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Factors affecting visual outcomes of pituitary macroadenoma following transsphenoidal surgery

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ABSTRACT

Objective: 1. To provide quantitative objective measurement of the efficacy of surgery for pituitary macroadenoma. 2. To discuss different factors that could affect visual outcomes of pituitary macroadenoma

Method: This is a single centre prospective study, conducted at DEPARTMENT OF NEUROSURGERY SMS MEDICAL COLLEGE AND HOSPITAL JAIPUR over one year (May 2021-May 2022), 50 cases of sellar, suprasellar tumours were included were treated with surgery. Our study excluded pituitary apoplexy and included both functioning and non-functioning pituitary adenomas. We analyzed how various factors impacted vision outcomes, including post-surgical tumour height reduction (vertical decompression) and changes in Knosp grade (lateral decompression). Vision results were assessed using the Visual Impairment Score (VIS), combining visual acuity and visual field deficits.

Results: Preoperative tumour height and supracarotid height significantly affect VIS ($p < 0.005$) and Knosp grading also showed a significant correlation with VA ($p = 0.03$) and VF ($p = 0.03$). Our study found significant impact of tumour height reduction on VIS improvement. Change in supracarotid height showed a trend towards correlation with VIS change ($p = 0.054$). Additionally, there were no significant differences in complications between groups, with a marginal trend observed in diabetes insipidus ($p = .372$)

Conclusion: The research highlights that the degree of optic nerve compression, particularly measured from the bend of the internal carotid artery, is crucial for predicting vision outcomes. Endoscopic surgery is preferred for treating these tumours because it allows for better sideways decompression, which is essential for relieving nerve pressure in both vertical and horizontal directions. This approach is pivotal in achieving optimal vision recovery and maximizing vision improvement compared to other surgical methods.

INTRODUCTION

Benign pituitary tumors, originating from the pituitary gland, can exert pressure on the optic nerves and optic chiasm as they grow, leading to visual impairment. Transsphenoidal surgeries, either performed microscopically or endoscopically, are effective in decompressing the optic apparatus and restoring visual function. [1,2] The advancements in endoscopic technology have improved the ability to achieve

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visual outcomes,
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complete tumor removal and enhanced visual outcomes. Visual improvement can occur immediately after surgery, at three months, and even over several years. [2,3] Multiple factors, including age, the extent of tumor removal, Knosp grading, the duration of preoperative visual field defects, and the thickness of the peripapillary retinal nerve fiber layer, have been identified as influencing visual outcomes. [4] Despite this, there is a need for more quantitative studies to investigate the impact of tumor compression and surgical methods on visual outcomes.

OBJECTIVES

Aims

To Study visual outcomes of Transsphenoidal surgery for pituitary macroadenoma.

Objectives

1. To provide quantitative objective measurement of the efficacy of surgery for pituitary macroadenoma.
2. To discuss different factors that could affect visual outcomes of pituitary macroadenoma.

STUDY DESIGN

This study is a prospective analysis and a sample of 50 patients on 1st come 1st basis was included in the study with cases of pituitary macroadenomas that underwent surgical intervention at a tertiary neurosurgical referral center between May 2021 and May 2022.

Inclusion criteria

Cases of pituitary macroadenomas that were functioning or nonfunctioning and without apoplexy at initial presentation who will undergo surgery will be included.

Exclusion criteria

Patients will be excluded if:

1. Patients with recurrent tumors to avoid confounding bias.
2. Patients without preoperative magnetic resonance imaging (MRI) or with PAs lacking SSE
3. Patient having pituitary apoplexy

Methodology

Patient demographics including age, sex, percentage of apoplexy on presentation, excision methods,

percentage of gross total excision, and cerebrospinal fluid (CSF) leak rate will be recorded. Preoperative magnetic resonance imaging (MRI) scans of the pituitary gland will be done and studied. The extent of vertical compression, both absolute height and supracarotid height, will be recorded, signifying chiasmal compression (Fig. 1). The absolute height of the tumor will be defined as the distance from the most caudal portion to the most cranial portion of the tumor. In contrast, the supracarotid height will be the distance measured from the midpoint joining both genu of the cavernous internal carotid artery to the most cranial portion of the tumor [17]. On the other hand, the extent of lateral compression, measured by Knosp grading, was recorded, signifying optic nerve compression [18]. Postoperative visual outcomes were assessed with visual acuity (VA), VF, and visual impairment scale (VIS). Visual impairment scale is a quantitative tool, ranging from 0 to 100, commonly employed by ophthalmologists to assess visual function. The scale combined VA and VF defect of both eyes quantitatively. The values of VIS correlate with the severity of visual function impairment. [19,20]

