cite this article: S. Hemachandran, R. Muthukumar, R. Anuradha. A Study of Pituitary Macroadenoma Transnasal Endoscopic Excision Indian Journal of Public Health Research and Development / Vol. 16 No. 2, April-June 2025.

Abstract

Background: Pituitary macroadenomas are typically benign tumors over 10mm in size, originating from glandular tissue in the pituitary gland. Understanding tumor consistency is crucial for determining the surgical approach. Imaging, especially MRI, helps assess tumor size, extent, and consistency, which influence the ease of resection, success, and complication risks.

Aim: To study the presentation, radiological evaluation, surgical technique, complication and management of pituitary macroadenoma.

Materials and Methods: This observational study was conducted at a tertiary care hospital in Chennai from March to September 2016, involving 28 patients with pituitary macroadenomas. Data on demographics, tumor type, presentation, consistency (from MRI T2-weighted images), intraoperative findings and complications, along with their management were collected and analyzed using descriptive statistics.

Results: Of the 28 cases, 17(60.7%) were nonsecretory, and 11(39.3%) were secretory. Common symptoms included headaches (71.4%) and visual defects (42.8%). MRI revealed 46.4% of tumors were solid, 35.7% semisolid, and 17.9% cystic, with 50% extending to the suprasellar region. Surgical findings indicated that most solid tumors (92.3%) were firm, 60% of semisolid tumors were soft and 40% were firm, while cystic consistency matched MRI predictions. The most common postoperative complication was diabetes insipidus in 3 cases (10.7%).

Conclusion: Pituitary macroadenomas were most common in the 5th decade. Nonsecretory tumors were more common, particularly in females, while secretory tumors were more prevalent in males. MRI was useful tool in predicting tumor consistency, and the transsphenoidal endoscopic approach was effective for removing cystic and soft macroadenomas.

Key Words: Pituitary Macroadenoma, Magnetic Resonance Imaging, Transnasal endoscopic excision

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Submission date: Sep 14, 2024 **Acceptance dat**e: Oct 28, 2024 **Published date: March 11, 2025**

Introduction

Pituitary adenomas (PA) are tumors from hormone-secreting cells of the pituitary gland. Most are benign, with 35% being invasive and only 0.1%-0.2% classified as carcinomas.[1] They account for 10%-25% of intracranial tumors[2], with a prevalence of 16.7% [3] based on meta-analysis. In Istanbul, 32% of pituitary adenomas were microadenomas, while 68% were macroadenomas.[4] Gruppetta M reported macroadenoma prevalence of 32.8 per 100,000.[5] A study in northeastern India found pituitary adenomas mainly in young adults (mean age 38.12 years), with a female preponderance and 40.6% of PA were non-functioning.[6] In Rajasthan, India, the prevalence of pituitary adenoma was 10%.[7] Microadenomas are tumors <1 cm, confined to the sella turcica, while macroadenomas are ≥1 cm and often extend beyond it.[3,8] Pituitary neoplasms are classified as functional (causing hormone-related symptoms) or nonfunctional (presenting with mass effects like headaches or visual defects, or found incidentally).[6,9,10] MRI is crucial in pituitary adenoma surgery, assessing tumor size, extent, and consistency, which impact resection ease and complication risks. It provides detailed visualization of the mass, optic chiasm, vessels, and cavernous sinuses. Variations in signal characteristics can indicate hemorrhage, cysts, or necrosis.[11] Clinical knowledge of macroadenoma consistency aids in surgical planning.[12] The transsphenoidal approach is the preferred surgical technique for macroadenomas due to its low morbidity and mortality.[13-15] Complete excision depends on factors such as cavernous sinus invasion, tumor size, and consistency. The surgical goals are tumor removal, vision restoration, and preservation of pituitary function. Key challenges in treating pituitary adenomas in developing countries include low awareness, limited brain imaging facility in rural areas, poor follow-up, and financial constraints.[16] Patient education is essential for early detection and understanding treatment risks.[17] Genetic screening in sporadic cases and family members will lead to improved outcomes.[18]

The present study was carried out to study the presentation, radiological evaluation, surgical technique, complication and management of pituitary macroadenoma in the given setting.

