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Original Research Article

The Risk Factors for the Development of Papilledema in Patients with Brain Tumour

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ABSTRACT

Background
Papilledema is a key indicator of increased intracranial pressure, transmitted through the optic nerve sheath. Historically, it was estimated that between 50% and 70% of patients with brain tumours developed papilledema. However, with advancements in neuroimaging, many individuals are now diagnosed at earlier stages, likely resulting in a significantly lower incidence of papilledema in contemporary cases. We investigated the risk factors for the development of papilledema in patients with brain tumours, as well as the prevalence of visual disturbances in those with papilledema.

Method
A total of 100 patients treated at our Institute over the course of a year were assessed for the signs of papilledema, type of tumour, location of tumour and age of the patient. Also, the visual changes in these patients concerning visual acuity, colour vision, and visual field defects were assessed.

Results
Papilledema was found in 31% of these patients. The occurrence of papilledema was influenced by factors such as tumour histology, location, and the patient's age. It was observed in 34.4% of patients with malignant brain tumours, compared to 28.2% in those with benign tumours ($p < 0.05$). Tumours located deep within the midline—both supra-tentorial (55.9%) and infra-tentorial (48.8%)—were more likely to cause papilledema than tumours in other areas ($p < 0.05$). Additionally, papilledema was less common in patients older than 59 years ($p < 0.05$). Among those with papilledema, 30.4% experienced a loss of visual acuity, and 48% had visual field defects. The frequency of visual disturbances was correlated with the stage of papilledema.

Conclusion
Based on our analysis, we concluded that the extent of visual loss is linked to the stage of papilledema. The key risk factors for developing papilledema in brain tumour patients include:

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Deep-seated midline brain tumours and high malignancy of the tumour. Intracerebral tumour location and relatively young patient age.
Keywords: papilledema, brain tumours, supra tentorial, infratentorial, visual field defects

INTRODUCTION

Papilledema, a sign of increased intracranial pressure, has been studied for 150 years. One of the primary causes of papilledema is a space-occupying lesion in the cranial cavity. This study aimed to identify the risk factors for developing papilledema in patients with brain tumours and to determine the frequency of visual loss in those with this condition.

MATERALS & METHODS

For a year, we assessed 100 patients who received care at our institute. With an average age of 43 years and a range of 4 months to 82 years, there were 46 males and 54 females among them. Of the patients, one had a third ventricle colloid cyst, one had cholesteatomas, 55 had benign brain tumours, and 45 had malignant tumours (refer to Tables 1 and 2). Two patients had tumours that extended into both regions, 37 patients had infra-tentorial tumours, and 61 patients had supra-tentorial tumours. The study did not include patients with tumours that affected the anterior optic circuits. The Mann-Whitney test was used to determine the P-values.

RESULTS

About 31 (31%) of our patients had papilledema. We identified four stages of papilledema figure 1: 2(6.8%) patients had secondary optic atrophy, 12 (37.5%) had severe papilledema, 9(31.1%) had moderate papilledema, and 8 (24.6%) had early papilledema. The tumour's histological pattern determined the frequency of papilloedema. Patients with malignant tumours had papilloedema more frequently (33.3%) than those with benign tumours (29%) (Table 2). The frequency of papilledema did not differ significantly between individuals with infra-tentorial tumours (31%), and those with supra-tentorial tumours (30.2%) ($p > 0.05$).

