Management of the painful blind eye: An update

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Abstract

The blind painful eye (BPE) can be defined as an end-stage ocular condition with no chance of visual restoration accompanied by ocular pain. The focus of care shifts to addressing quality of life, and counselling patients about the finality of the loss of vision. Evidence-based guidelines to treat BPE's don't exist. However, generally, initial treatment is often medical. Medical therapy consists of topical treatment oral analgesia, and bandage contact lenses. If a patient does not respond to medical therapy minimally invasive therapy should be considered these include laser cyclophotocoagulation, retrobulbar injections and intravitreal injections. More recently, stellate ganglion block has been proposed as a therapeutic option for BPE management. Studies revealed that patients with high initial pain scores are at risk for failure of medical treatment and may need earlier surgical intervention. In refractory cases, surgical removal of the eye tissue can effectively relieve ocular pain. Blindness causes a heavy socioeconomic burden for the patient. Management should be approached holistically. Good communication and counselling regarding treatment options are very important. Surgical removal of the eye should only be discussed if the patient has accepted the poor diagnosis.

The purpose of this article is to give an update on the various treatment options available to treat this often-overlooked devastating condition.

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Introduction

The blind painful eye (BPE) can be defined as an end-stage ocular condition with no chance of visual restoration accompanied by ocular pain.[1] Among blind eyes approximately 11% have been found to be painful.[2]

Blind, painful eyes are most frequently a result of previous trauma in up to 45% of cases (*Figure 1*).[3,4,6] Various ocular disease processes can lead to the development of a BPE (*Table I*)[3,5] and present challenges in patient care. The focus of care shifts to address quality of life, counselling patients about the impossibility of any visual restoration.[1] There are no evidence-based guidelines for the treatment of a BPE.[3,6] Targeting the underlying cause is critical to achieving successful pain management.[1]

Table I: Conditions leading to the development of a painful blind eye.

Trauma
End-stage glaucoma
Chronic retinal detachment
Decompensated corneal surface
Uveitis
Endophthalmitis
Neoplasm
Chronic hypotony
Phthisis bulbi
Anterior segment surgery

Types of pain

Nociceptors are nerve endings of the trigeminal nerve that are triggered in response to tissue injury and send signals to the central nervous system. Mechanical nociceptors are triggered by harmful mechanical forces. Polymodal nociceptors are stimulated by heat, external nuisances, and inflammation stimuli.[7] The brain interprets the signals as different forms of pain. Common reactions in response to the pain include increased lacrimation, blinking and protective lid closure.[6]

Pain can be characterised as:

