

Original Research Article

Visual Pathway Tumor Presenting as Visual Disturbances Without Extraocular Signs.

Abstract

Purpose: To evaluate visual pathway tumor presenting as visual disturbances without extraocular signs and assess the usefulness of various examinations.

Methods: Only 35 patients with intracranial tumors (22 males and 13 females) who were initially diagnosed at our hospital and confirmed by magnetic resonance imaging were enrolled, and previously known intracranial tumor patients and patients with strabismus or proptosis were excluded. Best corrected visual acuity (BCVA), pupillary reflex test, fundus examination, color vision test and visual field test were done to evaluate visual impairments. We investigated the incidence of intracranial tumors and sensitivity of tests.

Results: The most common tumors were pituitary tumors (60.0%), followed by meningioma (20.0%) and optic nerve glioma (5.7%). The BCVA ranged from 1.0 to no light perception and the visual acuity of 3 patients was 1.0 in both eyes. Positive relative afferent pupillary defect was seen in 71.4% and abnormal disc findings were found in 58.8% of patients. The color vision test was more specific (sensitivity: 76.6%), and all patients had abnormal visual field defects.

Conclusions: Pituitary tumor is the most common intracranial tumor. Among tests, a visual field test is a more sensitive test than other tests for detecting compressive optic neuropathy.

Key words : tumor; compressive optic neuropathy; visual field test, visual pathway, pituitary tumor

24 INTRODUCTION

25 Compressive optic neuropathy results from several diseases such as thyroid
26 associated orbitopathy, intraorbital inflammation, orbital tumor and intracranial tumor.
27 Among those causes, some intracranial tumors are life threatening. Hence, ophthalmologists
28 should be concerned about the possibility of an intracranial tumor in compressive optic
29 neuropathy patients.

30 Several symptoms of brain tumors include diplopia, proptosis and visual disturbance,
31 and patients may complain of visual disturbances or narrow visual field. A visual disturbance
32 is usually slowly progressive. However, some cases of compressive optic neuropathy show
33 acute or subacute visual disturbances.[1] Moreover, certain intracranial tumors are found
34 incidentally. In compressive optic neuropathy, there are several subjective and objective signs
35 including deteriorated visual acuity, abnormal color perception, relative afferent pupillary
36 defect (RAPD), a defect seen in the visual field test, and optic disc swelling or atrophy.
37 Making the right diagnosis based on those signs is important to differentiate compressive
38 optic neuropathy from other optic neuropathies. Accordingly, we evaluated characteristics of
39 compressive optic neuropathy patients who were initially diagnosed at our hospital and made
40 correlations between the ophthalmic examination and intracranial tumors.

41

42 METHODS AND MATERIALS

43 We retrospectively reviewed charts from total of 35 patients with intracranial tumors
44 (22 males and 13 females) diagnosed by magnetic resonance imaging (MRI). The patients
45 were enrolled between May 2008 and May 2011 in the department of Neuro-ophthalmology
46 of Kim's Eye Hospital. Inclusion criteria were as follows : (i) the compressive optic
47 neuropathy was initially diagnosed at our hospital and confirmed by MRI. (ii) The diagnosis
48 of intracranial tumor was performed by an radiologist. We excluded patients with strabismus

49 and proptosis to evaluate the pure visual disturbance patients related with intracranial tumor.
 50 Previously known intracranial tumor patients and the retrochiasmal lesions were excluded.
 51 This research study was reviewed and approved by the Institutional Review Board (IRB) of
 52 Kim's Eye Hospital, and all procedures conformed to the guidelines of the Declaration of
 53 Helsinki.

54 We performed general ophthalmic examinations including visual acuity test,
 55 intraocular pressure measurement, slit lamp examination and fundus examination. Best
 56 corrected visual acuity (BCVA) was checked using Snellen chart at the initial visit. The
 57 relative afferent pupillary defect was graded using a neutral density filter bar which has 6
 58 steps (0.3 to 1.8 log unit). To evaluate the optic disc, fundus photography was conducted
 59 using a digital fundus camera (Canon CR6-45NM with Canon EOS 20D, Tokyo, Japan). We
 60 investigated optic disc abnormalities such as optic disc swelling, disc pallor and large
 61 cup/disc ratio. A large cup/disc ratio was defined as an optic disc with an intact temporal rim.
 62 An Ishihara color plate with 21 plates was used for disturbances of color perception. As per
 63 the manual of the Ishihara color plate, the color vision test was abnormal when each answer
 64 was not given within 3 seconds. We used Goldmann perimetry (MT325-UD, Takagi, Nagano)
 65 or Humphrey visual field perimetry (Carl Zeiss Meditec, Dublin, CA) as the occasion
 66 demanded.