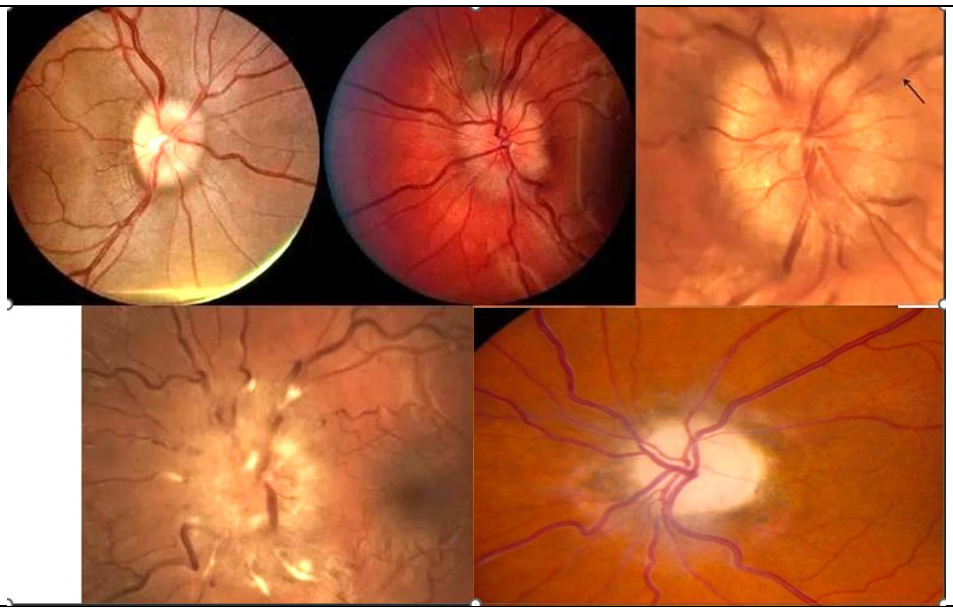

Figure 1: The various stages of papilledema- normal optic disc, early papilledema, moderate papilledema, severe papilledema and secondary optic atrophy

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The histological pattern of space-occupying lesions	Number of patients	Number of patients with papilloedema
Astrocytoma	21	7
Glioblastoma	16	5
Oligodendrogkioma	5	1
Ependymomna	5	1
Meduloblastoma	3	2
Meningioma	23	8
Neurinoma	11	3
Haemangioblastoma	1	1
Germinoma	1	-
Lymphoma	1	-
Metastasis	8	2
Cholesteatoma	1	-
Colloidal cyst	1	-
Neurocytoma	2	1
Pinnealoblastoma	1	-
Total	100	31

Table 1 Shows the prevalence of papilloedema in patients who have lesions that occupy cerebral space.

Histological pattern of the tumour	Number of patients	Number of patients with papilledema (%)
Benign (Grade I–II)	55	16 (29%)
Malignant (Grade III–IV)	45	15(33.3%)
Total	100	31 (31%)

Table 2: The histological grade of the brain tumour and the prevalence of papilledema

The difference between Grade I–II and Grade III–IV is statistically significant ($p < 0.05$).

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Location of the Brain tumour	Deep-seated midline tumours/Papilloedema/percentage	Others	Total
Supratentorial	9/ 5/ 56%	28/ 6/ 22%	37/ 11/ 29.72%
Subtentorial	15/ 8/ 49%	46/ 12/ 25.5%	61/ 20/ 31.14%
Sub supratentorial	2/-/-	-	2/-
Total	26/ 13/ 50%	74/ 18/ 24.3%	100/ 31/ 31%

Table 3. The frequency of papilloedema and location of the brain tumour

There is no significant difference in the frequency of papilloedema between patients with subtentorial tumours and those with supratentoria tumours ($p > 0.05$).

Those with deep-seated midline supratentorial tumours have a significantly different frequency of papilloedema than those with other supratentorial tumours ($p < 0.05$).

There is a significant difference ($p < 0.05$) in the frequency of papilloedema between patients with deep-seated midline subtentorial tumours and those with other subtentorial tumours.

Cerebral and extracerebral tumours	Total number of patients	Number of patients with papilledema (%)
Cerebral tumours	64	24 (37.5%)
Extracerebral tumours	36	7 (19.4%)
Total	100	31

Table 4. The frequency of papilloedema in patients with cerebral and extracerebral tumours

Patients with brain and extracerebral tumours have significantly different frequencies of papilloedema ($p < 0.05$).

However, papilledema was more frequently caused by deep-seated midline supra- (56%) and infra-tentorial (49%) brain tumours than by other supra- (22%) and infra-tentorial (25.5%) tumours ($p < 0.05$) (Table 3).

