Original article

Intravitreal injection of triamcinolone acetonide in nonarteritic anterior ischemic optic neuropathy

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Abstract

Background: Systemic corticosteroid may play a vital role in treating nonarteritic ischemic optic neuropathy (NAION). An intravitreal route provides the advantage of avoiding systemic side effects. In this study, we investigated the treatment result of intravitreal injection of acetonide (IVITA).

Methods: We retrospectively reviewed six patients with NAION who were treated with a single IVITA. The patients were followed monthly for 6 months.

Results: Visual acuity improved in three patients. One patient also had a better visual field at the 6th month follow up. Two patients with more severe swelling of the optic disc initially did not gain better visual acuity. One patient with a pre-existing epiretinal membrane maintained stable visual acuity.

Conclusion: Some patients with NAION may improve with IVITA treatment. Further randomized controlled clinical trials are needed.

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1. Introduction

Nonarteritic anterior ischemic optic neuropathy (NAION) affects a large number of middle-aged patients with microvascular diseases worldwide. To date, there is no definitive treatment for NAION. Among the suggested treatments, systemic corticosteroid therapy effectively improves visual acuity in some patients by faster resolution of optic disc edema (ODE). A possible mechanism is via relieving the pressure on the disc capillaries to restore some circulation to the vessels of the optic nerve head. The systemic application of corticosteroids carries the risk of systemic side effects such as worsening control of diabetes mellitus and hypertension. Intravitreal injections of triamcinolone acetonide (IVITA) can minimize systemic complications; however, only a few case reports and case series have discussed the effects of IVITA treatment in NAION. We report our experience with IVITA in six patients with NAION.

2. Methods

We conducted a retrospective medical chart review of six patients with NAION treated by IVITA at the Buddhist Tzu Chi General Hospital (Hualien, Taiwan) and at the Kaohsiung Medical University Hospital (Kaohsiung, Taiwan) from January 2011 to January 2013 (Table 1).

All patients experienced sudden unilateral painless visual loss and presented with relative afferent pupillary defects and ODE. The diagnosis of NAION was based on the typical history and clinical presentation. Complete ophthalmic examinations were performed and included visual acuity (measured by the Landolt chart), fundus examination, automated visual field examination (Humphrey 30-2), and optical coherence tomography of macular thickness and nerve fiber layer thickness. Complete blood cell count, erythrocyte sedimentation rate, and C-reactive protein level were obtained to exclude the arteritic type of anterior ischemic optic neuropathy and to exclude optic neuritis. Ocular comorbidities were also assessed to rule out pre-existing glaucoma. Triamcinolone acetonide
Shincort; Yung Shin, Taiwan) was allowed to stand without disturbance for 1 day before use. The superior part of the clear suspension was removed immediately before it was injected. Quantification analysis by lyophilization in our laboratory identified 9.7 mg of triamcinolone acetonide in one 0.05 mL injection. In the operating room, after standard sterile preparation, IVITA (0.05 mL) was administered with a 27-gauge needle 3.5 mm from the limbus. Before and after the injection, the intraocular

Table 1
Demographic data of the six patients with NAION.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age (y)/sex DM/HTN/Dyslipidemia</th>
<th>Ocular condition in the diseased eye</th>
<th>C/D ratio in the fellow eye</th>
<th>Time from symptom onset to the first visit</th>
<th>Visual acuity at the first visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>57/M +/+/+</td>
<td>NS+</td>
<td>0.2</td>
<td>4 wk</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>75/M +/+/+</td>
<td>Macular pucker</td>
<td>0.2</td>
<td>2 wk</td>
<td>0.2</td>
</tr>
<tr>
<td>3</td>
<td>45/M +/+/+</td>
<td>None</td>
<td>&lt;0.1</td>
<td>4 wk</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>54/M +/+/+</td>
<td>None</td>
<td>&lt;0.1</td>
<td>1 wk</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>61/M +/+/+</td>
<td>None</td>
<td>0.1</td>
<td>1 wk</td>
<td>0.6</td>
</tr>
<tr>
<td>6</td>
<td>59/F +/+/+</td>
<td>NS+</td>
<td>0.2</td>
<td>3 d</td>
<td>0.1</td>
</tr>
</tbody>
</table>

C/D ratio = cup-to-disc ratio; DM = diabetes mellitus; HTN = systemic hypertension; NAION = nonarteritic ischemic optic neuropathy; NS+ = grade 1 nuclear sclerosis.