68 RESULTS

69 The mean age was 43.7 years (6-77 years). The most common tumors in the patients
 70 were pituitary tumor (60.0%), followed by meningioma (20.0%) and optic nerve glioma
 71 (5.7%) (Fig. 1). Only 2 of 7 in the meningioma group was a meningioma whose origin was
 72 the optic nerve. The duration of symptoms had a diverse range (Fig. 2). Pituitary
 73 "incidentalomas" are, by definition, masses that are discovered by computed tomography

(CT) or MRI exams done to evaluate unrelated disorders (such as head trauma), for cancer staging, or because of nonspecific symptoms such as dizziness and headache.² All incidental cases (cases 2 and 4) were pituitary adenomas. One case showed bilateral quadranopsia; the other case showed a unilateral arcuate defect.

Those with compressive optic neuropathy had many different visual acuity scores, from 1.0 to no light perception (Table 1). All 3 patients (cases 2, 4 and 11) with scores of 1.0 in both eyes had a pituitary adenoma. All 3 cases (cases 3, 24 and 29) had bilateral poor visual acuity and were in poor health (due to conditions such as dementia and uncontrolled diabetes mellitus). A relative afferent pupillary defect (RAPD) was seen in 20 of 28 patients (71.4%). Eight cases with a negative RAPD included 6 relatively symmetric visual field defect patients and one small scotoma patient. One of 8 patients with no RAPD was not performed visual field test because of poor visual acuity. Abnormal disc findings were found in 20 of 34 patients (58.8%). The most common abnormal disc feature was optic disc pallor. Disc pallor was noted 17 of 32 eyes with abnormal disc findings and there were 8 with a large C/D ratio and 7 with optic disc swelling. The color vision test was more specific (16 of 21 patients, sensitivity: 76.6%). Although 2 of 21 patients were performed the color vision test, we could not obtain results in the involved eye due to poor visual acuity. All patients who were able to take a visual field test exhibited abnormal visual field defects. Typical bitemporal hemianopsia was found in 3 of 21 pituitary tumor patients.

DISCUSSION

Compressive optic neuropathy resulting from an intracranial tumor can occur at any age. In our study, the youngest child was just 6 years old. The child had no light perception in the right eye and the chief complaint was exotropia. A 2.8cm X 2.9cm X 3.2cm sized pituitary tumor was found on the MRI. Thus, we need to keep a lookout for any intracranial

tumor when the patients show atypical optic neuritis or progressive visual disturbances. Compressive optic neuropathy should be distinguished from other optic neuropathies such as optic neuritis, ischemic optic neuropathy, hereditary optic neuropathy and traumatic optic neuropathy because compressive optic neuropathy is a treatable or curable optic neuropathy unlike various other optic neuropathies. Tumors affecting the optic nerve are divided into primary optic nerve tumors (optic nerve glioma and optic nerve meningioma) and secondary optic nerve tumors such as meningioma, metastatic cancer and pituitary adenoma. Our results included a primary optic nerve tumor in only 4 cases (2 optic nerve gliomas and 2 optic nerve meningiomas). The low incidence of primary optic nerve tumors in the present study is because a primary optic nerve tumor often accompanies proptosis and a primary optic tumor without proptosis might be detected in an advance stage. Thus, the visual acuity of 4 patients with primary optic nerve tumors varied from 0.2 to finger count.

Pituitary tumors were the most common in the present study. The clinical features of a pituitary adenoma are very diverse. Visual acuity ranges from hand motion to 1.0 and visual field defects vary greatly. The prevalence of visual field defect has been variable. In one study, 94.6% had a visual field defect.[3] Another study showed only 9% with visual field defects in patients with pituitary adenomas.[4] In the present study, all patients with a pituitary tumor and had taken a visual field test had an abnormal visual field. A pituitary incidentaloma is a previously unsuspected pituitary lesion that is discovered on an imaging study performed for an unrelated reason.[5] By definition, the imaging study is not done for a symptom specifically related to the lesion, such as visual loss, or a clinical manifestation of hypopituitarism or hormone excess, but rather for the evaluation of symptoms such as headache, or other head or neck neurological or central nervous system complaints or head trauma. The incidentaloma prevalence was 2 of 21 pituitary adenoma patients (9.5%) in the

present study, and two cases showed small quadranopsia without visual disturbance and color change.