Patients with intra-cerebral tumours had papilloedema more frequently (37.5%) than patients with extra-cerebral tumours (20.8%) ($p < 0.05$) (Table 4). We solely examined ophthalmological symptoms in patients with intra-cerebral and extra-cerebral benign tumours (Grades I–II) with similar findings because of the high percentage of malignant tumours in the sample. Of patients with extra-cerebral benign tumours, papilloedema was seen in 19.4% of cases ($p < 0.05$) and in 37.5% of patients with intra-cerebral benign tumours (Table 4). This conclusion remained unchanged when patients with deep-seated midline cancers were

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excluded from this group: papilloedema was seen in 18% of patients with extra-cerebral tumours and 25.58% of patients with cerebral tumours ($p < 0.05$) (Table 6).

Cerebral and extracerebral tumours	Benign tumours (Grade I–II)	Malignant tumours (Grade III–IV)
Cerebral tumours: total/papilloedema (%)	22/ 8 (36.36%)	42/16 (38%)
Extracerebral tumours: total/papilloedema	34/ 7 (21%)	2/ 1 (50%)

Table 5: Shows the prevalence of papilledema in patients with extracerebral and cerebral tumours of varying malignancy grades.

Patients with cerebral tumours Grade I–II and those with extracerebral tumours Grade I–II have significantly different frequencies of papilloedema ($p < 0.05$).

Cerebral and extracerebral tumours	Deep-seated midline tumours	Other	Total
Cerebral tumours; total/papilloedema (%)	23/ 13 (56.5%)	43/ 11 (25.58%)	64
Extracerebral tumours; total/papilledema (%)	3/1	33/ 6 (18%)	36

Table 6: The frequency of papilloedema in patients with cerebral and extracerebral tumours

There is a substantial difference in the frequency of papilledema between patients with extracerebral and cerebral tumours that are not deeply seated ($p < 0.05$).

Although papilledema was seen in individuals of nearly all ages, it was far less common in those over 59 ($p < 0.05$) (Figure 2). Younger patients were more likely to have severe papilloedema, while patients over 50 were more likely to have early-stage papilloedema (Figure 3).

In 31 papilledema patients, visual acuity was examined. In 10 patients (32.2%), visual acuity was lost. A total of 30 papilloedema patients had their visual fields examined. Fifteen patients (50%) had a deficit in the nasal portion of the visual field, concentric constriction, or an enlarged blind spot. Such alterations of the visual field were common in cases of papilledema. There were homonymous visual field defects in 3 individuals. The remaining 12 patients had normal visual fields.

The frequency and degree of visual impairment depended on the stage of papilledema (Figure 4). Few visual abnormalities were noted in the eyes with early and moderate stages of papilledema. Blindness or practical blindness was noted in 62.7% of eyes with secondary optic atrophy and 4.4% of eyes with severe papilledema.

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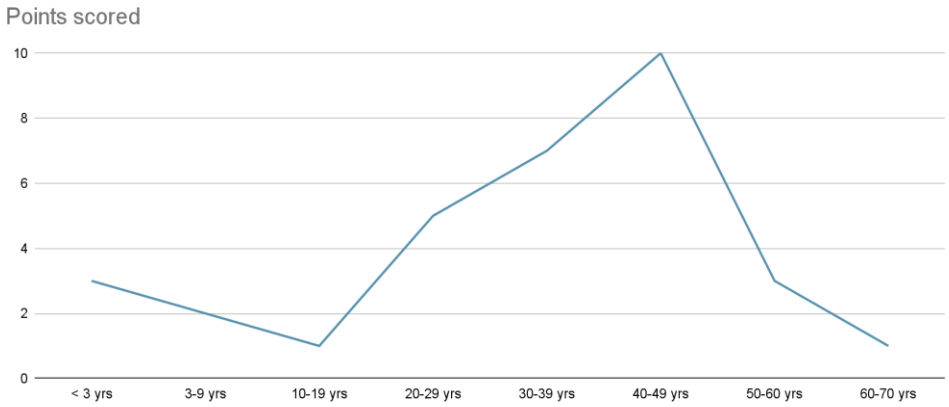

