Selection of Cases for Optic Nerve Sheath Decompression Success in Pseudotumer Cerebri

Essam Elmalbouly Saber

**Purpose:** To evaluate the factors that can affect the success of optic nerve sheath decompression operation, to save the visual functions in both eyes. Also the role of MRI in cases of papilloedema due to pseudotumer cerebri. Also timing of surgery and its role to save vision.

**Methods:** Fifteen patients having pseudotumer cerebri failed to respond to medical treatment with deterioration of their visual functions, were selected to do optic nerve sheath decompression operation, either to one eye or the other eye needed reoperation. MRI was done to all cases at time of reference.

Duration of papilloedema prior to surgical interference was recorded. Optic nerve sheath appearance during surgical exposure was recorded, the rate of flow of CSF on opening the sheath was noted, and also subarachnoid trabeculations were opened. Follow up ranged from fourteen months to four years.

**Results:** MRI of early treated cases of pseudotumer cerebri show marked distension and ballooning of optic nerve sheath, as the duration of papilloedema increases the distention decreases. During surgical exposure this distention was apparent in the early treated cases also there was marked gush of CSF on opening the sheath. Subarachnoid trabeculations were opened to facilitate flow of CSF. Early treated cases resumed visual functions and resolved papilloedema after surgery for one eye. As the duration of papilloedema increases, there is a need to do surgery for both eyes. If chronic atrophic changes occurred the results of surgery become poor.

**Conclusion:** If medical treatment failed to resolve papilloedema or visual functions are deteriorating, surgical decision must be taken to save vision in cases of papilloedema due to pseudotumer cerebri. MRI has to be done to all cases of pseudotumer cerebri.

**Key words:** MRI Magnetic resonance image - CT Computerised tomography.

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Numerous other authors reported cases of bilateral optic nerve sheath decompression because unilateral decompressions do not result in resolution of papilloedema in the other eye that is not operated upon.\textsuperscript{11,12,13,14}

Keltner et al\textsuperscript{15} tried to explain this observation.

He stated that the subarachnoid space is a three-compartment system consisting of the subarachnoid space around the brain and the subarachnoid space around each optic nerve.

The degree of communication between the orbital and the intracranial subarachnoid spaces is highly variable, as shown in autopsy specimens of 20 rhesus monkeys and 80 humans by\textsuperscript{16}. He found dense fibrous adhesions in the region of the optic canal, extensive in some while sparse in others, but a communication is found to exist in all.

Thus the subarachnoid space in both optic nerve sheaths is protected to some extent by a variable pressure gradient in the region of each optic nerve. The degree of decompression appears to depend on the resistance produced by the trabeculations in the subarachnoid space of the optic nerve sheath both in the optic canal and in the orbit.

Byrne, Glaser\textsuperscript{17} reported that each patient having pseudotumor cerebri, demonstrated retrobulbar optic nerve sheath distention with intradural fluid by orbital echography (a positive 30° test). But Brounman et al\textsuperscript{1988} did CT scans to all his patients preoperatively and postoperatively from one day to four months with intrathecal injection of iopamidol contrast dye followed by orbital CT. He did not get valuable data from the CT scan.

He reported that improvement was most evident in patients with acute papilloedema. Corbett et al\textsuperscript{19} stated that patients with chronic atrophic papilloedema did not have dramatic restoration of visual functions or disc changes. This suggests that surgical intervention should be earlier as soon as possible before visual functions is affected irreversibly.

**Aim of the work**

In this work we studied the role of MRI in cases of papilloedema due to pseudotumor cerebri, and also factors that can affect the success of optic nerve sheath decompression operation, to save the visual functions in both eyes.

Also if surgery for one eye is enough, or there is a need to do surgery for both eyes. Also timing of surgery, and its role to save vision have been studied.

**Subjects and Methods**

This study was performed in Banha university hospitals, eight cases were referred from neurological department of Banha university hospitals, and seven cases were referred to assess cause of the chronic headache, vomiting, and blurring of vision.

Full history of illness together with any medical complaint, therapy taken before the onset, or during the present illness.

Full ophthalmological examination was done on all the cases. Special consideration was performed to assess optic nerve head elevation, sheathing vessels, gliosis; best corrected visual acuity, ocular motility.

Goldman perimetry was performed to all patients every month regardless of performing optic nerve sheath decompression or not.

CT scan was done to all the cases for diagnosis of pseudotumor cerebri, and exclusion of other causes of increased intracranial pressure. Lumbopuncture was done to three patients in a neurological section before reference, and one case did lumboperitoneal shunt.