Methods and Material

This observational study was conducted at a tertiary care medical college and hospital in Chennai and data was collected from March to September 2016. Institutional ethical clearance (IEC NO-19022016) was obtained. Informed consent was obtained from the study participants. It included patients diagnosed with pituitary macroadenoma from neurology and surgical endocrinology OPDs, referred to otorhinolaryngology. Participants included those fit for surgery, newly diagnosed, and recurrent cases. Exclusion criteria were patients in poor general condition or with comorbidities unfit for surgery.

The study included 28 patients, who were recruited using a convenient sampling method. Data collected involved patient age, sex, tumor type, presentation, consistency, intensity, extension based on MRI T2 images, intraoperative findings, tumor excision, and both perioperative and postoperative complications, along with their management.

Statistical analysis: Data was coded in Excel and analyzed using EPI INFO version-7. Descriptive statistics, including mean, standard deviation, frequency, and proportion, were used to describe the study characteristics.

Results

A total of 28 pituitary macroadenoma cases were studied, with participants aged 24 to 58 years (mean age 40.39 ± 10.76). Most pituitary macroadenomas were found in the 41-50 age group, accounting for 9 cases (32.14%). The study included 15 females (53.6%) and 13 males (46.4%). Of the 28 cases, 17(60.7%) were nonsecretory, while 11(39.3%) were secretory. Secretory tumors were more common in males, accounting for 7 cases (53.8%), while nonsecretory tumors were predominant in females, comprising 11 cases (73.3%) [Table-1].

MRI showed tumor intensity as hyperintense in 14 cases (50%), isointense in 8(28.6%), and hypointense in 6(21.4%). Of the 28 cases, 25(89.3%) were new and 3(10.7%) were recurrent. The most common symptom was headache (71.4%), followed by visual defects (42.8%) [Table-2].

In the MRI-weighted images, 13 tumors (46.4%) were classified as solid, 10(35.7%) as semisolid, and 5(17.9%) as cystic. Most tumor extensions occurred in the suprasellar region, with 14 cases (50%), while 7 cases (25%) showed extensions into both the suprasellar and parasellar regions. In 3 cases (10.7%), the tumors were confined to the sellar region [Table-3].

MRI image shows suprasellar extension of pituitary macroadenoma in Figure 1.

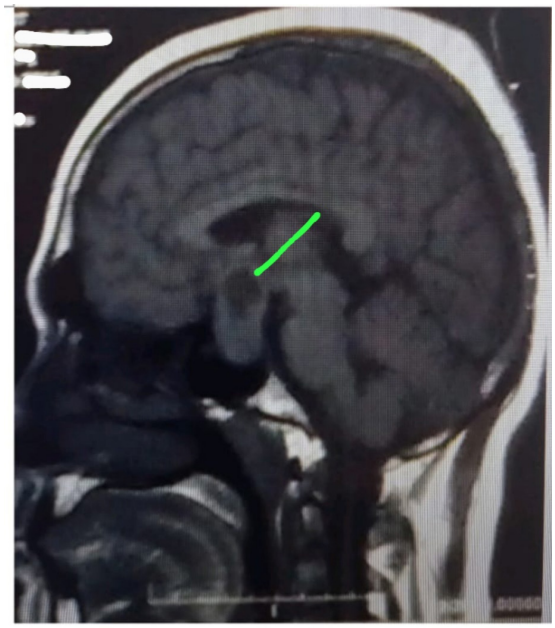

Figure 1: MRI –Suprasellar extension of pituitary macroadenoma

MRI revealed 10 tumors as semisolid; intraoperatively, 6(60%) were soft and 4(40%) were firm. Of the 13 solid tumors, 12(92.3%) were firm and 1(7.6%) was soft during surgery. Cystic consistency on MRI matched intraoperative findings [Table-4]. Cystic tumours were removed by suction.

