Influence of retrobulbar neuritis and papillitis on echographically measured optic nerve diameter

Uticaj retrobulbarnog neuritisa i papilitisa na prečnik optičkog nerva izmerenog ehografski

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Abstract

Background/Aim. Retrobulbar (optic) neuritis is inflammation of the optic nerve that may cause a complete or partial loss of vision. This inflammation can affect a part of the nerve within the eyeball (neuropapillitis) or a part of the nerve behind the eyeball (retrobulbar neuritis). The aim of this study was to establish whether there is a correlation between the diameter of a retrobulbar part of the optic nerve and either visual acuity, prominence of the optic disk (papillitis), or nature of the neuritis (papillitis or retrobulbar). Methods. We tested 23 patients with retrobulbar neuritis and papillitis. In addition to a complete ophthalmologic examination, the diameter of retrobulbar region of the optic nerve was measured by the B-scan method. Following this, the 30-degree test was carried out. Results. We found an increased thickness of the retrobulbar region in 22 patients and different responses to the 30-degree test, as well as a statistically significant negative correlation between the thickness of retrobulbar part of the optic nerve and visual acuity. Conclusion. The retrobulbar part of the optic nerve is thicker in 94% of the patients with retrobulbar neuritis and in all the patients with papillitis. There is a correlation between the reduction of visual acuity and thickening of a retrobulbar part.

Key words: optic neuritis; papilledema; visual acuity; ultrasonics; sensitivity and specificity.

Apstrakt


Key words: n. opticus, neuritis; papila, edem; vid, oštrina; ultrazvuk; testovi, osetljivost i specifičnost.

Introduction

Retrobulbar (optic) neuritis is inflammation of the optic nerve that may cause a complete or partial loss of vision. This inflammation can affect a part of the nerve within the eyeball (neuropapilitis) or a part of the nerve behind the eyeball (retrobulbar neuritis). The aetiology of optic nerve neuritis is very complex and not yet completely understood1. In papillitis, inflammation is often a causative factor. This is similar to the situation with retrobulbar neuritis where compression on the optic nerve is caused by oedema arising from an inflammatory process such as that seen in demyelization diseases2,3. Optic neuritis is the strongest predictor for developing clinically definite multiple sclerosis. Almost half of patients with optic neuritis have white matter lesions consistent with multiple sclerosis4.
The technique for measurement of diameter of the retrobulbar region of the optic nerve was described for the first time by Karl Ossoinig\textsuperscript{5,6}. He analyzed the refraction of ultrasound waves by standardized A-scan echography. In the same year, Schroeder et al.\textsuperscript{7} described a technique for measuring the diameter of retrobulbar part of the optic nerve using B-scan method. Recently, orbital echography is an extremely useful tool for determining the presence of papilledema, particularly when there is a question of pseudopapilledema from optic disc drusen or tilted optic nerves. Ultrasound measurement of the optic nerve diameter is a very valuable and straightforward method for retrobulbar neuritis diagnosis. The normal values for the arachnoidal diameter and the internal dural diameter are similar being 3.1 mm and 4.4 mm, respectively, since both values actually measure the optic nerve diameter with subarachnoidal space and arachnoida\textsuperscript{6–8}. Diameter differences larger than 0.3 mm between two eyes of the same patient are considered pathological\textsuperscript{9}.

The quantity of subarachnoidal fluid in the orbital part of the optic nerve depends on intracranial pressure, compression in the optical canal and pressure of soft tissues in the orbit\textsuperscript{10,11}. When the optic nerve is straightened through maximal abduction, subarachnoidal fluid is pushed from the orbit into the intracranial space, which is the basis of the 30-degree test developed by Ossoinig et al.\textsuperscript{13} and used by many others\textsuperscript{12,14}. This test can be used for estimating the thickening of retrobulbar part of the optic nerve by compressive syndrome, due to increased intracranial pressure.

The aim of the present study was to analyze the thickening of a retrobulbar part of the optic nerve in papillitis and retrobulbar neuritis.

