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Research Article

MALIGNANT GLAUCOMA, FOLLOWING POSTERIOR CAPSULAR RENT, EVIDENCE BASED UNDERSTANDINGS AND THERAPEUTIC APPROACHES

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ABSTRACT

Malignant glaucoma, though the name implicates something neoplastic, but its acute or insidious onset and ominous presentation can be a nightmare for the ophthalmologist. As posterior capsular rent (PCR) is a commonly encountered complication even in experienced hand it can lead to malignant glaucoma in about 1.2-4% cases. Intraoperative clinical suspicion and serial post-operative evaluation can diagnose and monitor the ailment. Exchanging the aqueous and vitreous though the rent and jeopardisation of the anterior chamber physiology are the basic mechanism to set up the clinical entity. Several other postulations and evidence based studies came into play which helped us to better understand and search the ideal therapeutic approach that can potentiate the optimum visual outcome. The age old notion of refractory to medical therapy (Von Greafe's nomenclature) has been challenged by application of proper medical therapy as well as surgical intervention. These ushered a new era of malignant glaucoma management by incisional and laser techniques. This review article enlightens evidence based concepts and newer therapeutic approaches.

INTRODUCTION

Many diverse form of glaucoma occurs as complication of various surgical procedures including cataract surgery. Malignant glaucoma, though a rare condition, happens classically in 0.6-4% of complicated cataract surgery[1]. In 1869, Von Graefe described the condition characterized by acute or insidious shallowing of anterior chamber and resultant elevation of intra ocular pressure(IOP) resulting from ocular surgeries. He coined the term 'malignant glaucoma' because it relentlessly worsened despite conventional treatments. As time passed the concept expanded regarding its development from different clinical situations. Several nomenclatures followed like 'ciliary block glaucoma', 'aqueous misdirection syndrome'. Posterior capsular rent is a frequent jeopardy during cataract surgery, it not only affects the visual outcome but also predispose the patient for aqueous misdirection and malignat glaucoma. In this literature review we highlight the on and off table clinical situations when PCR encountered, followed by pathophysiology and management strategies of malignant glaucoma.

METHODOLOGY

A PubMed based search was performed using the keywords, 'malignant glaucoma', 'posterior capsular rupture', 'ciliolenticular block', 'vitrectomy'. Articles published up to December 2016 were reviewed and filters used like 'human studies' and 'English language articles'. Eminent textbooks and case reports relevant to this context were adjudged for this article.

Posterior capsular tear-epidemiology and risk association for post-operative glaucoma

The torn posterior capsule is probably the most dramatic accident during any form of cataract surgery, particularly in phacomorphic glaucoma or sclerotic cataract, it continues to happen in albeit expert's hand. Beside the familiar outcomes like-cystoid macular oedema, retinal detachment, the posterior capsular rent (PCR) also invites shallowing of anterior chamber and trespassing of aqueous and vitreous in opposite direction through the rent resulting on table hypotony and precarious ciliolenticular block. Different studies suggest that young patients with soft cataracts, brunescent cataract (where the nucleus get indistinguishable from cortex), or low scleral rigidity are at greater risk for PCR. Taskapili *et al*[2] showed

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highest rate of PCR during phacoemulsification (59.56%) followed by irrigation aspiration(28.8%). High post-operative IOP rise due to retained visco elastic material in anterior chamber or cortical matters impacted in trabecular meshwork, the cumulative risk found to be 13-40% [3]. Out of them 1.2- 4% leads to malignant glaucoma[4,5], which has been documented post operatively even on day one and late as several years after[6]. Malignant glaucoma seen more frequently in Asian pseudophakic eyes, probably their short axial length and predisposition to the narrow angles. It has been also associated with central retinal venous occlusion (CRVO), persisting inflammation, trauma, retinopathy of prematurity(ROP)[7], intravitreal triamcinolone injection[8], large intraocular lenses[9].

Complications can lead to malignant glaucoma when PCR encountered

On table complications

1. Sudden deepening of anterior chamber followed by hardly manageable shallowing.
2. Miosis.
3. Ocular hypotony, which makes the intraocular manipulations tedious.

Off table complications

1. Pain (progressive and intolerable).
2. Redness.
3. Diminution of vision
4. Very high IOP (>50 mm of Hg in some cases)
5. Significantly shallow AC.
6. No iris bombe, no pupillary block.
7. Cornea hazy.
8. Striate keratopathy or bullous keratopathy are not uncommon.