MRI imaging was done to all the cases at time of reference, to assess the condition of the optic nerve sheath.

Surgical decision was taken after giving chance for medical therapy in the form of steriods, diuretics, and carbonic anhydrase inhibitors with assessment of visual functions.

ONSD was performed to all the cases under general anethesia, through the medial approach.

Generous conjunctival periotomy of about 2 cm was done through 3.0 mm. Apart from the medial limbus, medial rectus hooked, and two sutures 3 mm. from its insertion were taken and cut from insertion.

Traction sutures applied and a malleable retractor was engaged within the wound to expose the optic nerve sheath, which appears or rotation the globe.

A tympanic membrane needle knife was used to incise the optic nerve sheath, two parallel incisions 3.0 mm. apart, and extend 3.0 mm.

A Sinsky hook passed beneath the traction sutures, release any trabecular septa in the subarachnoid space. Two horizontal incisions were performed to complete the window opening, care not to injure the central retinal artery at entrance 9-12 mm. behind the globe.
The condition of the optic nerve sheath was recorded, whether glistening, ballooned, or not glistening. The rate of gush or flow of cerebrospinal fluid was noted during doing the longitudinal incisions whether severe, marked, or slow flow. In all the cases ONSD was done first to the more affected eye. The patients were followed-up in the second postoperative day, one week, and then every month during the follow up period.

Reoperation for the other eye was done after two months of surgery for the first eye if succeeded to improve its visual functions and the other eye does not improve.

Follow-up period ranged from 14 months to 4 years in all operated cases or who continued the medical therapy.

Results

15 cases having pseudotumer cerebri with papilloedema not responding to medical treatment did optic nerve sheath decompression.

They were 13 females and 2 males ranging in age from 20 to 45 years old. All the patients took medical treatment in the form of systemic cortico steroids, carbonic anhydrase inhibitors, and diuretics.

Three cases did lumbar puncture in the neurological department before reference, with no improvement of their papilloedema.

One case was referred after doing lumbar peritoneal shunt surgery, with no improvement of visual functions.

As regards the duration of papilloedema from table (no. 1) 8 cases had bilateral papilloedema from one to two months. Four cases had papilloedema not responding to medical treatment from two to four months, and three cases had papilloedema for more than four months. These three cases had chronic atrophic papillaroptic nerve changes.

CT scan was done to all the cases at time of reference. CT scans showed no space occupying lesions in the brain, but the orbital views did not give any data about the papilloedema (photo no. 1).

MRI was done to all the cases, at the time of reoperation (table no. 1) marked distention and ballooning of the optic nerve sheath as shown from MRI photo no. (2,3).

Table (2): Overall patient data doing optic nerve sheath decompression.

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age</th>
<th>Medical conditions</th>
<th>Previous therapy</th>
<th>CT/MRI scan</th>
<th>Eye operated</th>
<th>Follow-up duration</th>
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<tr>
<td>997F</td>
<td>45</td>
<td>None</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>14 months</td>
</tr>
<tr>
<td>205F</td>
<td>35</td>
<td>Hypertension</td>
<td>Diuretics</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>16 months</td>
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<tr>
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<td>Hypertension</td>
<td>Diuretics</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>24 months</td>
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<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>20 months</td>
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<td>505F</td>
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<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>14 months</td>
</tr>
<tr>
<td>605F</td>
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<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>21 months</td>
</tr>
<tr>
<td>705F</td>
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<td>None</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>22 months</td>
</tr>
<tr>
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<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Right eye</td>
<td>19 months</td>
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<td>905F</td>
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<td>Obesity</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Left eye</td>
<td>14 months</td>
</tr>
<tr>
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<td>None</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Left eye</td>
<td>4 months</td>
</tr>
<tr>
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<td>None</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
<td>Left eye</td>
<td>4 months</td>
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<tr>
<td>1200F</td>
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<td>None</td>
<td>Corticosteroid</td>
<td>CT vs MRI</td>
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<td>4 months</td>
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<td>CT vs MRI</td>
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<td>14 months</td>
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<tr>
<td>1400F</td>
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<td>CT vs MRI</td>
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<td>Diuretics</td>
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</table>
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Photo no.1- Computerised tomography scan of a patient demonstrating no data for optic nerve sheath distension.

Photo no.2- Magnetic resonance image of a patient having pseudotumor cerebri with papilloedema that was early in onset demonstrating marked distension and ballooning of the optic nerve sheath behind the globe.

Photo no.3- Magnetic resonance image of another patient having papilloedema due to pseudotumor cerebri of early onset. It demonstrate marked fullness and distension of the optic nerve sheath.