- ***Physiological (normal)***

Physiological pain results from local

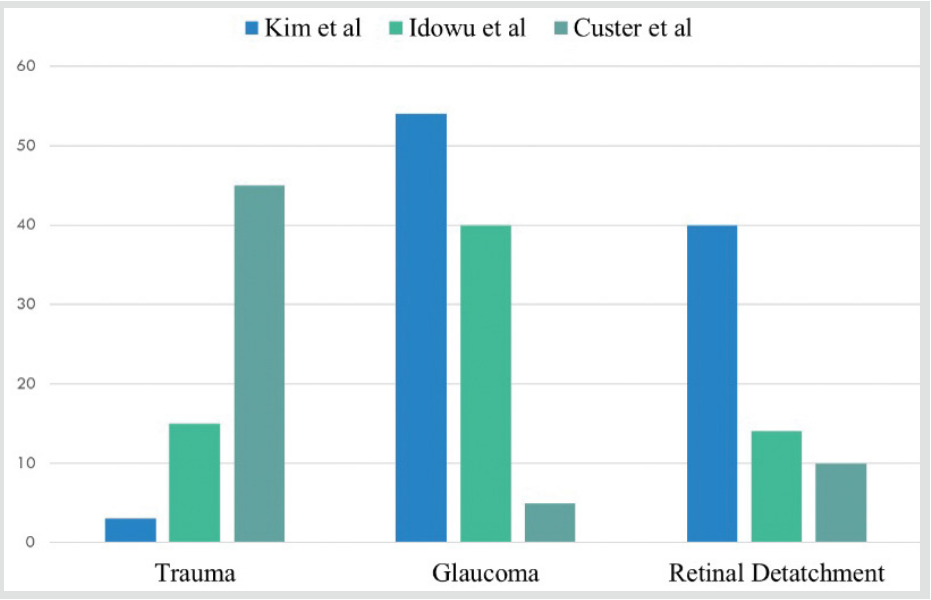

Figure 1: *Most common conditions leading to a PBE painful blind eye.*

injury to eye structures. Inflammatory mediators increase the excitability of polymodal nociceptors, sensitising the nerve ending and subsequently augmenting the sensation of pain. Long-standing inflammatory conditions, alter the expression and function of the transduction of the stimulus. Voltage-gated ion channels develop, changing the excitability of the polymodal nociceptors, and inducing exaggerated chronic inflammatory pain.[6,7] Physiological pain responds to anaesthetic eye drops implying that it originates from peripheral nerves. Management of physiological pain includes treating the underlying cause and the inflammation.[6]

- ***Neuropathic***

  Neuropathic pain is caused by injury to the nociceptors or other structures that form part of the pain-processing pathway between the peripheral and central nervous systems. Impaired signalling reactions give rise to painful sensations in response to painless stimuli.[6] Neuropathic pain is created and sustained either by sensory nerves or by abnormal reactions of their sympathetic pathways. It can be caused by direct insults to sensory nerves, metabolic disorders such as diabetes mellitus, as well as direct damage from chemical, toxic, or infectious substances to peripheral sensory nerves at any point of their path.[7,8] The sympathetic nervous system can therefore maintain pain even if it is not the primary source of pain.[8]

  Sympathetic nerve pain is described as a burning sensation and sensitivity to temperature changes.[8] Numbness and increased sensitivity to stimulation are common and oedema and other signs of autonomic dysfunction can be present.[8] Poor response to topical corticosteroids and anaesthesia during treatment of ocular inflammation is suggestive of a neuropathic type of pain. Neuropathic pain management can be challenging and may require systemic and/or psychological interventions.[6]

Aetiology and workup

A comprehensive history and slit lamp examination assist in determining the underlying cause.[1] The type of pain should be noted. Patients may complain of ocular pain, periocular headache, concurrent blinking, or photophobia (even with complete vision loss).[1,6] Pain resulting from raised intraocular pressure is commonly described as a dull intraocular or periocular ache involving the front and side of the head. If corneal oedema is present, especially accompanied by bullae, the pain is typically described as sharper and worse in the morning. This is most likely a result of increased oedema forming overnight when the eyelids are closed, with the decrease in drying of tears and oxygenation, and can improve as the day progresses.[7]

If visualisation of the posterior segment is obscured, B-scan ultrasonography should be performed to rule out an underlying malignancy. Other imaging modalities are usually not indicated.[1]