Suprasellar extension on MRI matched intraoperative findings in 12 cases, while 2 cases showed lateral (parasellar) extension without carotid encasement or cavernous sinus invasion. Suprasellar and parasellar extensions were consistent in only 5 cases, with 2 cases showing discrepancies between MRI and intraoperative findings [Table-5].

Intraoperative cerebrospinal fluid (CSF) leaks were detected in six cases (21.4%) [Table-6].

Complete excision was achieved in 21 cases (75%), while 7 cases (25%) had incomplete excision. The most common postoperative complication was diabetes insipidus, occurring in 3 cases (10.7%). Additionally, one case experienced pneumoencephalocoel with CSF leak, and another had a cerebrovascular accident (CVA) alongside diabetes insipidus [Table-7].

Intraoperative CSF leak repairs were performed in 6 cases, with 1 additional repair done postoperatively; a lumbar drain was placed in 1 case. Postoperative diabetes insipidus was treated with intranasal desmopressin in 3 cases, while 2 cases of CVA were managed conservatively [Table-8].

Table 1: Age and Sex wise Distribution of Types of Pituitary Macroadenoma [n=28]

	Type of Pituitary Macroadenoma		
Age Groups In Years	**Secretory-n(%)**	**Non Secretory-n(%)**	**Total(%)**
20-30	5(71.4)	2(28.6)	7(100)
31-40	2(28.5)	5(71.4)	7(100)
41-50	3(33.3)	6(66.7)	9(100)
51-60	1(20.0)	4(80.0)	5(100)
Total(%)	11(39.3)	17(60.7)	28(100)
Sex			
Male	7(53.8)	6(46.1)	13(100)
Female	4(26.7)	11(73.3)	15(100)
Total(%)	11(39.3)	17(60.7)	28(100)

Table 2: Modes of Presentation of Pituitary Macroadenoma [n=28]

Modes of Presentation*	Number of Individual-n	Percentage
Head Ache	20	71.4
Prolactinoma	05	17.8
Apoplexy	01	3.5
Visual Defects	12	42.8
Acromegaly	05	17.8
Cushings Syndrome	01	3.5

*Multiple responses

Table 3: Tumour Consistency and Tumour Extension Based on MRI Weighted Images[n=28]

Tumour Consistency	Number of Individual-n	Percentage
Cystic	5	17.9
Semisolid	10	35.7
Solid	13	46.4
Total	28	100
Tumour Extension		
Sellar	03	10.7
Suprasellar	14	50.0
Sellar And Parasellar	04	14.3
Suprasellar And Parasellar	07	25
Total	28	100

Table 4: Surgical Implication of Consistency Based On MRI WI [n=28]

	Tumour Consistency Per Operative			
Consistency Based On MRI	**Cystic-n(%)**	**Firm-n(%)**	**Soft-n(%)**	**Total (%)**
Semisolid	0(0.0)	4(40.0)	6(60.0)	10(100.0)
Solid	0(0.0)	12(92.3)	1(7.69)	13(100.0)
Cystic	5(100.0)	0(0.0)	0(0.0)	5(100.0)
Total(%)	5(17.8)	16(57.1)	7(25.0)	28(100.0)

Table 5: Surgical Implication of Tumour Extension Based on MRI WI [n=28]

	Tumour Extension-Per Operative		
Tumour Extension On MRI	**Matching-n(%)**	**Not Matching-n(%)**	**Total(%)**
Sellar	3(100)	0(0.0)	3(100.0)
Suprasellar	12(85.7)	2(14.2)	14(100.0)
Sellar And Parasellar	4(100.0)	0(0.0)	4(100.0)
Suprasellar And Parasellar	5(71.4)	2(28.5)	7(100.0)
Total (%)	24(85.7)	4(14.2)	28(100.0)

Table 6: Peroperative Complication [n=28]

Peroperative Complication	Number of Individual-n	Percentage
CSF Leak	6	21.43
Nil	22	78.5
Total	28	100

Table-7: Post Operative Complication [n=28]

Post Operative Complication*	Number of Individual-n	Percentage
Diabetes Insipidus	3	10.7
Pneumoencephalocoel	1	3.5
CVA	2	7.1
CSF Leak	1	3.5
Nil	23	82.1

*multiple response.