Table 2
Clinical course of the six patients with NAION after IVITA treatment.

<table>
<thead>
<tr>
<th>Case</th>
<th>Time from symptom onset to injection</th>
<th>VA at injection</th>
<th>Location of max ODE (max thickness [um])</th>
<th>VF pattern</th>
<th>Initial VF (MD, dB)</th>
<th>Post IVITA Time to ODE resolution</th>
<th>VA at the 6th mo (MD, dB)</th>
<th>VF at the 6th mo</th>
<th>OCT at the 6th mo Sup ave/Inf ave (um)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 wk</td>
<td>0.6</td>
<td>Inf/364</td>
<td>Inf altitudinal</td>
<td>18.81</td>
<td>4 wk</td>
<td>1.2</td>
<td>18.05</td>
<td>59/147</td>
</tr>
<tr>
<td>2</td>
<td>4 wk</td>
<td>0.1</td>
<td>Inf/398</td>
<td>Inf altitudinal</td>
<td>12.61</td>
<td>4 wk</td>
<td>0.2</td>
<td>12.76</td>
<td>63/131</td>
</tr>
<tr>
<td>3</td>
<td>5 wk</td>
<td>0.6</td>
<td>Inf/252</td>
<td>Inf altitudinal</td>
<td>13.54</td>
<td>4 wk</td>
<td>1.0</td>
<td>6.5</td>
<td>44/126</td>
</tr>
<tr>
<td>4</td>
<td>5 wk</td>
<td>0.04</td>
<td>Inf/437 [Sup max (300)*]</td>
<td>Constricted</td>
<td>31.42</td>
<td>8 wk</td>
<td>0.08</td>
<td>Loss</td>
<td>71/74</td>
</tr>
<tr>
<td>5</td>
<td>8 wk</td>
<td>ND</td>
<td>Inf/295</td>
<td>Inf altitudinal</td>
<td>24.37</td>
<td>8 wk</td>
<td>0.1</td>
<td>21.14</td>
<td>38/76</td>
</tr>
<tr>
<td>6</td>
<td>10 d</td>
<td>0.1</td>
<td>Sup/417 [Inf max (266)*]</td>
<td>Constricted</td>
<td>17.7</td>
<td>8 wk</td>
<td>0.01</td>
<td>20.91</td>
<td>54/65</td>
</tr>
</tbody>
</table>

ave = average; dB = decibel; Inf = inferior; IVITA = intravitreal injection of acetonide; max = maximal; MD = mean deviation; NAION = nonarteritic ischemic optic neuropathy; ODE = optic disc edema; Sup = superior; VA = visual acuity; VF = visual field.

* For comparison.

(Shincort; Yung Shin, Taiwan) was allowed to stand without disturbance for 1 day before use. The superior part of the clear suspension was removed immediately before it was injected. Quantification analysis by lyophilization in our laboratory identified 9.7 mg of triamcinolone acetonide in one 0.05 mL injection. In the operating room, after standard sterile preparation, IVITA (0.05 mL) was administered with a 27-gauge needle 3.5 mm from the limbus. Before and after the injection, the intraocular

Fig. 1. Serial change in Case 3. (A) The fundus initially shows upper pallor and lower hyperemic swelling. An upper filling defect and leakage from the lower swollen portion are visible with fluorescein angiography. The mean deviation of the visual field defect is --13.54 dB. (B) One month after IVITA, the ODE has resolved and the optic disc is pale. The mean deviation of the visual field defect is --7.88 dB. (C) At the 6th month, the mean deviation is --6.5 dB.
pressure was measured with noncontact tonometers. All patients were examined on the first day, and then monthly up to 6 months after the injection. A significant improvement in visual acuity was defined as more than three lines on the Landolt chart or from counting fingers to 0.02 or greater. An improvement in the visual field was defined as a decrease in pre-existing scotoma by at least 7 dB in the mean deviation. All patients provided informed consent. The Institutional Review Board of the Tzu Chi General Hospital (Hualien, Taiwan) approved the study.