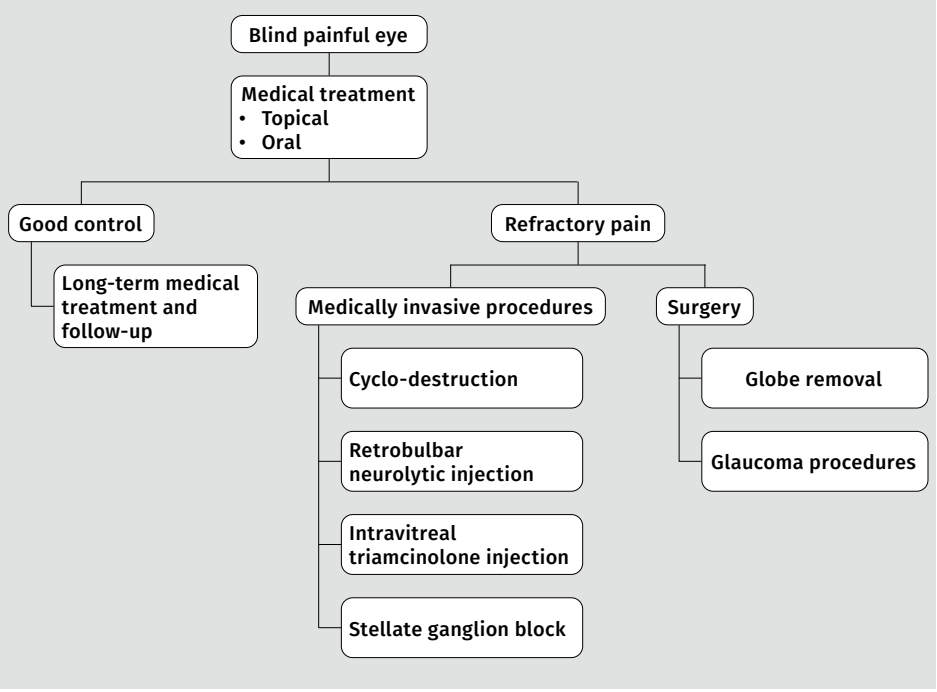

Figure 2: Algorithm summarising treatment options for BPEs. Treatment provided should target the underlying cause of pain.[1-10]

Treatment overview

Pain reduction is the main goal in the management of a blind, painful eye. There is a lack of Evidence-based guidelines for managing PBEs. Treatment can either be generalised or condition specific. Initial treatment is often medical. Medical therapy includes topical drugs that target ocular inflammation, raised intraocular pressure (IOP), and ciliary body spasms. Additionally, oral painkillers such as sedatives and antipsychotics may be used.[1,6] Minimally invasive therapy (laser 'cyclophotocoagulation', retrobulbar injections and intravitreal injections) should be considered if a patient does not respond to medical therapy.[1] Studies revealed that patients with high initial pain scores are at risk for failure of medical treatment and may need earlier surgical intervention.[5]

In refractory cases, surgical removal of the eye tissue (enucleation and evisceration) has effectively relieved ocular pain.[3] Surgery may also be considered for cosmetic purposes as it provides the benefits of a fitted scleral prosthesis.[3,9] Surgery has associated risks and complications, and absolute pain resolution is not always guaranteed.[6]

It is important to target treatment at the underlying cause. Patients need to be aware of the irreversibility of visual loss to discuss the best management options, especially when surgery is indicated.[6]

Generalised treatment

Treatment options can be divided into non-invasive treatment, minimally invasive procedures, and surgical management.

Non-invasive *Medical therapy*

Topical treatment including antiglaucoma agents, cycloplegic agents and steroid agents, oral analgesia, and bandage contact lenses are the first-line management for cases with severe ocular pain.[3] The aim is to modulate stimuli causing pain including inflammatory mediators, raised IOP, and ciliary muscle spasm.[3] Studies have shown that medical treatments are more likely to fail compared to surgery. This is most likely related to the mechanism of action of different agents.[3]

Topical treatment

- ***Steroids***

  Anti-inflammatory drops are indicated in cases where eye pain is induced by inflammation, uveitis, refractory raised IOP, and ischemic eye conditions. An

example is prednisolone acetate 1% QID.[1]

- ***Cycloplegic agents***
  Cycloplegics also known as anticholinergic/antimuscarinic agents inhibit the action of acetylcholine. Acetylcholine receptors are situated within the iris sphincter muscle and the ciliary body. The iris and ciliary body contract when these receptors are activated.[6] Cycloplegics temporarily inhibit this contraction, paralysing the ciliary body and dilating the pupil. Various mechanisms contribute to the effectiveness of pain relief with the use of cycloplegic drops. These include:[1,6]
  - Relaxation of the ciliary spasm by paralyzing the muscle.
  - Prevention of posterior synechiae formation by decreasing the area of contact between the iris and lens capsule in a mydriatic pupil.
  - Stabilisation of the blood-aqueous barrier thus minimising the inflammatory reaction in the anterior chamber.
- ***Anti-glaucomatous agents***
  Raised IOP causing ocular pain can be treated with IOP-lowering agents. Maximum medical therapy of topical anti-glaucoma drugs often provides pain control for many years but increases the risk of developing ocular surface breakdown. Drugs can be prescribed at their usual frequency; these include:[1]
  - Alpha-agonist
  - Beta-blocker
  - Carbonic-anhydrase inhibitor
  - Prostaglandin.