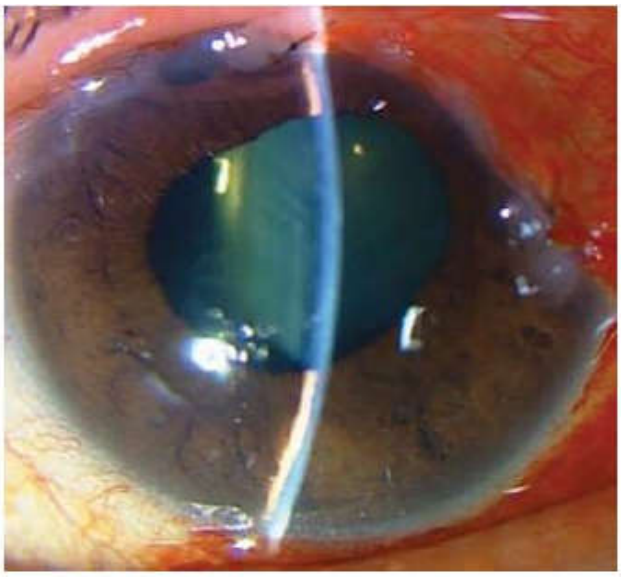
Aqueous misdirection-how to diagnose?

When posterior capsular tear is encountered during any form of cataract surgery, there is a probability of aqueous and vitreous exchange between chambers. There is a lack of general agreement regarding the sequelae of events responsible for development of malignant glaucoma, which comprises of a spectrum of atypical angle closure glaucomas. Several terms were incorporated like- 'hyaloid block glaucoma', 'posterior aqueous entrapment'. Although most commonly seen in glaucoma filtration surgery, nevertheless cataract surgery being the frequently performed procedure, a meticulous attention ought to be implicated to reduce the incidence of indolent angle closure and regularpost-operative follow up to evaluate the irido corneal adhesion status.

Clinically ciliary block glaucoma is suspected in the presence of Speath grade 1 or 2 shallow anterior chamber, with prominent axial shallowing of peripheral as well as central chamber. We frequently encounter IOP<8 mm of Hg in first post operative day but patients often land with even IOP> 50 mm of Hg after 2 weeks or more.(figure 1)

Anterior peripheral iridectomy is also a commonly done procedure along with anterior vitrectomy when PCR encountered, but to diagnose a ciliary block status it is extremely important to identify these two factors, absence of pupillary block and patent iridectomy.

An pseudophakic eye with malignant glaucoma. Extremely shallow AC with IOP 48 mm of Hg



Another Presentation after glaucoma filtration surgery

Sometimes the diagnosis is made only by retrospect. After observing the eye's response to several interventions, e.g – cycloplegics can ameliorate the condition but miotics aggravate.

Pathophysiology

Analysing several studies and theories regarding development of malignant glaucoma from accidental capsular tear, the following mechanism might be instrumental.

1. *Posterior pooling of aqueous* – Shaffer, hypothysed that accumulation of aqueous behind the posterior vitreous cause the forward displacement of lens and iris diaphragm. The concept progressed as the experimental studies in vitro showed creation of aqueous pockets in vitreous. The theory was also supported by experiments by serial ultrasonography by Buschman and linert[9]. Epstain[10]further elaborated the mechanism in enucleated eyes also.
2. *Ciliolenticular or ciliovitral block*- the names were conceptualised from anterior rotation of ciliary body against the lens equator in pseudophakic eyes. Tello C *et*

al and Trop GE *et al* both showed collection of supraciliary fluid in this process.

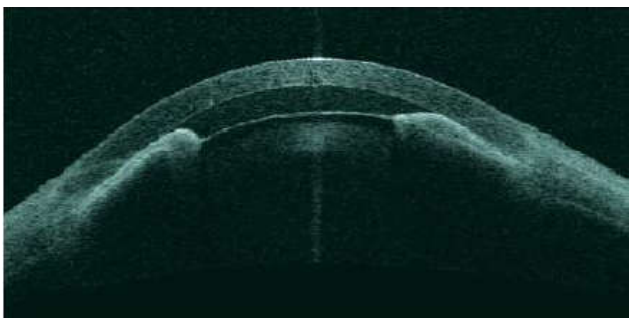
3. *Anterior hyaloid obstruction*-the anterior hyaloid may contribute to ciliolenticular block. Insidious rise of post-operative IOP resulting from choroidal expansion decreases the ability of the eye's ability to transmit the aqueous freely across the vitreous, during posterior capsular tear when the anterior hyaloid face broken that can allow vitreous base under pressure and subsequently reducing the available area of anterior hyaloid through which the fluid could flow.
4. *Slackness of lens zonules*-Chandlar and Grant postulated forward movement of lens iris diaphragm simultaneously weakens the zonules. Several studies accepted that the laxity of zonules might lead to the severe and prolonged angle closure.

Differential diagnosis

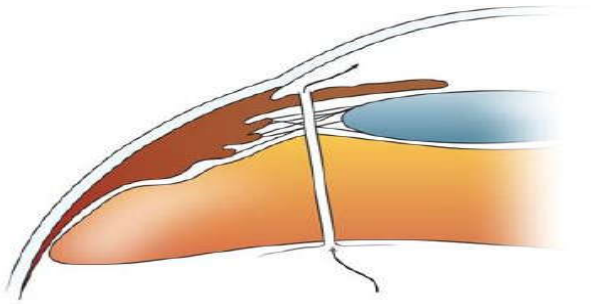
1. