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Increased frequency of cataract surgery in patients over age 50 with pituitary macroadenomas and chiasmal compression

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Abstract

Background Patients with visual loss from macroadenomas compressing their optic apparatus may also have concomitant age-related visual pathology such as cataracts. How these two pathologies interact with each other is not well documented.
Objective The interaction between these two pathologies in elderly patients is the subject of this study.
Methods We identified a series of non-functioning macroadenoma patients over age 50 years with tumors compressing the chiasm who underwent transsphenoidal surgery at our institution between 2004 and 2018. Pre- and post-operative visual complaints, tumor size and extent of resection were analyzed. Prevalence of the diagnosis of cataract and prevalence of cataract surgery in each decade were compared with national averages.
Results We identified 200 patients who met selection criteria. 18% of these patients had a diagnosis of cataract and 12.5% had cataract surgery. Compared with the Eye Diseases Prevalence Research Group (EDPRG) study, the prevalence of cataract surgery was 2.5 times the national average of 5.1%. 32% of these patients had no improvement in their vision after cataract surgery but 76% improved after transsphenoidal surgery.
Conclusions We reported a high prevalence of cataract surgery in patients over age 50 in patients with pituitary macroadenomas compressing the optic pathway compared with national averages in patients without adenomas. While visual loss from adenoma likely precipitated more cataract surgeries in this group of patients, some who may not have required it, those patients with cataracts who did not have their cataracts extracted were less likely to recover vision after transsphenoidal surgery. Addressing both pathologies is beneficial.

Keywords Chiasma · Cataract · Cataract Surgery · Prevalence · Vision · Elderly · Macroadenoma · Pituitary Adenoma · Transsphenoidal Surgery · Endoscopic

Introduction

Visual impairment and blindness are one of the major forms of disabilities in older individuals [1]. The prevalence of visual impairment and blindness increases with age as a result of high prevalence of major causes such as glaucoma, age-related macular degeneration, diabetic retinopathy and cataracts among the older patients. Cataract remains the leading cause of world blindness, the second most frequent cause of unilateral blindness and the most frequent cause of

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mild to moderate visual impairment [2]. Cataract prevalence increases steadily with age [3]. As the population ages, the prevalence and burden of visual impairment from cataracts are expected to rise further [4]. Cataract surgery is the most commonly performed ophthalmic surgical procedure [5].

Pituitary adenomas account for 10–15% of intracranial tumors [6], with an age-adjusted prevalence of 16.7% in the general population [7]. Particularly in the elderly population, adenomas are diagnosed when compression of the optic apparatus leads to progressive visual loss [8–10]. In this demographic, the presence of cataracts and their role in visual decline may obfuscate the clarity of the diagnosis. The interaction between cataracts and chiasmal compression from adenomas is multifaceted. Patients with visual loss from a macroadenoma may be referred for unnecessary cataract surgery if the adenoma is the primary cause of the visual loss. Conversely, adenomas may be removed for visual loss caused by cataracts. On the other hand, cataracts may be identified and treated earlier if visual loss comes to medical attention from the macroadenoma.

In order to gain a better understanding of the interplay between these two diagnoses, we examined the prevalence of cataract surgery and post-operative visual outcome in a series of elderly patients with macroadenomas compressing the chiasm who underwent transsphenoidal surgery.

Method

We queried a prospectively acquired database at our Hospital for all pituitary tumors operated on by the senior authors between 2004 and 2018. Cases over the age of 50 were selected, since they were more likely to have a higher prevalence of cataracts. The surgical results of these same patients has been previously described in our prior publications with different inclusion and exclusion [11–13]. IRB approval for this study was obtained. Patients were not required to explicitly consent to this study. Estimating the interaction between cataract and pituitary adenoma diagnosis regarding vision enhance the patients care. From this group, MRI scans were reviewed and only patients with non-functioning adenoma compressing the chiasm were considered eligible for inclusion in the study. Patients with incomplete records were excluded.

