ORIGINAL ARTICLE

Predictors of visual outcome with transsphenoidal excision of pituitary adenomas having suprasellar extension: A prospective series of 100 cases and brief review of the literature

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ABSTRACT

Objective: The aim was to assess the factors influencing the visual outcome following trans-sphenoidal excision of pituitary adenomas.

Materials and Methods: One hundred consecutive patients of pituitary adenomas with suprasellar extension (SSE) were operated by trans-sphenoidal approach from July 2003 to December 2006. There were 52 male and 48 female patients with a mean age of 42.47 years. The visual impairment score, which was used to evaluate the visual outcome was produced by adding the scores for visual acuity and visual field defects of each patient (from the tables of the German Ophthalmological Society). The mean diameter, the SSE and the parasellar extension of the lesion were noted in the magnetic resonance imaging study. The average follow-up was 43.5 months.

Results: The mean diameter of the tumor was 32.97 mm, and the mean SSE was 14.95 mm. The parasellar extension was present in 27 patients. The vision improved in 61 of the 71 patients (85.91%). The shorter the duration of visual symptoms and smaller the size of the lesion resulted in better visual outcome. The age and the preoperative visual impairment did not show any correlation with the visual outcome.

Conclusions: Patients with visual symptoms of <1-year duration ($P < 0.01$) and adenomas of <36.5 mm diameter ($P < 0.009$) have better visual outcome.

Key words: Pituitary adenoma, suprasellar extension, trans-sphenoidal, visual outcome

Introduction

Pituitary adenomas represent 10-12% of all intracranial tumors. Despite their histologically benign nature, the mass effect on the optic apparatus and adjacent structures and the endocrinological dysfunction necessitates prompt and adequate treatment of these neoplasms. The preferred treatment is surgical removal by the trans-sphenoidal route because it is less invasive and allows a direct approach to the pituitary gland. Several factors like the age,[1] the preoperative visual impairment,[1,2] the duration of the visual symptoms,[1,3] the size of the lesion influence the visual outcome following excision. In the present study, we analyzed the factors affecting the visual outcome in pituitary adenomas with suprasellar extension (SSE).

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Materials and Methods

One hundred consecutive patients of pituitary adenomas with SSE operated by trans-sphenoidal approach from July 2003 to December 2006 were included. During this period, 138 patients with pituitary adenomas were treated surgically in the Department of Neurosurgery, Nizam's Institute of Medical Sciences, Hyderabad, India. Pure intrasellar lesions and adenomas with extrasellar extension operated through transcranial approach (38) were excluded.

Of the 100 patients, 52 were males, and 48 were females. Age range was 14-74 years with a mean of 42.47 ± 1.32 years. Most of these patients were in third to sixth decades of life. Along with the neurological examination, the patients were evaluated by ophthalmological, endocrinological and imageological workup. The visual acuity, visual field charting and the fundus examination of each patient were evaluated. The ophthalmological findings of visual acuity and visual fields were analyzed according to the guidelines of the German Ophthalmological Society.[4]

The scores for visual acuity and visual field defects in each patient were added, thus providing the visual impairment score (VIS), which enabled an exact comparison between subsequent examinations in each patient. A change in the score of more than 5% was considered to be improvement or deterioration.[5] Endocrine workup included thyroid profile, serum cortisol level at 8 a.m., serum prolactin level, serum growth hormone level, serum insulin like growth factor - 1, serum luteinizing hormone and serum follicular stimulating hormone.

All the patients were evaluated by magnetic resonance imaging (MRI) brain plain with or without contrast. The adenomas were classified into microadenoma (up to 10 mm), macroadenoma (>10-40 mm), giant adenoma (>40 mm). A spherical volume distribution was assumed, and the estimated mean diameter of the tumor was used for further calculations. In the craniocaudal direction, the SSE was measured. A line was drawn on the mid-sagittal image from the tuberculum sellae to the upper end of the dorsum sellae to define the sella entrance. The maximal SSE perpendicular to that line was measured on the mid-sagittal section.[6] The degree of SSE was graded into 4 grades, grade A (moderate SSE up to 10 mm), grade B (Large SSE up to 20 mm), grade C (Very large SSE up to 30 mm) and grade D (huge SSE in excess of 30 mm).[7] Parasellar extension of the adenoma was done according to Knosp *et al*. classification.[8]

Standard endonasal microscopic trans-sphenoidal approach was used for the surgical excision. The excision rates were classified into 4 grades based upon the amount of the residual lesion that was present in MRI at 3 months follow-up after excision as shown in Table 1.