Oral treatment

Oral analgesics, including narcotics, can be prescribed with a step ladder approach. Caution should be taken if opioids are prescribed as chronic use can lead to a patient becoming tolerant, dependent, and addicted to the drug.[6] Paradoxical hyperalgesia and impaired cognitive functioning are further complications. Chronic nonsteroidal anti-inflammatory drug usage increases the risk of gastrointestinal ulceration and haemorrhage, heart disease, and kidney impairment.[3] It has been hypothesised that pain in a glaucomatous blind eye can be caused by structural nerve damage evoking neuropathic pain. This hypothesis has led to research on the possibility of anticonvulsants as an adjuvant to IOP-lowering treatment for pain relief. A case series reported the use of gabapentin to be effective as an adjuvant for pain relief.[1]

The underlying pathophysiology of neuropathic pain and inflammation in migraines involves the expression of calcitonin gene-related peptide (CGRP). Research has shown overexpression of CGRP in blind, painful eyes, but future studies are needed to establish its relationship given the emergence of CGRP-targeting therapies. Modulation of CGRP for treating the BPE can be an emerging form of therapy in the future to avoid more invasive treatment options.[1]

Minimally invasive procedures

1. Cyclodestructive procedures

Cyclodestruction therapy aims to lower IOP by destroying the ciliary body and subsequently reducing aqueous humour production.[10] It offers the advantage of repeated treatments. When pain is caused by elevated IOP levels transscleral and endocyclophotocoagulation, high-intensity focused ultrasound (ultrasound cycloplasty), and cyclocryotherapy could be indicated.[6] The IOP-lowering effect of cyclodestructive procedures likely provides relief of pain.[3] Studies have shown that an important factor to achieve complete pain relief with one treatment was a reduction in IOP of >30% from baseline.[3] Burns created by ultrasound cycloplasty are precisely positioned over the ciliary body without causing damage to adjacent structures. This significantly improves the accuracy of treatment compared to cyclocryotherapy as seen on histology.[3]

- ***Cyclophotocoagulation (CPC)***
  Cyclophotocoagulation is indicated in patients that are resistant to maximum glaucoma treatment.[1] Various lasers can be used and applied either transsclerally or with an endoscopic probe. The diode laser is favoured since it is better absorbed by the melanin in the ciliary epithelium and ciliary destruction is more targeted with a decreased inflammatory response. CPC has the advantage of being performed in the office setting under local anaesthesia.[1] The most common complications are hyphaema, inflammation, cystoid macular oedema, need for retreatment. Hyphaema is more frequently encountered in neovascular glaucoma. Albeit rare other reported complications include sympathetic ophthalmia, hypotony, and phthisical changes.[1]
- ***Trans-scleral cyclophotocoagulation (TS- CPC)***
  The 'long posterior ciliary arteries and nerves' can be affected during transscleral procedures applied to the ciliary area, and sensory stimuli from the cornea can subsequently be impaired. The 3 o'clock and 9 o'clock locations should therefore not be treated.[4] A peribulbar or retrobulbar regional block is needed prior to starting the procedure. The semiconductor diode laser has mostly replaced the Nd:YAG laser for TS-CPC as it is more effective. Treatment protocol varies and is not standardised. Using less total energy can lower the risk of hypotony but increase the need for repeated treatments.[4]
  Treatment protocols as suggested by the American Academy of Ophthalmology (AAO):[10]
  - *Noncontact Nd-YAG laser*
    Therapy is done at a slit lamp. The laser beam is pointed 1.0 mm to 1.5 mm behind the corneal limbus. A surface area of 270° to 360° is treated.
  - *Contact Nd-YAG laser.*
    A sapphire probe generates the Nd:YAG laser and is linked to a fibre optic system. The probe is directly applied to the conjunctiva at 0.5 mm to 1.0 mm posterior to the surgical corneal limbus. A surface area of 270° to 360° is treated. The ciliary body can be identified by transilluminating the globe.
  - *Semiconductor diode laser (Cyclodiode)*
    A semiconductor diode laser utilises a probe emitting a continuous wavelength of 810 nm. It is positioned 1 mm to 2 mm behind the limbus in line with the visual axis. A surface area of 270° to 360° is treated. Standard parameters: 16 to 24 spots at 1.250 MW to 2.500 MW of energy, for a period of 2000ms. Destruction of the ciliary body produces an audible popping sound. Energy should be titrated one level below the energy level where the popping sound was produced. Topical steroids should be administered for one month after each treatment. Complications include malignant glaucoma, neurotrophic corneal ulcers, perforation of the sclera, and possibly the risk of developing sympathetic ophthalmia.
- ***Endocyclophotocoagulation (ECPC)***
  A semiconductor 810-nm diode laser connected to a fibreoptic intraocular endoscope is inserted at the limbus (most common) or pars plana.
  The endoscope allows for direct visualisation of the ciliary body with precise delivery of energy. An area of 270° to 360° is treated. Laser energy is titrated between 150MW and 300MW