3. Results

All study patients completed at least 6 months of follow up (Table 2). The time of receiving IVITA was on average 4.6 weeks after the onset of symptoms. Three patients (Cases 1, 3, and 5) had better visual acuity at the final examination. Case 3 also had an obvious improvement in the visual field. The mean deviation of −13.54 dB at baseline decreased to −6.5 dB at the 6th month of follow up (Figs. 1 and 2). No significant change in visual field was noted in the other patients. There were no improvements in Cases 2, 4, and 6. The latter two patients had more severe swelling of the optic disc associated with a constricted visual field at the time of the IVITA. The visual status remained static before and after the treatment in Case 2, who had a pre-existing epiretinal membrane. The time to the resolution of ODE after IVITA in Cases 1, 3, and 5 and in Cases 2, 4, and 6 were 5.3 weeks and 6.7 weeks, respectively, and the time to the resolution of ODE after the onset of symptoms was a mean of 11 weeks and 13.5 weeks, respectively (Table 3). Disc pallor remained in all patients after the disc edema had resolved. No patients presented with macular edema during the study. Case 4 was a steroid responder, and we used brimonidine tartrate (Alphagan-P; Allergan, Irvine, CA, USA) to control his intraocular pressure. No other complications were noted in this study.

4. Discussion

In this study, it took less time for the ODE to resolve in the patients who benefitted from the treatment. The time of ODE resolution was longer in Cases 4 and 6, who presented with more severe swelling of their discs and a constricted visual field at treatment (Table 3). These two patients also subsequently developed diffuse optic atrophy. Cases 1, 2, and 3 developed sectorial pallor optic discs at the site opposite the previous area of maximal swelling. The

![Fig. 2. Nerve fiber layer thickness in Case 3. (A) Just before intravitreal injection of acetonide, the nerve fiber layer displays some optic disc edema. (B) Four weeks after the injection, the optic disc edema is resolved, but the upper nerve fiber layer has become atrophic, which is evidence of ischemia and impingement damage.](image-url)
severity of visual field loss is a reflection of the amount of axonal loss due to ischemia: the more marked the ischemic damage, then the earlier and more marked is the destruction of the axons. This may be why Cases 4 and 6 did not respond well to the IVITA treatment.

The observed resolution time was longer in our study, compared to previous studies. Some case reports and case series studying IVITA in acute NAION reported that the resolution of ODE occurred 2–3 weeks after the injection. A large study reported that the overall median time to spontaneous resolution of ODE occurred within 2 weeks. However, some of them still obtained benefits. The role of steroids may reduce capillary permeability and inflammation, thereby lessening axoplasmic flow stasis and destruction from impingement. It has been shown that corticosteroids can also induce tightening of endothelial barriers, thereby contributing to a direct effect on enhancing vascular junctions at the molecular level. Even if the treatment is not applied at the acute stage and is not administered systemically, it may still work in some NAION patients with disc edema.

Some patients in the current study had improvements in visual acuity, which is consistent with previous studies. However, the visual field in five of our patients remained the same at the 6th month follow up, and only Case 3 showed an improvement. The resolution of disc edema occurred concurrently with better visual acuity and visual field in this patient. This surprising finding may be explained by this patient having fewer vascular risk factors, a younger age, and less swelling of the nerve fiber layer on initial examination. Therefore, when the impingement pressure is released, there may be a chance for restoration of visual field function (Fig. 1). However, Hayreh and Zimmerman have shown that visual acuity spontaneously improved in 41% of patients with NAION and it declined in 9–18% of patients. In addition, 24.5% of patients showed a spontaneous improvement in their visual fields. It is possible that the changes observed in this study were the result of the natural history of the disease rather than as an effect from the medication. To provide more convincing evidence, further large-scale randomized clinical trials with a control group are required to evaluate the effect of IVITA.

References