Table 8: Management of Complications [n=28]

Management Of Complications*	Number of Individual -n	Percentage
CSF Leak Repair	7	25.0
Desmopressin	3	10.7
CVA Conservative Management	2	7.1
Lumbar Drain	1	3.5

*multiple response.

Discussion

This study included 28 pituitary adenoma patients with a mean age of 40.39 ± 10.76 years. Non-secretory macroadenomas were more common (60.7%) than secretory types (39.3%). Similarly, Cawich S et al[19] found a mean age of 45.4 ± 14.8 years, with 55% non-secretory and 44.4% secretory macroadenomas. Castro MC[20] reported 74.42% non-secretory and 22.58% secretory adenomas.

The predominant symptoms were headache (71.4%) and visual defects (42.8%) in the present study. Table-9 shows the comparative studies on modes of presentation of pituitary macroadenoma.

Table 9: Comparative Studies On Modes Of Presentation

Modes Of Presentation	Castro MC[20]	Cawich S et al[19]	Junko et al[21]	Present Study
Head Ache	-	72.3%	12.8%	71.4%
Galactorrhoea	6.9%	19.3%	18.0%	10.7%
Apoplexy	-	05%	-	3.5%
Visual Defects	-	80.7%	71.7%	42.8%
Acromegaly	7.6%	-	5.1%	3.5%
Cranial Nerve Palsy	-	16%	-	-
Amenorrhoea	-	26%	-	-

In this study, MRI showed tumor intensity as hyperintense in 50%, isointense in 28.6%, and hypointense in 21.4% of cases. According to Heck A et al[22], T2-weighted MRI revealed 40% hyperintense, 33% isointense, and 27% hypointense tumors.

In the present study, MRI showed 46.4% of tumors were solid, 35.7% semisolid, and 17.9% cystic. Among 10 semisolid tumors, 60% were soft and 40% firm during surgery. Of 13 solid tumors, 92.3% were firm and 7.6% soft. Cystic tumors had consistent MRI and surgical findings.

Yamato et al[23] reported that 62.06% of pituitary macroadenomas were solid and 37.93% semisolid. Of 15 semisolid tumors on MRI T2WI, 13 were soft and 2 were hard during surgery, while 3 of 14 solid tumors were hard and 11 were soft. They found no significant correlation between tumor consistency on MRI T2WI and during surgery.

In the present study, 50% of tumors extended to the suprasellar region, while 25% extended to both the suprasellar and parasellar regions. MRI showed suprasellar extension consistent with surgery in 85.7% of cases, while 14.2% showed lateral extension. Suprasellar and parasellar MRI findings matched surgical findings in 71.4% of cases, with 28.5% showing discrepancies. Ramakrishnan VR[24] reported that 67% of the 106 patients had suprasellar tumor extension. Ahmadi et al studied 198 pituitary adenomas using preoperative high-resolution CT. Direct cavernous sinus invasion was noted in 19 cases[25]. Evaluating parasellar extension is crucial, as clinical signs appear late and tumor markers show inconsistent correlations.[26] Hardys' classification indicates grade A and B tumors are easier to remove, while grade C and D tumors (with a superior margin over 20 mm) are more challenging, with 40% showing residual tumor post-surgery.[27] Knosp et al[28] proposed

a grading system for cavernous sinus invasion, where greater lateral growth around the Internal Carotid Artery (ICA) indicates higher grades, allowing en masse dissection only for tumors with minimal suprasellar extension.

