

## TRAUMA

# Traumatic Optic Neuropathy: Previous Therapies Now Questioned or Shelved

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**T**reatment of posterior traumatic optic neuropathy (TON) has long been a subject of debate. The standard of care was once high-dose corticosteroids or decompression surgery, but studies in recent years have failed to find benefits from these treatments—and have documented some serious complications. Thus, the treatment of TON is now handled on an individual basis, in careful consultation with the patient and family members.

## Mechanisms of Injury

There are two broad mechanisms for TON. One is obvious—direct injury to the optic nerve by projectiles from accidents or firearms. But the more common cause is blunt trauma to the head, such as that associated with rapid deceleration events—traffic or recreation collisions—or even less dramatic blows from tripping or hitting the head against a solid object. Blunt traumas, with their resulting contusions of the optic nerve or canal, and sometimes concussion of the brain, are most common in young men in their 20s or 30s.

Both blunt and penetrating mechanisms for TON weigh on troops returning with combat injuries from Afghanistan and Iraq.

Between 1.5 and 5 percent of individuals with closed-head injuries will sustain insults to the visual pathway, according to Kimberly P. Cockerham, MD, adjunct clinical associate professor of ophthalmology at Stanford University in Palo Alto, Calif. Dr. Cocker-

ham said that the severity of the visual loss does not always correlate with the seriousness of the head injury.

Some scientists think the pathophysiology of TON, which can result in partial or complete visual loss, is due to ischemic injury to retinal ganglion cell axons within the optic canal. The nerve can also become swollen after acute injury, compromising the vascular blood supply through a reactive vasospasm or a rise in intracanalicular pressure.<sup>1</sup> Although swelling or contusions to the nerve may subside, the damage to axons may be permanent.

## Diagnosis a Challenge

Diagnosing TON is not a snap. “Many of these patients are comatose when you see them in an emergency room setting. There may be a hematoma in the brain, and the patient may be unable to cooperate with vision testing,” Dr. Cockerham said. “The pupils may not be reactive due to heavy sedation and multiple medications.

The problem is that you have to try to find signs of optic nerve damage without the typical clues of visual acuity, color vision, pupillary function and visual field.”

Yet if the pupils work, an afferent pupillary defect is one suggestion that a patient has TON, said Kenneth S. Shindler, MD, PhD, assistant professor of ophthalmology at the University of Pennsylvania in Philadelphia. “An optic nerve injury is not the only condition that can cause this defect, but it’s far and away the most common.”

## Closed-Head Injury



Traumatic optic neuropathy and choroidal rupture in a veteran injured in Iraq by a blast.

Afferent pupillary defects with a head injury and decreased vision are suggestive of TON, Dr. Shindler said, and imaging studies such as CT and MRI scans can be used to rule out other conditions such as a brain tumor.

## Treatments Equivocal

Starting in the 1970s, steroid therapy and surgery were used to treat TON after a series of case studies seemed to show benefit from these interventions, Dr. Shindler said. Treatment with high-dose steroids was based on the rationale that these drugs can reduce any swelling around the nerve, which may allow recovery of vision. This treatment gained support in 1990 with the publication of the Second National Acute Spinal Cord Injury study, which showed that treatment with high dose methylprednisolone improved neu-

rologic recovery in spinal cord injury when given in the first eight hours after surgery.<sup>2</sup> “People hypothesized that because the optic nerve is part of the central nervous system and, like spinal cord nerves, is housed in a very tight space, the effects would be similar. However, no randomized controlled scientific studies have proven this belief,” Dr. Shindler said.

A number of studies have suggested that the use of corticosteroids or decompression surgery to treat TON may not only be unhelpful but may actually be ill-advised.

• **Corticosteroids vs. nothing:** In a study called MRC CRASH, more than 10,000 adults with head injury and a Glasgow Coma Scale score of 14 or less were allocated to receive a 48-hour infusion of corticosteroids (methylprednisolone) or placebo within eight hours of injury.