until blanching and shrinkage of the ciliary processes are observed.[10] Ciliary processes are targeted during ECPC and damage to the adjacent ciliary muscle and stroma is minimised.[10] This avoids the side effects associated with TS-CPC.[10] ECPC treatment protocols vary, and no standard protocol is available.[4] Complications include postoperative IOP spike, hypotony, intraocular haemorrhage, and phthisical changes.[4] ECPC has an increased risk of infection as it is a surgical procedure.[10]

- ***Cyclocryotherapy***
  Cyclocryotherapy inflicts damage to the ciliary epithelium using a freezing procedure with a subsequent decrease in aqueous humour production. Blood flow to the ciliary epithelium and ciliary body is obstructed post-procedure by a reactive inflammatory response, attributing to ciliary body dysfunction.[10] Formation of intracellular ice crystals occurs at temperatures less than -15°C. A freezing time of more than 30 seconds is needed to produce definite cell damage from intracellular changes. The effectiveness of the procedure relies on optimal tissue temperature, freezing tissue at -80°C for 60 seconds usually provides adequate results.[10]
  Documented complications include transient IOP spikes, uveitis, discomfort, hyphaema, choroidal detachment, vitreal bleeding, ischemia, subretinal fibrosis, lens subluxation, and hypotony.[4] Treating more than 180° can lead to the formation of phthisis bulbi. The treatment protocol from the OOA suggests direct application of the cryoprobe 2 mm behind the corneal limbus. A surface area of 180° is treated. When a 3 mm to 4 mm frozen section is formed around the probe start the timer and freeze the underlying tissue at each position for a 40-seconds to 60-seconds period.[10]
- ***Ultrasound cycloplasty (UCP)***
  Ultrasound cycloplasty (UCP) makes use of high-intensity focused ultrasound waves to coagulate the ciliary body. This in turn leads to a reduction in IOP by altering the aqueous humour dynamics.[1] This novel device consists of disposable parts including an aligning cone and a therapy probe. The transducers located in the probe correspond with the ciliary processes with sub-millimetre accuracy and precise temperature control.[10] Partial coagulation of the ciliary body can be obtained without damaging the ciliary pigment or the blood-aqueous barrier. Studies have reported UCP to be effective in pain control, but this method is not readily available.[1]

2. Retrobulbar injection

Retrobulbar injection of neurolytic agents was first suggested in the 1900s as a substitute for surgical intervention. Its analgesic effect is thought to be from both nerve fibril coagulation and structural damage associated with lipid deposition.[2] Recurrent pain is likely associated with the degree of nerve damage.[2] Retrobulbar injections of neurolytic substances (alcohol and chlorpromazine) as a form of management for painful blind eyes have been used for many years. These substances can easily be administered close to the ciliary ganglion. These substances provide an analgesic effect by degeneration, stabilisation, or blockage of nerve conduction in the afferent fibres of the ciliary ganglion.[2]

Complications include direct optic nerve damage, erroneous injection, or extravasation of the substance into the meninges around the optic nerve (with a high risk for mortality) and hematogenous spread of the drug with toxic systemic concentrations.[2] Significant complications, such as external ophthalmoplegia, retrobulbar bleed, optic atrophy, and globe perforation have also been reported.[2,6] Orbital inflammation post-injection is believed to extend the analgesic effect.[2] Its use has fallen out of favour because of associated mortality.[3]