In this study, complete excision was achieved in 21 cases (75%), while 7 cases (25%) had incomplete excision. Of the incompletely removed tumors, 5 underwent subtotal removal and 2 partial removal. Complete resection was possible when there was a clear dissection plane and minimal suprasellar extension. Intraoperative carotid Doppler monitoring was used to avoid carotid artery injury. Among the 5 subtotal resections, 3 involved suprasellar and parasellar extension affecting the right cavernous sinus and sphenoid sinus, while the other 2 had suprasellar extension with lateral carotid encasement. One of these patients, who had galactorrhea and developed pituitary apoplexy, required urgent surgery, but the blood-clotted sellar tissue was difficult to identify. These 5 tumors were very hard and had to be removed in pieces. Arbolay Omar[29] found that endonasal endoscopic transsphenoidal surgery achieved gross tumor removal in 92.4% of cases and subtotal resection in 7.8%. Fan YP et al[30] reported that out of 28 patients, total resection was performed in 16, subtotal resection in 8, partial resection in 3, and biopsy in 1 due to excessive bleeding and hardness.

In this study, CSF leak was the only perioperative complication, occurring in 6 cases (21.4%). The most common postoperative complication was diabetes insipidus, noted in 3 cases (10.7%). One case also had pneumoencephalocoel with a CSF leak, while another had a CVA with diabetes insipidus. Castro MC et al[20] found that complications in patients included CSF fistulas in 8.5%, meningitis in 3.1%, and one death from major intracerebral hemorrhage postoperatively. Junko et al[21] reported transient diabetes insipidus in 13 cases (33.3%), cerebrospinal fluid leakage in 3 cases (7.7%), and subarachnoid hemorrhage in 1 case (2.6%). The low complication rate is influenced by factors such as tumor resection extent, tumor type, and preservation of surrounding structures. Junko et al[21] noted that 11 patients with CSF fistulas were treated conservatively in 7 cases (5.53%), while 4 (3.1%) required reoperation. Recent pooled data suggest that patients with endoscopically treated non-functioning pituitary adenomas experience lower rates of postoperative pituitary dysfunction, higher total resection rates, and improved visual acuity[31]. Vaibhav et al[32] also reported reduced morbidity and complications with the endoscopic transnasal transsphenoidal approach for pituitary adenomas.

In this study, perioperative CSF leak repair was performed in 6 cases using a multilayer closure method involving fat, cartilage, nasoseptal flap, Surgicel, and tissue glue, followed by nasal packing with Meurocell for one week. The postoperative period was uneventful, with no leaks observed during diagnostic nasal endoscopy. Three patients developed postoperative diabetes insipidus within 24-48 hours, presenting with polyuria, nocturia, and polydipsia. Biochemical tests confirmed hypernatremia, increased osmolarity, and hyposmolar urine. After fluid management, all patients improved within 7-10 days. Two hypertensive patients developed a postoperative CVA due to elevated blood pressure, resulting in anterior cerebral artery infarction. The CVA was managed conservatively and not attributed to surgery, as carotid artery monitoring was done preoperatively. Postoperative care requires a multidisciplinary approach involving neurosurgeons, endocrinologists, and intensive care teams. Preoperative hormonal assessments guide perioperative management. Prompt diagnosis and treatment of complications improve outcomes, though some may require lifelong surveillance and treatment.[33]

Limitations: This was an observational study conducted only in one medical college which may limit the generalizability of the findings.

Conclusion

In this study, pituitary macroadenomas were most common in the 5th decade of life, with non-secretory tumors being more prevalent, especially in females, while secretory tumors were more common in males. Headaches and visual defects were common symptoms, particularly with suprasellar extension. Acromegaly was the most frequent secretory tumor, followed by prolactinoma. MRI, especially T2-weighted imaging, was effective in

predicting tumor consistency. The transsphenoidal endoscopic approach was suitable for removing cystic and soft macroadenomas but less for solid tumors with extensive suprasellar extension and parasellar carotid encasement. Complications, such as CSF leaks and hemorrhage, were minimal with meticulous dissection techniques.

Source of Funding: Nil

Conflicts of interest: Nil

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