The diagnosis of pituitary adenoma was confirmed histopathologically in all the patients. Postoperative mortality was defined as all the deaths that occurred within 1-month of the surgery. The average follow-up was 43.5 (3-82) months. All the patients were assessed at the end of 3 months, 6 months, 1-year and then each year following surgery clinically, ophthalmologically, endocrinologically and imageologically. Postoperative MRI was done between 3 and 6 months following surgery and every year later on.

Data were entered in Excel software (Microsoft, Seattle, WA) and was analyzed using SPSS software, version 13.0 (SPSS, Inc., Chicago, IL, USA). Means and standard deviations were computed for continuous variables and marginal distributions for categorical variables. Comparison of categorical variables between the two was performed using the Chi-square test, and a $P < 0.05$ was considered significant. Comparison of continuous variables between the two groups was performed using Mann-Whitney U-test and $P < 0.05$ was considered as significant. Logistic regression with forward conditional was used when multivariate analysis was required.

Results

The clinical features of the patients were tabulated in Table 2.

The mean diameter of the tumor was 32.97 ± 1.03 (13-60) mm. The mean SSE was 14.95 ± 0.70 (2-40) mm. The parasellar extension was present in 27 patients. There were 1 and 8 patients of grade 1 and 2 parasellar extension respectively. There were 7 and 11 patients of grade 3 and 4 parasellar extension respectively with invasion of cavernous sinus. There were 15 patients with infrasellar extension into the sphenoid sinus. There were 14 patients with giant pituitary adenomas.

Table 1: Rating of the extent of excision

Excision rate	Amount of residual lesion (%)
Complete	No residual lesion
Near total	<15% residual lesion
Sub total	>15% residual lesion
Partial	Decompression of the lesion

Table 2: Symptoms and signs

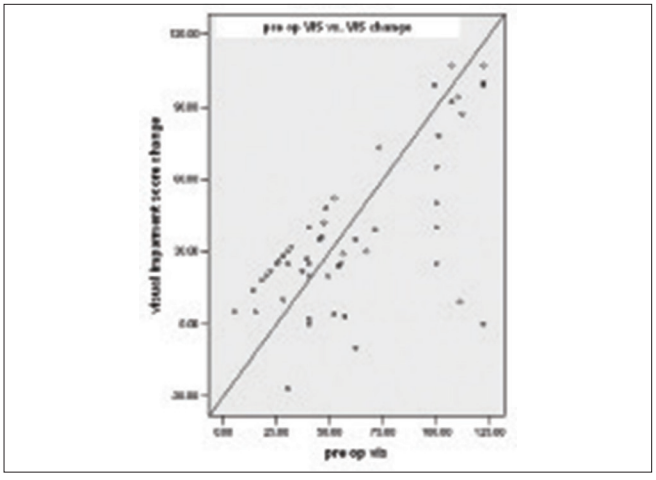
Presentation	Number
Headache	68
Visual acuity loss and field cuts	66
Diplopia	7
Endocrinological symptoms	49
Apoplexy	9
Seizures	3
Altered sensorium	2

Depending on the endocrine function of the adenoma, the patients were classified into functioning and nonfunctioning adenomas. There were 44 functioning adenomas with 24 prolactinomas and 20 GH secreting adenomas. Rest of the 56 patients had nonfunctioning adenomas.

There were 71 patients with preoperative visual impairment. Vision improved in 61 of the 71 patients (85.91%). Vision was normalized in 31 patients. Vision remained same in 6 patients and deteriorated in 1 patient.

Among the 71 patients who had preoperative visual impairment, only 66 patients had visual symptoms, and the rest had occult deficits. The mean duration of visual symptoms is 11.77 (0.15-100) months. Thirty-eight patients had visual symptoms of < 1-year duration and 25 patients had visual symptoms more than or equal to 1-year duration. Postoperatively 1 patients died with myocardial infarction.