Data abstracted from medical records included demographic data, medical history, clinical examination, and ophthalmological data regarding evidence of cataract diagnosed within 5 years prior to adenoma surgery, history and date and visual outcome of any cataract surgery and any other ophthalmological diseases.

Visual assessment for these patients included presence or absence of visual complaints (impaired vision or normal vision) and automated perimetry with Humphrey visual field analyzer (HVFA). Visual fields were considered abnormal if the mean deviation or the pattern plot was abnormal. Mean deviation (MD) (in decibels) was used to compare overall VF changes. Post operative vision was considered "good" if there was more than 30% improvement in the MD of visual field (to avoid inter- and intra-individual variation) or if there was improvement in either visual acuity or subjective visual report especially in patients without preoperative abnormal visual field and "poor" if it remained stable or deteriorated.

Radiological assessment was done including tumor volume, estimated according to the equation $(A \times B \times C)/2$ [14, 15]. Degree of involvement of the prechiasmatic optic nerve, optic chiasm, and optic tract was classified as abutment but no displacement, mild displacement (< 3 mm of elevation), moderate displacement (≥ 3, < 5 mm of elevation) or severe displacement (≥ 5 mm of elevation). For statistical purposes we combined abutment and mild displacement which was compared with the moderate and severe displacement groups.

Extent of resection on postoperative MRI was defined as gross total resection (GTR) if > 95% of the tumor was removed, subtotal resection (STR) if < 95% of the tumor was removed and inadequate tumor resection (ITR) if there was still chiasmal compression in the postoperative MRI scan. Statistical analyses were performed using SPSS statistical software (Chi square, independent samples T test and ANOVA test) with $p \leq 0.05$ considered statistically significant (IBM Corporation, Released 2011, SPSS Statistics for Macintosh, Version 20.0, Armonk, New York).

Results

Prevalence of cataracts and cataract surgery

A total of 200 patients were included, 83 females and 117 males (42 and 58%, respectively), with mean age of 64.5 ± 9.2 years, at the time of diagnosis. Separated by age groups, 32% (64 patients) were between 50 and 59 years, 36.5% (73 patients) were between 60 and 69 years and 31.5% (63 patients) were 70 years or older. Cataracts were present in 36 (18%) and glaucoma in 12 patients (6%; Fig. 1). Cataracts were diagnosed in 18.8% of all males and 16.8% of all females. The prevalence of cataracts also increased with increasing age (Table 1; $p < 0.0001$). 12.5% (25 patients) of all patients had cataract surgery prior to the diagnosis of pituitary tumor. The prevalence of cataract surgery also showed significant increase with age (Table 1; $p < 0.0001$). Cataract surgery was bilateral in 14 patients (56%), unilateral in 8 (28%) and not recorded in 3.

Comparing our adenoma patients with the normal population of a similar age range, as reported in the Eye Diseases Prevalence Research Group (EDPRG) [16], the prevalence