The second most common tumor in this study was meningioma. Orbital meningioma may be either a primary tumor of the optic nerve arachnoid or a secondary tumor due to extension of a meningioma into the orbit from a primary intracranial meningioma. Only 10% of orbital meningiomas are primary tumors of the optic nerve.[6] In the present results, 2 of 7 meningiomas were primary tumors (28.6%). Visual loss may be markedly decreased at presentation because of the compressive nature of the tumor and 2 cases showed finger count and 0.1 at presentation. Some of the optic nerve meningioma cases could have been misdiagnosed as optic neuritis or amblyopia, especially, in children.[7] Thus, we should have a high suspicion for the diagnosis of optic canal meningioma in patients with unexplained visual loss, particularly when visual loss is progressive.[8] Metastatic orbital lesions have been estimated to account for 1-13% of all orbital tumors reported, and the majority of metastatic lesions of the orbit and ocular adnexa are from breast carcinomas.[9] Our results showed only one metastatic cancer and that was a breast metastatic carcinoma.

Various examinations were useful to detect the compressive optic neuropathy. The useful objective tools were relative afferent pupillary defect and fundus examination because visual acuity tests, visual field tests and color vision tests require the patient's cooperation. The prevalence of abnormal disc findings in the fundus examination was similar to that of RAPD (70% and 69%, respectively). RAPD increases linearly with an increased visual field defect.[10] However, Kardon et al.[11] reported that there is a lot of variation in the correlation between RAPD and visual field defects among diseases. RAPD could be normal when the disease is in the early stage or when visual field loss was the same amount in both eyes. In the present results, 6 of 8 non-RAPD cases had a similar defect in the visual field

test; 1 case showed a small scotoma. Optic disc findings are sometimes normal in the early stages as well. Patients with a normal optic disc finding were noted to have relatively good visual acuity and a visual acuity over 0.5 was found in 54.5% (6 of 11 patients). The most common abnormal optic disc finding was optic disc pallor, and that is a matter of great importance. Optic disc pallor means that the disease has lasted more than 6 weeks and irreversible changes in optic nerve function were to be expected. Thus, we should diagnose compressive optic neuropathy at an early stage before the optic disc is damaged. In addition, optic disc swelling can be an initial finding in the compressive optic neuropathy.[12] A color vision test is a useful tool and has a high sensitivity and intracranial tumors with compression of visual pathways had an abnormal color test. However, the color test was not able to be taken when the visual acuity was lower than the finger count. Visual field tests showed abnormal findings in patients who were able to perform the test. A visual field defect is helpful to localize the lesion. However, the visual field defect was often nonspecific and delayed with respect to electrophysiologic alterations.[13] In the present cases, although bitemporal hemianopsia is one of the key signs in chiasmal disease, only 3 of 21 pituitary tumors revealed a typical bitemporal hemianopsia.

In conclusion, we should closely observe the visual field test, color vision test, RAPD and optic disc appearance to diagnose possible compressive optic neuropathy. Among those tests, the visual field is the most sensitive one. Although pituitary tumors are common, rare tumors such as metastatic cancer or optic glioma must be considered.

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196 **Figures and Table legends**

197 Table 1. The full data of the 35 patients.

Case	Sex	Age	Diagnosis	Visual acuity right	left	Visual field test right	left	Color test right	left	Optic disc right	left	RAPD
1	M	50	pituitary tumor	0.9	0.2	bitemporal		-		NL	pallor	OS equivocal
2	F	70	pituitary tumor	1.0	1.0	SA	NL	-		NL	NL	-
3	M	70	pituitary tumor	0.03	0.06	-	-	abnormal	abnormal	pallor	pallor	-
4	M	30	pituitary tumor	1.0	1.0	Q	Q	NL	NL	large C/D ratio	large C/D ratio	no
5	M	59	pituitary tumor	1.0	0.1	NL	diffuse	NL	abnormal	NL	disc swelling	OS (1.5)
6	M	44	pituitary tumor	FC	0.1	-	diffuse	abnormal	abnormal	large C/D ratio	NL	OD
7	F	62	pituitary tumor	HM	0.8	diffuse	SA	ND	abnormal	pallor	NL	OD
8	F	33	pituitary tumor	0.7	1.0	IA	NL	abnormal	NL	NL	NL	OD (1.2)
9	F	36	pituitary tumor	1.0	0.3	SA	hemianopsia	NL	abnormal	NL	NL	OD (1.2)
10	M	54	pituitary tumor	0.4	0.9	bitemporal				pallor	NL	no
11	F	54	pituitary tumor	1.0	1.0	NL	Q	NL	NL	large C/D ratio	disc swelling	OS (0.9)
12	F	70	pituitary tumor	0.5	HM	3Q	diffuse	-		pallor	pallor	OS
13	M	33	pituitary tumor	0.8	0.06	bitemporal		-		large C/D ratio	large C/D ratio	no
14	M	45	pituitary tumor	0.6	0.6	3Q	IA	-		NL	NL	-
15	M	39	pituitary tumor	1.0	0.1	3Q	SA	-		NL	NL	OS