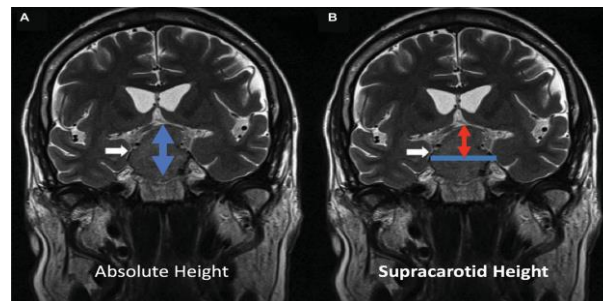


Figure 1. (A and B) Measurement for the vertical compression representing chiasmal compression. **(A)** The absolute height that is measured from the most caudal to the most cranial part of the tumor. White arrow indicates the tumor whereas the blue arrow indicates the absolute tumor height. **(B)** The supracarotid height that is measured from the most cranial part of the tumor to the midpoint joining both genu of internal carotid artery. The white arrow indicates the tumor whereas the blue line indicates the midpoint joining both genu of internal carotid artery. The red arrow indicates the supracarotid height.

METHODS AND STATISTICS

Data analysis was performed using Statistical Product and Service Solutions (SPSS) version 15. To investigate the relationships between visual acuity (VA), visual impairment score (VIS), tumor height, and

Knosp grading, linear regression analysis was employed. Additionally, independent sample t-tests and chi-square tests were utilized to examine the effects of Knosp grading, surgical modes, VA, visual fields (VF), and VIS.

RESULTS

Basic Demographics

Table 1. Basic demographics

Variables	N	Mean	Std. Deviation	Present	Not present
Age	50	43.0	1.119		
Sex	50	1.58	.499	42 % male	58% female
Sinusitis	50	2.00	.000		100%
Rhinorrhea	50	1.72	.454	28%	72%
Meningitis	50	1.96	.198	4%	96%
Diabetes insipidus	50	1.78	.418	22%	78%
Bleeding	50	1.94	.240	6%	94%

The sample comprised 50 participants, with a mean age of 43 years (standard deviation = 1.119). The gender distribution had a mean score of 1.58 with a standard deviation of 0.499. The complications analysis revealed that none of the individuals (100.0%) had sinusitis. Out of the total participants, 14 individuals (28.0%) had rhinorrhea, while 36 individuals (72.0%) did not encounter this problem. Meningitis was detected in 2 participants, accounting for 4.0% of the total, while the remaining 48 subjects, or 96.0%, did not have meningitis. 11 participants, or 22.0% of the total, had diabetes insipidus, while 39 participants, or 78.0% of the total, did not have it. Ultimately, 3 people (6.0%) experienced bleeding as a problem, while 47 participants (94.0%) did not. The average values for these problems were as follows: sinusitis (mean = 2.00, standard deviation = 0.000), rhinorrhea (mean = 1.72, standard deviation = 0.454), meningitis (mean = 1.96, standard deviation = 0.198), diabetes insipidus (mean = 1.78, standard deviation = 0.418), and bleeding (mean = 1.94, standard deviation = 0.240).

Vertical compression

The linear regression analysis aimed to examine the correlation between the independent variables, supracarotid and tumour height, and the dependent variable, VIS. The results showed that the intercept is significantly different from zero, with a t-value of

1.217 and a p-value of 0.005. The coefficient for supracarotid is -0.450, with a beta value of -0.032, indicating significant impact on VIS. The coefficient for tumour height is -0.546, with a beta value of -0.056, and the coefficient for tumour height is statistically significant ($p < .005$), indicating substantial impact on VIS. Thus tumour height has significant impact on VIS.

