Effective management of traumatic optic neuropathy (TON) is still controversial and a matter of debate. Hence an analysis of the current options and their supportive studies is elaborated.

Background

Optic nerve injury is seen in 0.5 to 2% of head injuries. Optic nerve injury is of two types – direct and indirect. Direct trauma will result in optic nerve transection secondary to a penetrating injury or to compression from orbital or optic canal fracture. The mechanism for indirect traumatic optic neuropathy is transmission of shearing forces to the optic nerve, concentrated at the optic canal without disruption of structures around the optic nerve. First there is compression of the superior orbital rim, which is transferred to the orbital roof and then to the optic canal where the optic nerve is fixed and is more vulnerable to damage (Figure 1). There occurs a shearing injury to the axons and microvasculature leading to TON.

Treatment Options for Indirect Traumatic Optic Neuropathy

Corticosteroids

Anderson popularised corticosteroids for TON in 1982 based on reports that high doses of intravenous corticosteroids [intravenous methylprednisolone (IVMP) 15-30 mg/kg] improves microcirculation, energy metabolism, post-injury histology and functional outcomes in animal models of spinal cord injury. Finally there was something in the hands of ophthalmologists who could offer at least something to their patients. However, there are no prospective, randomized trials to attest to its benefit. There were numerous small case series/studies which recommended high dose steroids and their efficacy in improving visual outcome. More than 75% of the patients in all these series have been treated with corticosteroids showing a trend towards this modality of treatment.

National Acute Spinal Cord Injury Study (NASCIS II) 1990

The National Acute Spinal Cord Injury Study (NASCIS II) was a step forward in this direction since it was intended to be a controlled study to assess the value of high-dose corticosteroids and optic canal decompression in patients with acute spinal cord injury. This study was a randomized, double-blind, placebo-controlled study where patients were randomly assigned to 1 of 3 treatment arms within 12 hours of injury: high-dose methylprednisolone, naloxone, or placebo. The term high dose corticosteroids referred to IVMP 15-30 mg/kg.
to the treatment protocol of a loading dose of 30mg/kg followed by a continuous intravenous infusion of 5.4mg/kg per hour for 24 or 48 hours.

The study propelled widespread use of corticosteroids in TON. NASCIS II found that patients who received steroids within 8 hrs of their injury had significantly better improvement in neurological functions compared with those in placebo group, but this 8 hrs data was chosen as a result of posthoc data analysis. Without this the results were poorer with steroids. NASCIS III found that patients who received extended maintenance dose from 24 to 48 hrs had additional benefit but again here the treatment was started within 3 to 8 hrs of injury.

**International Optic Nerve Trauma Study (IONTS)**

This was a non randomized interventional study which compared the visual outcome of TON treated with corticosteroids, treated with optic canal decompression surgery or observed without treatment. A total of 133 patients with initial presentation within 3 days were included in the study. Visual acuity increased by more than 3 lines in 32% of the surgery group, 57% of the untreated group and 52% of the steroid group. After adjustment for the baseline visual acuity, there was no significant difference between any of the treatment groups. So no clear benefit was found for either corticosteroid therapy or optic canal decompression surgery. The study concluded that neither corticosteroids nor optic canal surgery should be considered the standard of care for the patients with TON.

The point to be noted for this study is the bias toward treatment. Of 133 patients, 125 received corticosteroids in varying doses, and 33 of those also had optic canal surgery. This bias for treatment means that we do not know the natural history of TON and the likelihood of spontaneous visual recovery. Also a striking feature is the delay in initiating treatment. Only 62% of the corticosteroid group had their treatment started within 24 hrs and only 15% of the surgery group were operated on within 24 hrs.

**Corticosteroid Randomization for Acute Head Trauma (CRASH) trial**

To fill the lacunas of IONTS, CRASH study was started. This was a multicenter, randomized, placebo controlled study where patients were treated within 8 hrs of injury. All the patients were randomized to receive either placebo or high dose of intravenous methylprednisolone for 48 hrs. Goal was to recruit 20000 patients from tertiary care eye centres across the globe. The study was stopped at 10008 patients as an increased rate of death among patients with acute head trauma treated with high-dose corticosteroids was reported compared to placebo-treated patients (21% vs 18%, P = .0001). One thing which has indeed come out of this study is that informed consent for steroids is taken where the patient is informed about the increased mortality issue.

**Toxicity of high dose corticosteroids**

Recent animal studies also suggest that high-dose corticosteroids are toxic to the injured optic nerve. To mention the most quoted study of Steinsapir et al, steroids led to more axonal loss than controls. However lower doses of steroids were not studied (only 30 to 120 mg/kg).

**Optic Canal Decompression Surgery**

Optic nerve swelling following trauma would compromise the blood supply to the optic nerve as the nerve is enclosed within the optic canal thus further aggravating the ischaemic damage to the nerve (Figure 2). Based on this presumption, optic canal decompression surgery was advocated by few reports. Fukado et al in the largest series of 400 cases had suggested good results in optic canal decompressive surgery. Optic nerve decompression remains useful as a salvage procedure for conventional dose steroid failed cases of TON. In cases which are not completely blind, vision can be improved even when surgery is undertaken a few months after the injury. But complications and sequelae of the surgery should not be neglected.

**Observation**

The rate of reported spontaneous visual improvement for untreated cases of TON has ranged from 0% to 67%. But the natural history of untreated TON and the rate of spontaneous visual recovery is a matter of speculation and a debatable topic.
Conclusion

In summary, there is inadequate evidence from clinical trials to support any specific treatment for indirect TON, and animal and clinical studies suggest that one such treatment, high-dose corticosteroids, may even be harmful. The lack of class I evidence makes it difficult for us to agree on the treatment of a well-recognized entity, such as indirect TON. This controversy emphasizes the importance of randomized clinical trials, without which the debate will continue.

The families of such patients should be taken into confidence and explained that there is no proven therapy for such patients.

To quote Oscar Wilde “The truth is rarely pure and never simple”. There are many ifs and buts and the message that high-dose corticosteroids may be harmful appears to be taking hold.

References