Photo no.4- Magnetic resonance image of a patient having papilloedema due to pseudotumor cerebri. The duration of papilloedema was three months. It demonstrates distension of the sheath of the optic nerve behind the globe, but not to the extent of the early cases.

Photo no.5- Magnetic resonance image of a patient having pseudotumor cerebri papilloedema for a long duration more than four months. It demonstrates marked obstruction of the subarachnoid space around the optic nerve.

MRI of cases that had papilloedema from four months (table no. 1) but not developed any changes showed fullness and distention of optic nerve sheaths, but less than the early cases as shown from photo no. (4).

MRI of cases developed chronic papilloedema of duration more than four months (table no. 1), does not show fullness or distention of their optic nerve sheaths as shown from photo no. (5).

From tables (no. 1, 2) eight cases did optic nerve sheath decompression for one eye only and bilateral resolution of papilloedema, improvement of their visual functions. These had papilloedema for less than two months.
Also four cases did optic nerve sheath decompression for one eye, and did reoperation for the other eye after two months of the first surgery. These cases had long standing papilloedema for more than two months with drop of their visual functions, but no atrophic changes developed in their optic nerve head.

Three cases did optic nerve sheath decompression for one eye, and did not get improvement of their visual functions in the operated eye so we did not do surgery for the other eye. These cases had long-standing papilloedema for more than four months with chronic atrophic changes in their optic nerve head.

As regards the appearance of the optic nerve sheath on surgical exposure, the eight early treated cases showed marked ballooning and glistening of their optic nerve sheaths, and on opening of the sheath there was marked gush of CSF.

Cases that had papilloedema from two to four months (four cases) showed fullness and glistening of their optic nerve sheaths, and on opening of the sheath there was flow of CSF but the rate of flow was not as that of the early treated cases.

The three failed cases showed no glistening, and no fullness of their optic nerve sheaths on exposure, and on opening of the sheath there was trivial flow of CSF.

During surgery in all the cases the trabeculations in the optic nerve sheath has been opened as much as we can, and this facilitates the flow of CSF.

As regards visual functions, we found that the early treated cases improved their visual functions earlier and better than cases that had papilloedema for a long duration as shown from table no. 2.

From table no. 2 the age of patients ranged from 20 years old to 45 years old. Four patients were hypertensive, two were obese, and nine were medically free.

All patients took medical treatment in the form of corticosteroids, carbonic anhydrase inhibitors, and/or diuretics.

CT scan of all patients gave no valuable data about the optic nerve sheath. MRI of early treated cases showed marked distension and ballooning, while cases of long duration showed no marked distension of their sheaths. Eight cases did surgery on one eye and improved papilloedema on both eyes. Four cases needed to do surgery on both eyes one after the other. Three cases failed to improve in their visual functions, these cases had chronic atrophic changes in their optic nerves.

Follow up period in all cases ranged from 14 months up to four years.

Discussion

The subarachnoid space within the optic canal is not dispensable and depending on the density of arachnoid trabeculae fluid may have easy communication or almost no communication with the intracranial subarachnoid space.

Thus the subarachnoid space in both optic nerve sheathes is protected to some extent by variable pressure gradient. Keltner (15) described this as a trabecular meshwork; also this explains why patients can have asymmetric papilloedema.

Sergott et al (5) reported that this trabecular meshwork is formed of collagenous elastic fibers, and in pseudotumor cerebri this trabeculation is transformed to fibrous tissue, that contributes to the resistance, flow, and filtration mechanisms involved in that three compartment system.

This trabecular meshwork, formed of collagenous elastic fibers allow the subarachnoid space around the optic nerve to distend as the pressure of CSF increases in cases of pseudotumor cerebri. This distension of the optic nerve sheath could not be seen in CT scan of patients of pseudotumor cerebri, but Byrne, Glaser (17) demonstrated retrobulbar optic nerve sheath distension by intradural fluid by orbital echography (positive 30° test).

This appearance of distension of the optic nerve sheath was evident in MRI of our cases of pseudotumor cerebri. More over, as shown from our results the MRI of the optic nerve sheath appeared markedly distended in the early cases. As the duration of papilloedema increases with no response to medical treatment, and no surgical intervention the appearance of distension of the optic nerve sheath in MRI decreases as shown from our results.

Also in late atrophic papilloedema cases, the sheath did not appear distended at all.