- ***Alcohol***
  Retrobulbar alcohol causes the destruction of nerve cells. It is the preferred method when the preservation of the globe is a priority. Retrobulbar alcohol administration initially causes analgesia by coagulating the proteins of the sensory nerve fibres.[1] If the entire nerve is not infiltrated but only the area surrounding it, a limited number of fibres will be destroyed, and transmission will not be ceased but only depressed. The peripheral nerve fibres regenerate after a few months, and pain recurs. The recurrence of pain transmission depends on the degree and extent of nerve destruction.[2,3]
  Retrobulbar injection of alcohol is usually effective for three to six months.[1] The injected alcohol can spread and affect other nerves that are not targeted. The efficacy of retrobulbar alcohol injections in BPE management reportedly varies between 20% and 87%.[6] The procedure is painful, thus consecutive injection of a mixture of lidocaine is the preferred method of administration. Alcohol has a lower density than lidocaine and should be drawn up first.[2]
  Alcohol may cause a local inflammatory tissue reaction with lid oedema and conjunctival chemosis.[2] It can lead to blepharoptosis and external ophthalmoplegia from motor nerve involvement (at their entry through the superior orbital fissure).[2] These complications, however, are usually temporary and resolve spontaneously.[6] Other reported side effects include optical atrophy, palpebral ptosis, inflammatory orbital disease, and neurotrophic keratopathy.[2] Chronic trigeminal neuropathy has also been reported.[6]
- ***Chlorpromazine***
  Chlorpromazine is a phenothiazine primarily utilised as a first-generation antipsychotic. It blocks dopamine receptors and acts on the limbic pathway. Its neuronal effect has been termed neuroleptic because it slows down motor actions in patients after oral consumption. The precise mechanism of action in eye pain reduction of chlorpromazine is poorly understood but is thought to be due to its stabilising effect on the postsynaptic membrane of the ciliary ganglion.[2] Studies have reported a decrease in IOP, but it is not known if this contributes to pain control.[2] In comparison to retrobulbar alcohol injection, chlorpromazine is preferred, as the procedure is more tolerable, and the analgesic effect lasts longer.[1] The efficacy of retrobulbar introduction of chlorpromazine at a standard dose (25mg per 1-2ml) for pain relief in BPEs varies between 37% and 90%.[2]
  Post-procedure eyelid oedema and chemosis are the most reported side effects, it is transient and resolves spontaneously. Other complications include ptosis, sterile orbital cellulitis, temporary ophthalmoplegia, retrobulbar haemorrhage, and corneal ulceration.[2] Systemic side effects can occur from vascular infiltration or extravasation through the meningeal sheath surrounding the optic nerve. Symptoms include dizziness, nausea, heart palpitations, and loss of sphincter control.[2]

3. Stellate ganglion nerve block

The inferior cervical ganglion and the first thoracic ganglion fuse to form the stellate ganglion. It provides most of the sympathetic nerve supply to the head, neck, and upper limbs. A therapeutic ganglionic block has been used in the

treatment of numerous conditions including glaucoma and facial pain.[8] In 1953 a study revealed that a ciliary ganglion block leads to intraocular pressure change in glaucoma patients. However, its role in managing the BPE has never been described in the literature. A study by Xavier *et al*[8] administered a course of six weekly treatments of cervicothoracic (stellate) ganglion block of 0.5% bupivacaine and clonidine 1mg/Kg. Treatment was done via a paratracheal approach in the surgical suite.[8] This case series reported efficacy in pain control in blind glaucomatous eyes, but further randomised control trials are needed to establish its role in the treatment of BPE.[1,8]

4. Intravitreal triamcinolone

Triamcinolone acetonide is a synthetic corticosteroid with significant anti-inflammatory action. Pharmaceutically it is produced as a sterile suspension.[11]

Phthisis bulbi results from a series of proliferative reactions including persistent inflammation, progressive ocular fibrosis, and degeneration. Intraocular steroid administration could prevent the aforementioned reactions, ameliorate the inflammatory process, and alleviate symptoms.[11] In 2003 a study by Rodríguez *et al* demonstrated the successful use of intravitreal triamcinolone (injection 12.5 mg) for the management of ocular pain in phthisical eyes.[11] There were no complications reported in association with the procedure.[11] The crystalline composition of the substance, with its vitreal sequestration results in slow release of the drug, maintaining adequate intraocular concentrations over an extended period of time.[11] The majority of patients were still pain free at the 2-year follow-up.[11]

Surgery

Surgery is often the last resort for refractory cases but is also indicated for patients with globe disfigurement and concern for a desirable cosmetic outcome.[3] Patients that received a globe removal procedure, with or without an implant, presenting with ongoing postoperative pain should undergo a detailed examination to identify the underlying cause of the pain. Evisceration and enucleation are the most commonly performed eye removal procedures.[1,9] Complications including retrobulbar haemorrhage, conjunctival cysts, and wound dehiscence can be the underlying cause responsible for persistent ocular pain.[9] Treating the underlying cause could possibly lead to complete pain relief.[5,9]