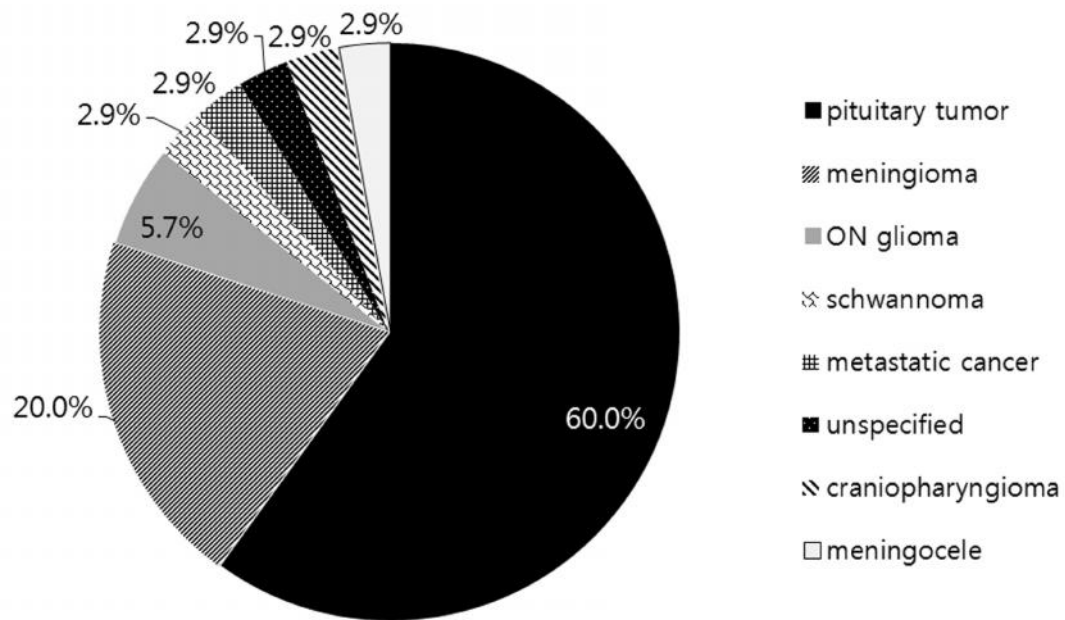
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16	M	66	pituitary tumor	0.3	1.0	3Q	temporal	-		pallor	NL	OD
17	F	29	pituitary tumor	1.0	0.7	NL	temporal	NL	abnormal	NL	NL	no
18	M	34	pituitary tumor	0.4	1.0	3Q	SA	abnormal	NL	large C/D ratio	NL	no
19	M	6	pituitary tumor	LP-	1.0	-	-	-		pallor	NL	OD
20	M	28	pituitary tumor	0.3	1.0	IA	NL	abnormal	NL	NL	NL	OD (0.3)
21	M	30	pituitary tumor	1.0	0.06	constriction	diffuse	NL	abnormal	NL	pallor	OS (0.9)
22	M	20	meningioma	0.6	0.6	NL	central	NL	NL	NL	NL	no
23	F	77	meningioma	0.2	0.6	3Q	NL	abnormal	NL	NL	NL	-
24	M	56	meningioma	HM	HM	diffuse	diffuse	-		disc swelling	pallor	OS equivocal
25	F	50	meningioma	1.0	FC	NL	diffuse	-		NL	pallor	OS (1.2)
26	M	54	meningioma	1.0	0.5	NL	Q	NL	abnormal	NL	NL	-
27	M	36	craniopharyngioma	0.5	0.8	Q	temporal	-		disc swelling	disc swelling	no
28	M	7	schwannoma	1.0	0.2	NL	central	abnormal	abnormal	NL	large C/D ratio	OS
29	M	75	unspecified	LP-	LP-	-	-	-		- pallor	pallor	no
30	F	63	metastatic carcinoma	HM	0.2	diffuse	3Q	ND	abnormal	pallor	pallor	-
31	M	10	Optic nerve glioma	1.0	0.2	Q	SA	-		-		-
32	F	39	Optic nerve glioma	FC	1.0	BS enlarged	NL	ND	NL	disc swelling	NL	OD
33	F	54	Optic nerve meningioma	1.0	FC	NL	diffuse	NL	ND	NL	disc swelling	OS 1.8<
34	F	40	Optic nerve meningioma	0.1	1.0	-	-	abnormal	NL	pallor	NL	OD 1.8<