At six months, data were obtained for almost 97 percent of the patients and indicated that the risk of death and severe disability was significantly higher in the corticosteroid group. And the effect of the corticosteroids did not differ by injury severity or time since injury.<sup>3</sup>

That study did have limitations, Dr. Cockerham said. All the patients were analyzed as a single group, although the TON that affected them did so via different mechanisms. “With TON, no two patients are really alike,” she said. Nevertheless, there is no definitive evidence that treating TON with high doses of corticosteroids will change visual function, she noted.

• **Corticosteroids vs. decompression vs. nothing:** In the International Optic Nerve Trauma Study, 133 patients with TON were randomized either to corticosteroids or optic canal decompression surgery, or to observation without treatment. The results showed that visual acuity increased by three or more lines in only 32 percent of the surgery group, 52 percent of the steroid group and 57 percent of the untreated group.<sup>4</sup> “No clear benefit was found for either corticosteroid therapy or optic canal decompression surgery . . . These results and the existing literature pro-

vide sufficient evidence to conclude that neither corticosteroids nor optic canal surgery should be the standard of care for patients with traumatic optic neuropathy. It is therefore clinically reasonable to decide to treat or not treat on an individual patient basis,” the authors conclude.

• **Varied approaches vs. nothing:** In a Cochrane Database review study published in 2005, researchers examine the effects and safety of surgical intervention for management of TON.<sup>5</sup> The scientists searched several databases for randomized controlled trials of TON in which any form of surgical intervention either on its own or in combination with steroids was compared to steroids alone or no treatment. However, none of the studies the authors found met their criteria for scientific validity. Moreover, because of the wide range of decompression surgeries used for TON, it’s difficult to compare studies of this treatment, the authors conclude. There was no clear evidence of benefit from surgery, they write.

“The problem with decompression surgery is that you are doing surgery right near the nerve, which can induce more injury, as well as complications,” Dr. Shindler said. Several types of decompression surgeries can be used for TON, including those that open up the bone or relieve pressure by opening up the meningeal covering of the nerve. “We don’t do surgery for traumatic optic neuropathy unless there’s a shard of bone pushing down on the nerve that we can go after and remove. And that’s a very rare situation,” Dr. Shindler said.

“When I counsel patients about traumatic optic neuropathy, I tell them that we don’t have good data about treatment,” Dr. Cockerham said. “There is no evidence that using steroids or even decompressing the canal will have any benefit—unless there’s a canal fracture or obvious hematoma.”

#### Until the Future Arrives, Do No Harm

Right now, the scientific consensus is that the best treatment for TON may be no treatment. “The best option is observation,” Dr. Shindler said. Pa-

tients can spontaneously recover from TON, and rates of spontaneous improvement have ranged from 20 to 57 percent in published studies.<sup>6</sup>

“There is no definitive answer,” Dr. Cockerham added. “You have to take into account each patient’s case and the risks and benefits of treatment to that patient,” she said.

If there is brain edema, for instance, the patient may need to be on steroids to treat it, TON or not. And the presence of a hematoma, facial fractures or coexistent ocular injuries may warrant surgery.

#### What’s on the horizon for TON?

Scientists are investigating ways to regenerate nerve cells that have died or been injured from TON, Dr. Shindler said. But it may be years before this research reaches clinical trials.

Dr. Cockerham said that future therapies might include small implants or even nanotechnologic devices that deliver neuroprotective substances directly to the photoreceptors and ganglion cells to prevent apoptosis. “An ideal device would be placed subconjunctivally and adhere to the sclera in a very noninvasive way.”

New treatments would be welcomed by patients who now have virtually none.

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*Dr. Cockerham is a consultant for Allergan and the Foundation Fighting Blindness, a shareholder in Activatek, a principal investigator for a Department of Defense study and coinvestigator for a Veterans Administration study. Dr. Shindler reports no related interests.*