1. Enucleation

Enucleation is the complete surgical removal of the eyeball with preservation of the extraocular muscles which get reattached to the intraocular implant.[1] Although enucleation often causes severe psychosocial problems for patients it remains a viable treatment option in patients with refractory pain. Enucleation is also indicated to acquire a histological diagnosis if an intraocular tumour is suspected.[1]

Persistent postsurgical pain (PPSP) is a well-documented complication.[8] PPSP can present as a 'phantom limb' type of discomfort. Surgical removal of the eye can lead to visual hallucinations. Patients should be reassured that it is a common phenomenon in the absence of a mental disorder. Enucleation can influence patients' self-esteem and their overall quality of life.[1,5]

2. Evisceration

An evisceration involves surgical removal of the cornea and uveal tissue of the eye. The sclera and extraocular muscles are preserved. An implant (like a silicone ball) gets placed into the shell of the remaining sclera. An evisceration with a fitted prosthesis is the preferred surgical procedure due to its remarkable post-operative cosmetic result.[1] In comparison to an enucleation an evisceration is an easier procedure with improved prosthesis motility.[9]

In theory, evisceration has an increased risk of developing sympathetic ophthalmia. The surgery can sometimes be unsuccessful in pain management since the sensory ciliary nerves are still intact and can transmit pain.[9] Facial paraesthesia in patients who have received prior retrobulbar alcohol injections is not relieved by enucleation.[6]

Condition-specific treatment

Decompensated corneal surface:

Bandage contact lenses (BCLs) are often used to relieve pain in conditions that cause decompensation of the corneal surface such as bullous keratopathy, epidermolysis bullosa, and superficial abrasions/erosion.[12] The analgesic effect of BCL is poorly understood but believed to act as a mechanical barrier protecting the eye against mechanical abrasion or contact from external forces such as eyelids.[1] BCLs are additionally utilised to assist in postoperative pain relief.[12] When pain is refractory procedures like an amnion membrane transplant, or a conjunctival advancement (Gunderson) flap can be performed.[6]

1. Band Keratopathy

Eyes that are painful secondary to band keratopathy (BK) can be managed by removal of the calcific deposits with topical EDTA. The use of EDTA decreases the damage caused to Bowman's layer and minimises the development of an uneven cornea. Recurrence occurs commonly as EDTA removes the precipitated calcium on the corneal surface and does not treat the underlying disease. EDTA can cause a chemical corneal burn as it is toxic to the ocular surface if not adequately removed.[1]

2. Bullous keratopathy

Initial management is typically medical and aimed to decrease corneal oedema. Topical hypertonic saline eye drops are administered. If medical therapy fails surgery may be indicated. The preferred option is corneal transplantation but is not always possible due to a shortage of donor corneal tissue or when the patient does not qualify for transplantation. In these cases, pain management from bullous keratopathy requires treatment that does not make use of donor corneas.[12]

Alternative methods include:[1,6]

- ***Phototherapeutic keratectomy (PTK)***
  Studies have reported effectiveness in pain control. An excimer laser is used to perform the procedure, thus limiting its availability.[1]
- ***Conjunctival flaps***
  This technique has been studied but is unfavoured due to associated complications. These include bad cosmetic outcomes, flap retraction, and forniceal shortening of the conjunctiva.[1]
- ***Amniotic membrane transplant (AMT)***
  Amnion grafting has successfully relieved pain in patients with persistent painful bullous keratopathy. Early complications include the dissolving of the graft prior to corneal re-epithelialisation. If the graft remains intact, visualisation of the anterior and posterior segments can be obscured.[1]
- ***Anterior stromal puncture (ASP)***
  Studies have demonstrated a reduction in pain, but not resolution. Long-term data from these studies are lacking.[6]
- ***Corneal crosslinking (CXL)***
  This is used as an off-label procedure in bullous keratopathy. Variable results in relieving pain symptoms have been reported with the diminished effect of CXL over time and the reformation of corneal bullae.[1]
- ***Rho-associated kinase (ROCK) inhibitor***
  The use of ROCK inhibitors as a treatment option for pain in bullous keratopathy has not been studied. Research has shown

it promotes corneal endothelial cell proliferation in vitro and in vivo.[1]