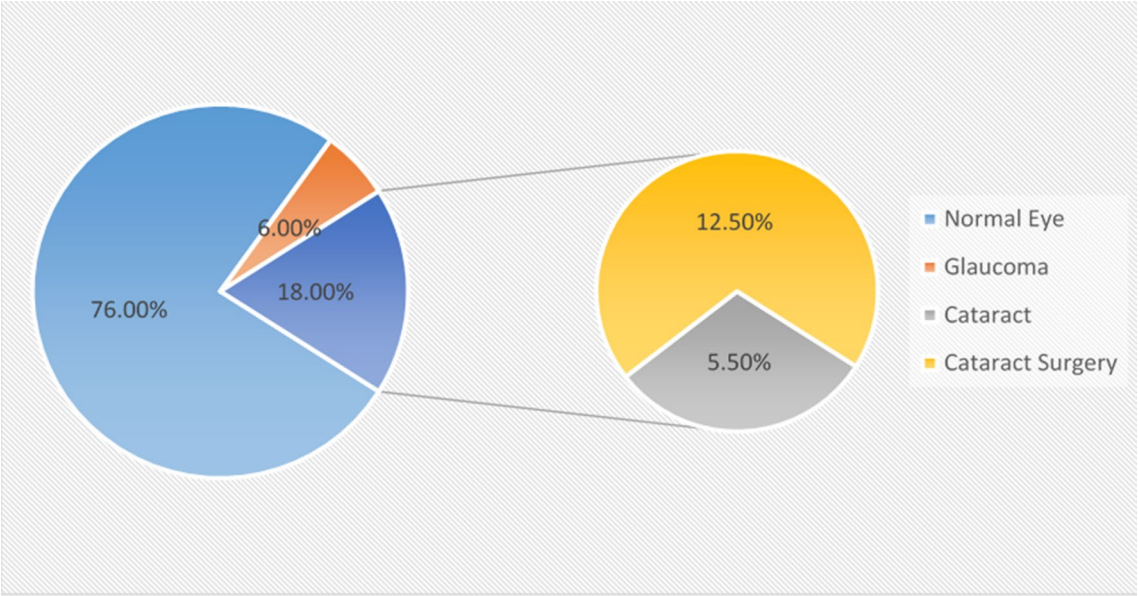

Fig. 1 Graph showing prevalence of eye pathology and cataract surgery in adenoma patents

Table 1 Gender and age distribution of cataracts and cataract surgery in pituitary macroadenoma patients

	Total patients	Patients diagnosed with a cataract	Patients who had cataract surgery
Age			
Mean	64.5	72.3	73.7
SD	9.2	8	7.7
Age groups			
50–59	64	1 (1.6%)	0 (0%)
60–69	73	13 (17.8%)	8 (11%)
≥ 70	63	22 (34.9%)	17 (27%)
Sex			
Male	117	22 (18.8%)	15 (12.8%)
Female	83	14 (16.8%)	10 (12%)
Total	200	36 (18%)	25 (12.5%)

of cataracts was roughly the same (17.2% versus 18%), but the prevalence of cataract surgery was 2.5 times higher (Table 2). Whereas the US population over 50 has a prevalence of cataract surgery of 5.1%, in our series of patients with macroadenomas touching the chiasm, the rate was 12.5% (Table 2).

Pre-operative vision, tumor size and chiasmal compression

Pre-operative visual complaints were present in 23/25 (92%) of patients with prior cataract surgery, 9/11 (81.8%) of patients with cataracts who did not have surgery and 96/152 (63%) of patients without a diagnosis of cataracts ($p = 0.004$). Similarly, pre-operative visual field deficits were present in 19/25 (76%) patients with prior cataract surgery, 8/11 (72.7%) of patients with cataracts who did not have surgery and 89/152 (58%) of patients without a diagnosis of cataracts ($p = 0.186$). Thus, patients with cataracts were more likely to have visual complaints, regardless of whether or not they had their cataracts extracted. Of the 25 cataract surgery patients, 8 (32%) had no improvement in their vision after cataract surgery. Pre-operative tumor size was larger in patients with cataracts but no cataract surgery (12.2 ± 10.2) compared with patients with prior cataract surgery (6.72 ± 7.13) and patients without a diagnosis of cataracts (6.53 ± 6.72), although this was not statistically significant ($p = 0.34$). Moderate to severe pre-operative chiasmal compression was more common in patients with cataracts but no cataract surgery 9/11(81.8%) compared with patients with prior cataract surgery 16/25 (64%) and patients without a diagnosis of cataract 65/162 (40.1%) ($p = 0.03$) (Table 3).

Post-operative visual outcome

Visual outcome after trans-sphenoidal surgery was worse in patients with cataracts but no prior surgery 3/11(27.2%) compared with patients who had cataract surgery 19/25 (76%) and those who did not have cataracts 127/152 (84%; $p = 0.0001$). Gross total resection was achieved in 120/152 (78.9%) of patients without a diagnosis of cataract, 17/25 (68%) patients with prior cataract surgery but only 5/11 (45.4%) patients with cataract diagnosis but no cataract surgery ($p = 0.03$) (Table 3).