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35	M	8	meningocele	0.4	0.8	Q	diffuse	abnormal	abnormal	NL	NL	OD equivocal
198	3Q : visual field defect in the three quadrants. Q: quadranopsia, SA : superior arcuate defect, IA : inferior altitudinal, BS : blind spot, NL : normal finding, FC : finger											
199	count, HM : hand motion, LP : light perception, - : no data, ND : not detectable											
200												
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203 Figure 1. The type of tumors

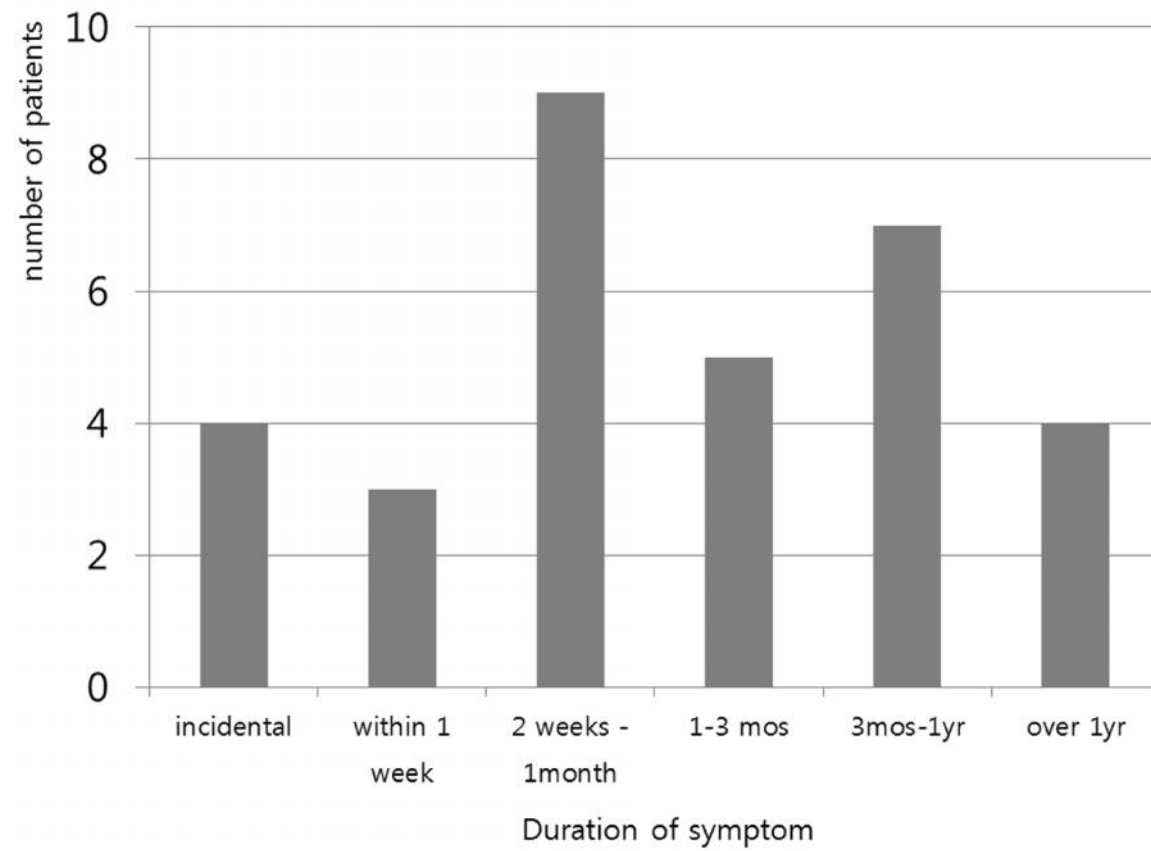


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206 Figure 2. The duration of time of onset.



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