Figure 2: The frequency of papilledema about the patient's age from the present study

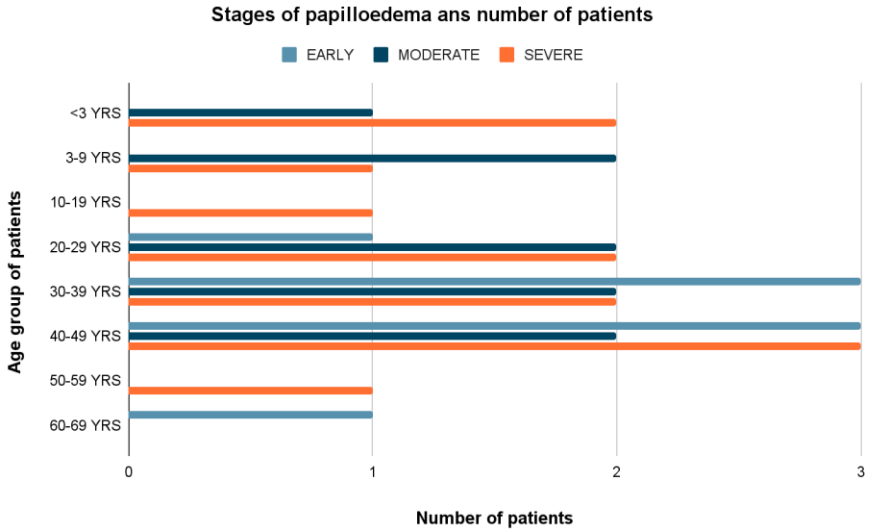

Figure 3: Shows the patients' age and papilledema stage

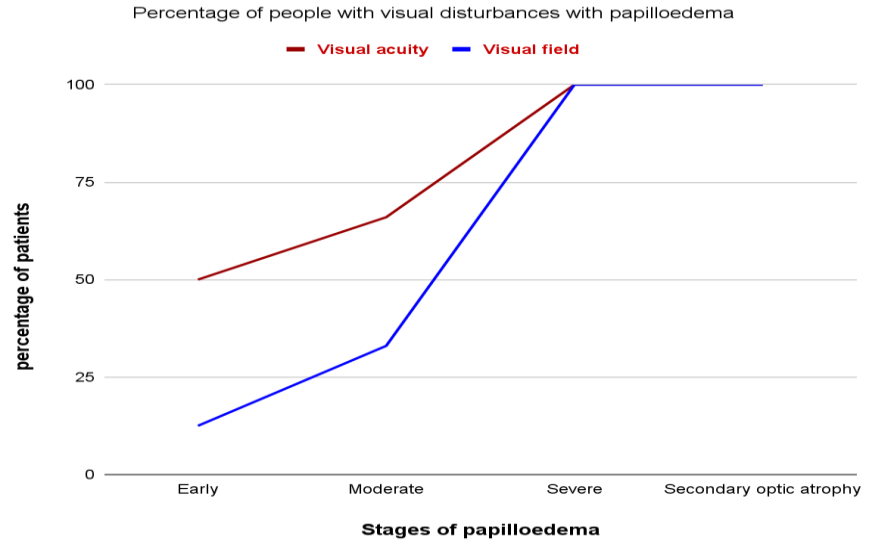

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Figure 4: Papilledema stage and visual problems

There is a significant difference ($p < 0.05$) in the incidence of visual abnormalities between patients with early and severe papilledema. There is a significant difference ($p < 0.05$) in the frequency of visual problems between patients with early papilledema and subsequent atrophy.

DISCUSSION

In a closed system like the cranial cavity, pressure and volume are correlated. The primary causes of intracranial hypertension in individuals with intracranial tumours include focal or widespread oedema, blockage of cerebrospinal fluid flow, and an increase in the total volume of intracranial tissue caused by a space-occupying lesion.