Table 2 Age and Gender distribution and prevalence of cataract surgery in US population (include reference) compared with our series of macroadenomas

	US study (Eye Diseases Prevalence Research Group)	Our study	P value
Cataract prevalence	17.2%	18%	0.76
Age			
50–59	7.10%	1%	0.06
60–69	20.20%	13%	0.13
> 70	51%	34.9%	0.01
P value trend with increase age	< 0.0001	< 0.0001	
Sex			
Male	13.3%	18.8%	
Female	20%	16.8%	
Cataract surgery prevalence	5.1%	12.5%	< 0.0001
Age			
50–59	1.3%	0%	0.8
60–69	4.1%	11%	0.003
> 70	17.6%	27%	0.04
P value trend with increase age	< 0.0001	< 0.0001	
Sex			
Male	4.2%	12.8%	
Female	5.9%	12%	

Table 3 Pre- and post-operative characteristics of macroadenoma patients without a cataract diagnosis compared with those with cataracts who either had, or did not have, cataract surgery prior to transsphenoidal surgery

	Patients without cataracts	Cataract surgery patients	Patients with cataract but no surgery	P Value
Preoperative visual complaints				
Normal vision	56 (37%)	2 (8%)	2 (18%)	0.01
Impaired vision	96 (63%)	23 (92%)	9 (82%)	
Preoperative visual field deficit				
No deficit	63 (42%)	6 (24%)	3 (27%)	0.186
Deficit	89 (58%)	19 (76%)	8 (3%)	
Postoperative visual outcome				
Good vision	127 (84%)	19 (76%)	3 (27.2%)	0.0001
Poor vision	25 (16%)	6 (24%)	8 (72.8%)	
Tumor volume (cm^3)				
Mean	6.53	6.72	12.2	0.34
SD	6.72	7.13	10.2	
Degree of chiasmal compression				
Mild	87	9	2	0.03
Moderate	44	9	5	
Severe	21	7	4	
Degree of tumor resection				
GTR	120	17	5	0.03
STR	32	8	6	
IR	0	0	0	
Total	152	25	11	

Discussion

In this report we demonstrate that the rate of cataract surgery in patients over 50 with macroadenomas compressing the chiasm is roughly 2.5 times the rate of the normal age-adjusted population. There are two possible interpretations for this finding. The first is that patients with visual loss from their macroadenoma are incorrectly diagnosed as having visual loss from their cataract and referred for unnecessary cataract surgery, which fails to improve their vision. Support for this interpretation of the data is the fact that 32% of patients who had cataract surgery obtained no improvement in their vison after their cataract surgery. An alternative interpretation of the data is that both the macroadenoma and the cataracts contributed to visual loss and the cataract was treated first, after which the visual fields could be correctly interpreted as showing a compressive chiasmopathy leading to the adenoma diagnosis. Subsequent adenoma surgery resulted in further improvement in vision. It is likely that these interpretations are not mutually exclusive but occur to variable degrees in different patients.

The second major finding of this paper is that visual improvement after transsphenoidal decompression of the chiasm was suboptimal in patients with cataracts that were not surgically corrected. These data support the second interpretation above, namely that there is clearly a subgroup of patients in whom the cataract is a major contributor to visual loss and in whom adenoma removal alone will not fully correct visual loss. In this group of patients, addressing both pathologies will likely optimize visual outcome.

Finally, there may also be a group of patients in whom the cataract is the primary cause of their visual loss, but the adenoma surgery is performed first for fear of permanent visual impairment from compression of the optic apparatus. It is well documented that visual improvement after transsphenoidal surgery is often partial and that permanent loss of vision can occur in direct relation to the degree of pre-operative visual impairment and axonal loss [15, 17]. Hence, in some situations it may be important to address the compressive chiasmopathy first since successful restoration of vision may be time sensitive, whereas with cataracts the timing is less critical.