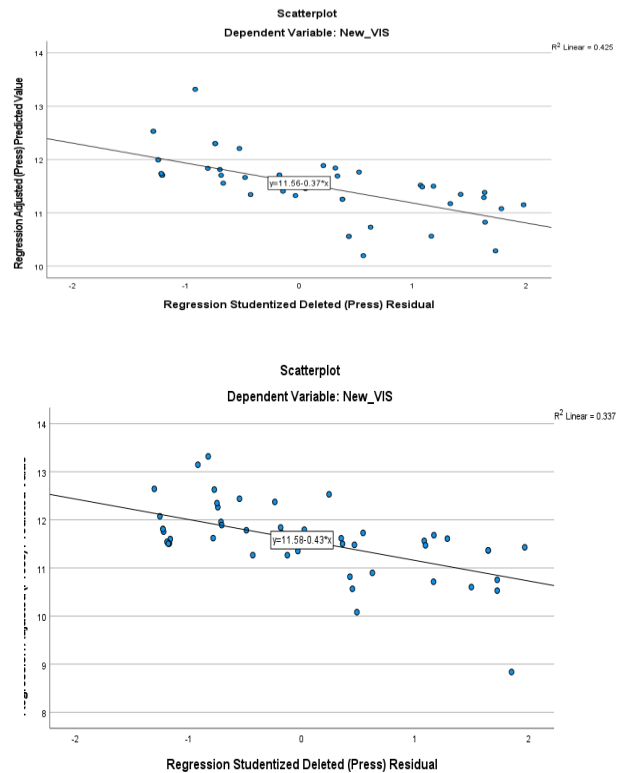


Figure 3. (A) The linear relationship between supra carotid height and visual impairment scale (VIS). **(B)** The linear relationship between tumor height and VIS.

Lateral compression

The study conducted two Chi-Square tests to examine the associations between knosp grading and VF and VA. The results showed a strong correlation between knosp grading, VF and VA. The chi-square test showed significant relationship between VA and knosp grading, with a test statistic of 40.273, with a p-value of 0.03. The independent samples t-tests were used to evaluate the disparities in complications between two distinct groups, specifically groups 1.00 and 2.00. There were no statistically significant differences between the groups in terms of mean scores for complications such as sinusitis, meningitis, and bleeding, assuming equal variances ($p > .05$). However, when considering

rhinorrhea and diabetes insipidus, there were no significant differences assuming equal variances. However, when variances were not presumed equal, there was a marginally significant difference in diabetes insipidus ($p = .372$), indicating a possible trend. In general, apart from diabetes insipidus, there is little evidence to support significant variations in the severity of complications among different groups.

Modes of surgeries

In terms of lateral decompression, endoscopic surgical method is effective in relieving pressure on the optic chiasm.

DISCUSSION

Our study aligns with prior research, demonstrating endoscopic transsphenoidal surgery's effectiveness for visual outcomes in pituitary adenoma patients. [9,10,11,12,13,14]. Consistent with Guo et al.'s meta-analysis, the endoscopic approach achieved superior gross total resection and visual improvement rates. Preoperative MRI findings correlated with visual impairment, with absolute and supracarotid height impacting visual impairment scores (VIS). [16] Knosp grading further aided in understanding visual dysfunction. [16] Notably, vertical compression (optic chiasm) and lateral compression (optic nerve) require separate evaluation, and both were crucial for optimal outcomes in our study. While both microscopes and endoscopes facilitated chiasmal decompression, the endoscope achieved superior lateral decompression and visual improvement. This likely reflects technological advancements offering broader visualization and manipulation angles. [16]

This study's limitations include its retrospective, single-center design with multiple surgeons, potentially introducing variability. [17] Additionally, the chronicity of optic nerve compression lacked standardization, and objective measures of optic nerve dysfunction (e.g., optical coherence tomography) were absent. Future studies incorporating these elements can further refine visual outcome prediction. [18]

CONCLUSION

The extent of both vertical and lateral decompression of pituitary macroadenoma is essential for achieving better visual outcomes. Height of tumor measured from genu of cavernous

ICA correlates better with the visual outcome than the absolute tumor height. As the endoscopic approach can achieve a greater degree of lateral decompression, it is preferred in pituitary surgery to achieve a better visual outcome.

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