The patients with duration of visual symptoms < 1-year had better visual outcome compared with those with longer duration ($P < 0.009$) with odds ratio of 11.68 [Table 3]. We analyzed the correlation between the age and visual outcome; there was no statistically significant correlation ($P < 0.396$). The mean preoperative VIS of the patients whose vision had improved ($n = 61$) was 53.45 ± 4.56, where as that of the patients whose vision remained same or deteriorated ($n = 7$) was 54 ± 12.09. There was no statistically significant difference between the two groups ($P < 0.969$). Visual outcome was inversely correlated with the size of the adenoma with statistical significance ($P < 0.010$) as shown in Table 3. Receiver operating characteristic was used to assess the significance of the correlation between the two variables, mean diameter and the visual outcome. The area under the curve was more than 0.75, which was significant. The best cut-off was 36.5 mm with a sensitivity of 0.857 and a specificity of 0.724.



Graph 1: Relation between preoperative visual impairment score and the visual impairment score change following surgery

The mean diameter and the mean SSE of the lesion were correlated to the duration of the visual symptoms ($P < 0.009$). The mean diameter ($P < 0.007$) and the mean SSE of the lesion ($P < 0.002$) were positively correlated with the preoperative visual impairment. There was a positive correlation between the preoperative visual impairment and the degree of the visual improvement with surgery ($P < 0.001$). A scatter plot graph was drawn and a formula was derived from the graph with which the degree of the visual improvement (VIS change) can be expected with the preoperative VIS [Graph 1]. List of the complications were tabulated in Table 4. Duration of visual symptoms are correlated with impairment scores and tumor dimensions and are tabulated [Table 5].

The formula is visual impairment score change = (pre operative visual impairment score X 1.2) – 30.

Discussion

Pituitary adenomas represent 10-12% of all intracranial tumors. Despite their histological benign nature, the mass effect on the

Table 3: Correlation of various factors with visual outcome

n=68	Vision improved (%)	Vision same or deteriorated (%)	*P*
Mean age	44.21±1.662	39.86±3.937	0.396
Gender			
Female	31 (45.6)	6 (8.8)	0.081
Male	30 (44.1)	1 (1.5)	
Duration of visual symptoms			
Visual symptoms <1 year	37 (58.7)	1 (1.6)	0.009
Visual symptoms ≥1-year	19 (30.2)	6 (9.5)	
Mean preoperative visual impairment	53.45±4.56	54±12.09	0.969
Mean diameter	32.43±1.06	41.42±4.11	0.010
Mean SSE	16.63±0.78	21.28±3.15	0.065
Excision rate			
Complete	17	1	0.555
Near total	15	2	
Sub total	26	4	
Partial	2	0	

SSE – Suprasellar extension

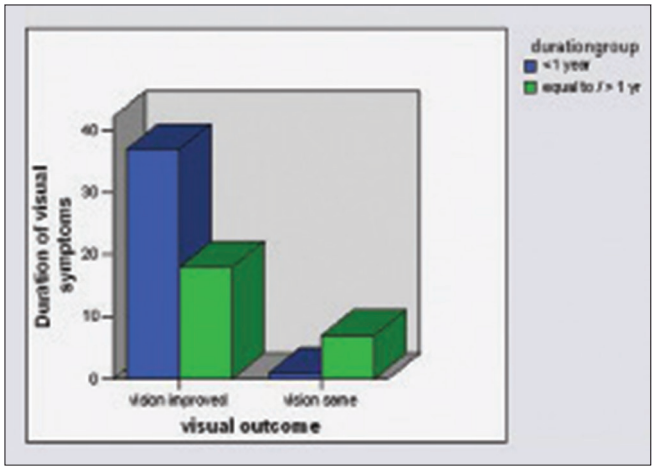
Table 4: List of complications

Complication	Number of patients
CSF rhinorrhea	6
Temporary DI	14
Persistent DI	8
Anterior pituitary hormone deficiency	4
Hematoma	3
III nerve palsy	1
Meningitis	2
Mortality	3

DI – Diabetes insipidus; CSF – Cerebrospinal fluid

optic apparatus, third ventricle, cavernous sinus structures, the endocrine dysfunction and the apoplexy necessitates prompt and adequate treatment. Various treatment options available are medical, surgical excision and radiotherapy depending on the hormonal activity of the tumor. The preferred treatment for the nonfunctional pituitary macro adenoma is surgical removal by the trans-sphenoidal route, as it is less invasive and allows a direct approach to the pituitary gland. Several factors like the age,[1] the preoperative visual impairment,[1,2] the duration of the visual symptoms,[1,9] the size of the lesion[9] influence the visual outcome following excision. In the present study, we analyzed the factors affecting the visual outcome in patients with pituitary adenomas with SSE following transnasal trans-sphenoidal excision.