Adenomas with suprasellar extension tend to cause any one of a variety of stereotypical patterns of visual loss such as monocular defects, bitemporal hemianopia (the typical type of chiasmatic compression), and homonymous hemianopia (unilateral optic tract compression), which is often determined by the position of the chiasm (prefixed, normal and postfixed), and/or the degree to which suprasellar extension of tumor is symmetric [18]. Compression of the anterior visual pathway may cause optic nerve disc cupping (ODC) or optic atrophy [18]. Symptomatically, patients with cataract will not complain of missing areas of vision as they might with compression of the optic apparatus, but instead will describe blurriness, poor night vision and glare. On visual field testing, cataracts do not cause neurogenic field defects such as altitudinal, arcuate or cecocentral scotomas, but instead cause a generalized depression of the field, where all pixels are decreased to a similar degree. Hence, cataracts may impair the accurate interpretation of visual field perimetry and render diagnosis of a compressive pattern of field defect more challenging [19]. Although transsphenoidal surgery in the elderly is safe, the risk increases with increasing age [9, 10]. In a patient with known cataracts and an adenoma compressing the chiasm, the decision of which pathology to address first must be made based on the severity of the visual loss and the likely primary contributing pathology. Assessment of optic nerve health based on funduscopy and utilizing optical coherence tomography (OCT) to measure the ganglion cell layer and retinal nerve fiber layer within the retina that form the optic nerve can help determine the degree to which vision loss is due to compression. If ambiguity exists, repair of the cataract first may assist with correct interpretation of the perimetry test. However, if the adenoma is very large and the field defect is consistent with chiasmopathy, the adenoma should be addressed first to avoid permanent field loss that can occur over time. Neuro-ophthalmologists and neurosurgeons need to be aware of the interaction between cataracts and visual field perimetry testing to accurately diagnose and treat the appropriate pathology to maximize improvement in vision.

One of the limitations of this study is the regional nature of our referral base. It is possible that cataract surgery is performed at a higher rate in the New York Metropolitan area than in other areas of the country. However, such data is not currently available. Further studies on the incidence of cataract surgery in macroadenoma patients over age 50 from other areas of the country and the world would be useful to substantiate our findings.

Conclusion

After a certain age, patients with non-functioning macroadenomas compressing the optic apparatus may have coexisting cataracts which can influence the quality and interpretation of their visual field tests. We observed that cataract surgery was performed at a higher rate above a certain age, and in some of these cases, the adenoma is the primary cause of the visual dysfunction. In many cases, both pathologies contribute to the loss of vision and should be treated sequentially. The order in which they should be addressed is determined for each patient keeping in mind that prolonged compression of the visual pathway could lead to irreversible visual loss. Although transsphenoidal surgery is safe in the elderly, the complications increase with increasing age [9, 10]. For this reason, if uncertainty exists regarding which pathology is most severe, repair of the cataract should be done first in order to provide more reliable and accurate HVF results, thus better interpretation of the patient's visual function and the actual need for transsphenoidal pituitary surgery.

Compliance with ethical standards

Conflict of interest The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References

1. World Health Organization (2015) World report on ageing and health. World Health Organization, Geneva
2. Attebo K, Mitchell P, Smith W (1996) Visual acuity and the causes of visual loss in Australia: the Blue Mountains Eye Study. Ophthalmology 103(3):357–364
3. Mitchell P, Cumming RG, Attebo K, Panchapakesan J (1997) Prevalence of cataract in Australia: the Blue Mountains eye study. Ophthalmology 104(4):581–588
4. Kanthan GL, Wang JJ, Rochtchina E, Tan AG, Lee A, Chia E-M, Mitchell P (2008) Ten-year incidence of age-related cataract and cataract surgery in an older Australian population: the Blue Mountains Eye Study. Ophthalmology 115(5):808–814. https://doi.org/10.1016/j.ophtha.2007.07.008
5. Keeffe JE, Taylor HR (1996) Cataract surgery in Australia 1985–94. Aust N Zeal J Ophthalmol 24(4):313–317
6. Ostrom QT, Gittleman H, Farah P, Ondracek A, Chen Y, Wolinsky Y, Stroup NE, Kruchko C, Barnholtz-Sloan JSJN (2013) CBTRUS statistical report: primary brain and central nervous system tumors