Compared to earlier publications, there is a tendency for the frequency of papilloedema to decline in the present. In 1935, Paton[1] discovered that 80% of patients with brain tumours had papilledema. In 1950, Petrohelos and Henderson[2] discovered that 60% of patients with intracranial tumours had papilledema. In 1976, Huber[3] examined the ocular fundi of 1166 patients who had brain tumours and discovered that 59% of them had papilledema. In 31% of the patients with brain tumours, we identified papilledema. We think that early disease diagnosis has been made possible by contemporary visualization techniques like computed tomography (CT) and magnetic resonance imaging (MR).

There has been debate on the relationship between the grade of tumour malignancy and the incidence of papilledema.

According to Walsh and Hoyt[4], there is no conclusive correlation between the neoplasm's cell type and the development of papilledema. Huber[3] discovered papilledema in 50% of patients with glioblastomas and 65% of patients with benign astrocytomas and meningiomas, supporting his theory that papilloedema was more prevalent in benign brain tumours. In our analysis, papilledema was more common in malignant tumours (34.3%) compared to benign tumours (29%) ($p < 0.05$). We propose that malignant tumours that are invasive and grow quickly, along with focal and diffuse cerebral oedema, are more likely than benign tumours to generate high intracranial pressure.

We examined the connection between the frequency of papilloedema and the location of the brain tumour.

Our findings contradict those of the investigators who believed that infra-tentorial tumours were more probable than supra-tentorial tumours to cause papilloedema.[2,4,5] The papilledema was discovered in 75.2% of patients with infra-tentorial tumours and 53.4% of those with supra-tentorial tumours, according to Petrohelos and Henderson[2]. The frequency of papilloedema did not significantly differ between patients with supra- and infra-tentorial tumours, however. Nonetheless, papilledema was more frequently generated by deep-seated midline brain supra- and infra-tentorial tumours than by other supra- and infra-tentorial tumours ($p < 0.05$). Additionally, Walsh and Hoyt[4] noted that papilledema frequently accompanied third ventricle tumours.

In our study, papilledema was most frequently observed in patients with deep-seated midline malignant brain tumours, such as germinoma and pineoblastoma. In addition to the cancerous component, these tumours can hinder the passage of cerebrospinal fluid and clog the Sylvius aqueduct, which can quickly result in intracranial pressure and hydrocephalus. Compared to patients with germinoma and pineoblastoma, the frequency of papilledema was slightly lower in patients with deep intraventricular localised midline benign brain tumours, such as choriopapilloma. These benign tumours simultaneously cause a blockage in the flow of cerebrospinal fluid and an increase in alcohol production.

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Patients with intra-cerebral tumours had papilloedema more frequently (37.5%) than those with extra-cerebral tumours (19.4%) ($p < 0.05$). We assume that the increased incidence of papilloedema in these patients is caused by the localised oedema that accompanies the brain tumour. Our findings concur with those of Hartmann and Guillaumat[6], who demonstrated that 40% of patients developed meningiomas and 76% of patients had papilledema as a result of gliomas.

We found that patients of nearly any age had papilloedema. Nonetheless, it was far less common in the elderly. An important pathogenic mechanism of intracranial hypertension is shown in our findings. In older people, brain atrophy and a decrease in the overall volume of intracranial tissue might lead to an increase in the reserve capacity of the cranio-vertebral contents[7,8]. In this sense, our research supports the findings of Walsh and Hoyt[4], who discovered that the incidence of papilledema was more after third decade, although the decline was most noticeable after the end of the fifth decade.

The visual function of our patients deteriorated, which is typical with papilledema. Similar visual impairment has been seen by several writers in patients with papilloedema of different causes.[9–13] Visual problems were substantially more common in our series of patients with severe papilledema or subsequent atrophy

CONCLUSION

According to our data, the degree of visual loss varies according to the stage of papilledema. The risk factors for the development of papilledema in brain tumours include

1. Deep-seated midline brain tumours
2. A high malignancy tumour.
3. Intracebral tumours.
4. The patient's comparatively youger age.

CONFLICT OF INTEREST

No conflicts of interest are disclosed by the writers. The paper's writing and content are entirely the authors' responsibility.

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