Cohen *et al.*,[1] in their study observed that the visual outcome (for both acuity and fields) was better in patients < 52 years. Sullivan *et al.*[5] and Powell[7] and present study concluded that patient age was not predictive of postoperative visual acuity. The reason for the inconsistency regarding the effect of age on the visual outcome was not clear. It may be related to the differences in the patient population studied, including the differences in duration of the visual symptomatology, preoperative visual impairment and mean size of the tumor.



Graph 2: Bar chart depicting the relationship between the visual outcome and the duration of visual symptoms

Cohen *et al.*[1] in their study observed that the visual outcome was better with shorter duration of symptoms. Symon *et al.*[9] reported that the degree of visual improvement correlated with the duration of visual complaints. In this study, it was observed that longer the duration of the symptoms, poorer was the visual outcome [Graph 2]. This result could be because the increase in duration of the visual symptoms resulted in the irreversible injury to the compressed visual pathways either by mechanical compression or by the vascular compromise.

According to Cohen *et al.*[1] better visual acuity outcome was seen in patients with lesser degree of preoperative visual acuity compromise.[1] Gnanalingham *et al.*[2] reported that the extent of the visual field recovery was mainly dependent on the preoperative visual field deficit. Sullivan *et al.* in their retrospective study of 45 patients concluded that the preoperative visual acuity was not predictive of postoperative visual acuity.[5] Powell in his series of 67 patients, reported that preoperative visual defect did not correlate to the postoperative visual recovery.[7] In the present study, there was no statistically significant correlation between the severity of preoperative visual impairment and the visual outcome. Agrawal and Mahapatra concluded that even if the preoperative visual impairment is severe, better visual outcome can be achieved if the duration of the symptoms is less.[10] Symon *et al.* reported that the degree of visual improvement correlated with the size of the lesion.[9] In our study, we noted that better visual

Table 5: Correlation of duration of the visual symptoms with tumor dimensions

n=63	Mean preoperative VIS	Mean preoperative VA	Mean preoperative VF	Mean postoperative VA	Mean VIS change	Mean diameter	Mean SSE
Visual symptoms <1 year	48.02±5.73	31.41±5.39	16.61±1.28	7.18±1.67	37.94±5.17	31.78±1.18	14.91±0.73
Visual symptoms ≥1 year	66.88±6.03	53.11±6.51	13.77±2.10	29.54±5.65	31.33±5.83	36.38±1.94	20.73±1.42
P	0.031	0.013	0.229	0.000	0.412	0.037	0.000

VIS – Visual impairment score; SSE – Suprasellar extension; VA – Visual acuity; VF – Visual field

Table 6: Outcome of visual disturbances after removal of pituitary adenoma

Series	Patients with deficits/ patients operated (%)	Normalized (%)	Improved but not normalized (%)	Unchanged (%)	Worsened (%)
Cohen *et al.*[1]	53/100 (53)	Not reported	79	18	3
Ebersold *et al.*[11]	72/100 (72)	Not reported	53/72 (74)	15/72 (21)	3/72 (4)
Bevan *et al.*[12]	33/58 (57)	9/33 (27)	20/33 (61)	4/33 (12)	0/33 (0)
Shone *et al.*[13]	24/35 (69)	8/24 (33)	11/24 (46)	4/24 (17)	1/24 (4)
Marazuela *et al.*[14]	21/35 (60)	5/21 (23)	7/21 (33)	9/21 (43)	0/21 (0)
Mortini *et al.*[15]	289/1140 (25.4)	117/289 (40.5)	140/289 (51.2)	21/289 (7.3)	3/289 (1)
Present series	71/100 (71)	31/71 (43.6)	30/71 (42.2)	6/71 (8.4)	1/71 (1.4)

outcome will be achieved in patients with adenomas with mean diameter size < 36.5 mm ($P < 0.010$) [Table 3].

Visual outcomes of the different series were compared in Table 6.

Conclusions

The analysis of the results of the trans-sphenoidal excision of pituitary adenomas with SSE resulted in the following conclusions. Patients with visual symptoms of < 1-year duration and adenomas of < 36.5 mm size have better visual outcome.

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Conflicts of interest

There are no conflicts of interest.

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