diagnosed in the United States in the United States in 2006-2010. Neuro-oncol 15(Suppl_2):ii1–ii56
7. Ezzat S, Asa SL, Couldwell WT, Barr CE, Dodge WE, Vance ML, McCutcheon IE (2004) The prevalence of pituitary adenomas: a systematic review. Cancer 101(3):613–619. https://doi.org/10.1002/cncr.20412
8. Barrow DL, Tindall GTJN (1990) Loss of vision after transsphenoidal surgery. Neurosurgery 27(1):60–68
9. Memel Z, Chesney K, Pangal DJ, Bonney PA, Carmichael JD, Zada G (2018) Outcomes following transsphenoidal pituitary surgery in the elderly: a retrospective single-center review. Op Neurosurg. https://doi.org/10.1093/ons/opy109
10. Wilson PJ, Omay SB, Kacker A, Anand VK, Schwartz THJJ (2018) Endonasal endoscopic pituitary surgery in the elderly. J Neurosurg 128(2):429–436
11. Esquenazi Y, Essayed WI, Singh H, Mauer E, Ahmed M, Christos PJ, Schwartz TH (2017) Endoscopic endonasal versus microscopic transsphenoidal surgery for recurrent and/or residual pituitary adenomas. World Neurosurg 101:186–195. https://doi.org/10.1016/j.wneu.2017.01.110
12. Chohan MO, Levin AM, Singh R, Zhou Z, Green CL, Kazam JJ, Tsiouris AJ, Anand VK, Schwartz TH (2016) Three-dimensional volumetric measurements in defining endoscope-guided giant adenoma surgery outcomes. Pituitary 19(3):311–321. https://doi.org/10.1007/s11102-016-0709-2
13. Negm HM, Al-Mahfoudh R, Pai M, Singh H, Cohen S, Dhandapani S, Anand VK, Schwartz TH (2017) Reoperative endoscopic endonasal surgery for residual or recurrent pituitary adenomas. J Neurosurg 127(2):397–408. https://doi.org/10.3171/2016.8.JNS152709
14. Alahmadi H, Vachhrajani S, Cusimano MD (2010) The natural history of brain contusion: an analysis of radiological and clinical progression. J Neurosurg 112(5):1139–1145. https://doi.org/10.3171/2009.5.JNS081369
15. Kothari RU, Brott T, Broderick JP, Barsan WG, Sauerbeck LR, Zuccarello M, Khoury J (1996) The ABCs of measuring intracerebral hemorrhage volumes. Stroke 27(8):1304–1305
16. Congdon N, Vingerling JR, Klein BEK, West S, Friedman DS, Kempen J, O'Colmain B, Wu Y, Taylor HR, Wang JJ, Grp EDPR (2004) Prevalence of cataract and pseudophakia/aphakia among adults in the United States. Arch Ophthalmol 122(4):487–494
17. Luomaranta T, Raappana A, Saarela V, Liinamaa MJ (2017) Factors affecting the visual outcome of pituitary adenoma patients treated with endoscopic transsphenoidal surgery. World Neurosurg 105:422–431. https://doi.org/10.1016/j.wneu.2017.05.144
18. Hajiabadi M, Alimohamadi M, Fahlbusch RJW (2015) Decision making for patients with concomitant pituitary macroadenoma and ophthalmologic comorbidity: a clinical controversy. World Neurosurg 84(1):147–153
19. Phu J, Khuu SK, Yapp M, Assaad N, Hennessy MP, Kalloniatis MJC (2017) Optometry E: the value of visual field testing in the era of advanced imaging: clinical and psychophysical perspectives. 100(4):313–332