This appearance of MRI could be explained, as in the early cases the subarachnoid space around the optic nerve is distended by CSF, this space having trabecular meshwork formed of collagenous elastic fibers, allowing easily distension of the sheath of the optic nerve as stated by Sergott (5). But as the duration increases with pressure increase on the optic nerve in its sheath, this trabecular meshwork is transferred into dense fibrous tissue adhesions in the
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region of the optic canal extensive in some and sparse in others as found by Hayreh (16). These fibrous adhesions contribute to the decreased distension of the sheath that appears in the MRI of the longstanding cases of pseudotumer cerebri.

Also if chronic atrophic changes allowed to occur, this fibrous tissue adhesions become extensive to the extent that it makes the subarachnoid space does not appear in the MRI as shown from our results in the late cases. This shows that MRI is important to assess the condition of the optic nerve sheath in pseudotumer cerebri before surgical intervention.

During surgery we found from our results that, in the early treated cases the optic nerve sheath appeared markedly glistening and distended, and on opening of the sheath a marked gush of CSF occurred, also opening the trabeculations in the subarachnoid space facilitate the flow of the CSF. But in the long-standing cases the sheath lost some of its glistening appearance, and on opening the sheath the flow of CSF was less than in the early cases, also on opening the trabeculations the CSF flow was less than in the early operated cases. So these trabeculations must be opened to allow maximum CSF flow as these trabeculations are responsible for the flow, resistance, and filtration mechanisms involved around the optic nerve. This explains why in our cases the early surgically treated cases resumed their visual functions while late cases did not benefit from surgery.

Also as many authors 8,9,10,19 reported that papilloedema resolved in both sided after decompression of one side, while others 11,12,13,14 reported that each eye needed decompression.

This was the case in our results as early surgical intervention can help resolving of papilloedema on the operated eye together with nonoperated eye, while in long-standing cases each eye needed optic nerve sheath decompression.

From our results, this is dependant on the duration of papilloedema, as in early cases opening the collagenous trabeculations allow pressure gradient changes to occur between both sides and the intracranial subarachnoid space. As we found that the sheath of the optic nerve in the early treated cases was full, ballooned and glistening, meaning that the trabeculations are elastic enough to allow this ballooning, and on opening the sheath to make the fenestration, a gush of CSF came as the trabeculations are still elastic, but in advanced cases these trabeculations are converted to fibrous tissue, that is variable in density affecting the resistance, flow, and filtration mechanisms involved in this three compartment system. So papilloedema on the other side will not be resolved.

If chronic atrophic papilloedema occurred these trabeculations become fibrous tissue preventing the flow of CSF, so the result of surgery will be less on the operated eye and of course on the unoperated eye.

This explains the glistening, and distended sheath appearance on surgical exposure, and the marked gush of CSF on opening the sheath in the early treated cases.

While on long-standing cases as shown from our results the glistening, and fullness appearance of the sheath is lost together with the decreased flow of CSF on opening the sheath.

So we agree with other authors that early intervention is important as papilloedema resolves, so it saves visual functions but in late cases of chronic atrophic papilloedema the chances of restoration of visual functions are less.

Summary

Cases that did not respond to medical treatment, or showed deterioration of their visual functions must be prepared for surgical interference to do optic nerve sheath decompression.

MRI has to be done in cases of pseudotumer cerebri at the time of reference to assess the appearance of the optic nerve sheath whether ballooned, markedly distended and full, not markedly distended, or not distended and their sheath is adherent to the optic nerve. Early cases of papilloedema show marked ballooning and distension of the optic nerve sheath, and as the duration of papilloedema increases this distension decreases as fibrous tissue starts to replace the elastic trabeculations of the subarachnoid space around the optic nerve.

During surgery the early cases of papilloedema showed markedly glistening distended sheath, and marked gush of CSF on opening of the sheath, and these cases get improvement of their visual functions in both eyes and resolved papilloedema in both eyes.

As the duration of papilloedema increases the distension and glistening of the sheath decreases together with the flow of CSF, and these cases get improvement in the operated eye only and need another surgery for the other eye.

If chronic atrophic changes allowed to occur in long standing cases, the distension of the sheath is lost, and the flow of CSF is trivial and of course the result of surgery is poor.
During surgery it is very important to open the trabeculations around the optic nerve to facilitate the flow of CSF and to decrease the pressure around the optic nerve.

Conclusion

MRI must be done to all cases of pseudotumor cerebri.

Early surgical interference saves visual functions in both eyes, and reoperation for the other eye must be done if no improvement occurs in it after operation of the first eye.

During surgery the appearance of the sheath together with the flow of CSF denote surgical success, also opening the trabeculations of the subarachnoid space is very important to facilitate the flow of CSF.

If chronic atrophic changes are allowed to occur the chances of surgical success is less.

References