**Methods**

We tested 23 patients with retrobulbar neuritis and papillitis. In addition to a complete ophthalmologic examination, the diameter of retrobulbar region of the optic nerve was measured by the B-scan method. Following this, the 30-degree test was carried out. The patient continuously swung his eyes left and right for 3 minutes, and after a 3-minute period the same procedure was repeated. The echographic examination was displayed on a Storz-Oftalscan using B-mode with 8 MHz tube. In order to establish the degrees of correlation, we used the Spearman nonparametric rank correlation test.

**Results**

Among patients tested there were 16 with retrobulbar neuritis and 7 with papillitis.

We observed thickening of the retrobulbar part of the optic nerve in 22 patients (95.7%), while in one patient (4.3%) with a diagnosis of retrobulbar neuritis the optic nerve was not thickened. In all the patients with papillitis the retrobulbar part of the optic nerve was thickened (Table 1). Fourteen patients (63.6%) out of 22 subjected to the 30-degree test were positive, while 8 (36.4%) had negative results. The 14 patients who showed the positive result had retrobulbar neuritis, while in all the patients with papillitis the test was negative (Table 1).

Visual acuity in all the examined patients was ranged from 0.02 to 1, a mean value ± standard error being 0.20 ± 0.05, and a median 0.08. Using the Spearman's test, we found that there was a statistically negative significant correlation between the thickness of the retrobulbar part of the optic nerve and visual acuity ($\rho = -0.687$, $p < 0.05$). This means that patients with lower visual acuity have a thicker optic nerve and vice versa.

Oedema of the optic disc in seven patients with papillitis are ranged from one to three dioptres – D > 0 (Table 2). There was no statistically significant correlation between the thickness of the retrobulbar region of the optic nerve and the degree of optical disc oedema (Spearman's test, $\rho = 0.02$, $p > 0.05$).

**Table 1**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Diameter (mm)</th>
<th>30-degree test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 4</td>
<td>&gt; 4</td>
</tr>
<tr>
<td>Retrobulbar neuritis</td>
<td>1/16 (6.3%)</td>
<td>15/16 (93.7%)</td>
</tr>
<tr>
<td>Papillitis</td>
<td>7/7 (100%)</td>
<td></td>
</tr>
</tbody>
</table>

Each value represents the number of patients and their percent (in brackets).

**Table 2**

<table>
<thead>
<tr>
<th>Dioptes</th>
<th>n</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>16</td>
<td>69.6</td>
<td>69.6</td>
</tr>
<tr>
<td>1.0</td>
<td>3</td>
<td>13.9</td>
<td>82.6</td>
</tr>
<tr>
<td>1.5</td>
<td>1</td>
<td>4.3</td>
<td>87.0</td>
</tr>
<tr>
<td>2.0</td>
<td>2</td>
<td>8.7</td>
<td>95.7</td>
</tr>
<tr>
<td>3.0</td>
<td>1</td>
<td>4.3</td>
<td>100</td>
</tr>
</tbody>
</table>

Total 23 100

**Discussion**

Inflammation of the optic nerve can be localized to its different levels, it can be detected by ophthalmoscope in the anterior region as papillitis, in a retrobulbar part of the optic nerve as retrobulbar neuritis, or in the top of the orbit in the optical canal\textsuperscript{15}. Most of the authors, no matter where the in-

flammarious process appeared, noticed a thickening of the retrobulbar part of the optic nerve. The increased diameter of the retrobulbar part in neuritis is due to compression of the optic nerve in the posterior part, while thickening in papillitis is due to oedema in the retrobulbar part of the optic nerve. In the present study we found thickening of the optic nerve in 94% eyes with retrobulbar neuritis. This finding is not in full agreement with the results of some other authors. Using B-scan (Schroeder method) Guthoff recorded thickening of the retrobulbar part of the optic nerve in 70% of patients with retrobulbar neuritis, and Dees et al. reported a significant thickening of the retrobulbar part of the nerve in 74% cases with optic neuritis. Our results, however, are in accordance with those of Byrne who noticed this thickening in 90% to 100% patients with papillitis. In our study we were also found thickening of the optic nerve in all the patients with papillitis being in accordance with findings of Guthoff.