- ***Bowman's membrane electrocautery***
  This technique was first described by Salleras *et al.* in 1965. It is hypothesised to decrease pain and formation of corneal bullae by inducing fibrosis. The subsequent destruction of the subepithelial nerve plexus contributes to pain control. Recent studies of Bowman's membrane 'electrocautery' demonstrated its feasibility, safety, and efficacy.[1]

Neovascular glaucoma

Neovascular glaucoma develops secondary to vascular disease of the retina, diabetes mellitus, and ocular ischemia.[4] The initial goal in the treatment of NVG is to decrease the IOP with anti-glaucomatous agents to avoid loss of vision in seeing eyes.[13] Additionally, photodynamic treatment, cyclophotocoagulation, and penetrant glaucoma surgery can be applied. Topical corticosteroids can be used to decrease inflammation if needed. Neovascularisation can be treated with anti-vascular endothelial growth factors and pan-retinal photocoagulation.[3,4]

Intravitreal bevacizumab has been reported to relieve pain in cases of refractory NVG.[13] It is suggested that pain control has been achieved not only in the long term by decreasing IOP but also within a week by decreasing the concentration of intraocular inflammatory mediators secondary to decreased vascularisation[13]

A study by Kim *et al.*[4] demonstrated that applying cyclocryotherapy to the 3 o'clock and 9 o'clock perilimbal area, with subsequent destruction of the long posterior ciliary vessels has improved long-term clinical outcomes for patients with NVG.[4] It is believed to slow down progression toward neovascularisation when compared to avoiding the 3 o'clock and 9 o'clock positions.[4]

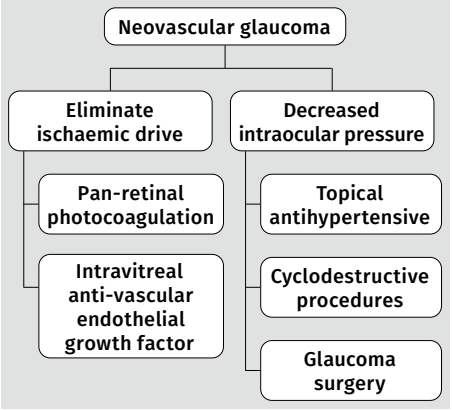

Figure 3: Algorithm for treatment of a painful blind eye secondary to neovascular glaucoma[4,13,14]

Glaucoma surgery to control pain in BPE secondary to raised intraocular pressure is poorly described in the literature. The novel laminar drainage implant (LDI) is a device without a tube with a thin and flat shape compared to existing glaucoma drainage devices.[14] This shape allows implantation without altering the contour of the ocular surface in the limbic area. A study by Jacobovitz *et al.* evaluated the feasibility and safety of LDI in glaucomatous BPEs. IOP lowering effect post-LDI proved to be effective for pain control, but further studies are needed to elucidate its potential in the treatment of glaucomatous eyes.[14] Complications include conjunctival retraction or erosion and blebitis. Excessive aqueous humour drainage can cause hypotony. Hypotony can lead to further complications including a shallow AC, serous or haemorrhagic choroidal detachment, hypotonic maculopathy, and formation of lens opacities.[14]

Emotional impact

Blindness causes a heavy socioeconomic burden for the patient.[6] Clinicians should coordinate care with a multidisciplinary team to provide the patient with the needed emotional support. Good communication and counselling regarding treatment options are very important.[6] Studies have found that patients who underwent eye removal have a poorer health-related quality of life, diminished self-esteem, and greater perceived stress, anxiety, and depression than the general population Surgical removal of the eye should only be discussed if the patient has accepted the poor diagnosis.[5]

Conclusion

Treatment of a blind painful eye can be challenging. Physicians should discuss the best treatment options regarding medical and surgical management with the patient. Treatment protocols unfortunately don't exist, but literature has shown that a stepwise approach is most frequently used to treat the pain with initial management being medical and surgical removal of the eye being reserved for patients with refractory pain. All patients presenting with BPEs should undergo a thorough examination to determine the underlying cause. Best results are achieved when management is targeted at addressing the underlying aetiology.

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