There was no consensus on the diameter of the retrobulbar part of the optic nerve in the patients with optic neuritis and controls. Current literature shows that the diameter of the retrobulbar optic nerve varies considerably even in normal subjects. Gerling et al. found that in patients with optic neuritis and disc swelling the diameter of the optic nerve was 5.4 mm in the affected and 3 mm in unaffected eye, while in patients with optic neuritis without disc swelling the diameter was a little smaller, being 4.4 mm. Atta reported that the normal thickness of the optic nerve is 2.4–3.4 mm. Beal et al. stated that the mean optic nerve diameter for the control group was 2.86 mm. Karim et al. reported that in cadaveric specimens, magnetic resonance imaging and histological measurements of optic nerve dimensions were in close quantitative agreement, showing significant decrease in the average optic nerve diameter along its retrobulbar course. This finding was confirmed by magnetic resonance imaging in living subjects, with average optic nerve diameter declining from 3.99 ± 0.04 mm just posterior to the globe, to 3.50 ± 0.04 mm at 10 mm further to the posterior. Titli et al. using the A-scan method found that the diameter of the unaffected neuron was 3.6 mm and the mean value of the affected neuron was 4.2 mm with the standard deviation of 0.2 mm. These results confirm our finding that the diameter in most of affected eyes cannot be less than 4 mm. Indeed, in the present study we adopted 4 mm as a border between affected and unaffected eyes because all our patients (except one) with retrobulbar neuritis had this diameter larger than 4 mm. The same values have been noticed by Hickman et al.

To evaluate the utility of optic nerve echography in patients with elevated intracranial pressure, Girgis et al. measured the optic nerve diameter and found 6.4 mm being much larger than those registered in patients with optic neuritis. It follows that the value of this diameter depends on the type of disease, so that it could be used as a suitable diagnostic parameter. It should be added in connection with it that the evaluation of the optic nerve thickness is a simple noninvasive procedure, which is a potentially useful tool in the assessment and monitoring of patients with different diseases.

The 30-degree test is a noninvasive and painless office technique, providing documentation of a distended subarachnoid optic nerve sheath in true papilledema that spares useless investigations in patients with other conditions that simulate it. As regard the results of the 30-degree test, in the patients with retrobulbar neuritis with a positive result for the B-scan, there appeared to be a reduction in the thickness of the optic nerve after the 30-degree test. In the patients with papillitis (all negative results) Ossoing et al. argued that there was a compressive optic neuropathy at the posterior optic neuritis. In fact, pressure on the sheath caused by oedema, would also offer an acceptable explanation. On the other hand, in patients with papillitis (inflammation in the anterior region), in both tests we measured the part of the optic nerve that was inflammed, so that the negative finding in the 30-degree test was expectable.

We also wished to confirm findings obtained by Dees et al. that there is a correlation between the thickening of the retrobulbar part of the optic nerve and the degree of reduction in visual function. In our patients with neuritis, we found a statistically significant correlation between the reduction in visual acuity and the degree of thickening of the retrobulbar part of the optic nerve. This observation is expectable since it is well-known that oedema on any part of the optic nerve causes a reduction in eye function, and compresses sheaths in enlarged retrobulbar part of the optic nerve.

We were also interested to see whether there is a correlation between the prominence of the optic disc and the degree of thickening of the optic nerve in patients with papillitis. We found no significant correlation which can be explained by the possibility that the degree of oedema at the optic disc depends on the quantity and order of glial elements in the optic disc.

**Conclusion**

In our study the retrobulbar part of the optic nerve was thicker in most of the patients with retrobulbar neuritis and in all the patients with papillitis, as compared to the normal subjects. In other words, there are grounds for believing that the diameter larger than 4 mm should be considered pathological. No correlation between the amount of oedema in the optic disk and the degree of thickening of the optic nerve was noticed, but there was a strong negative correlation between visual acuity and thickening of the retrobulbar part of the optic nerve.

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REFERENCES


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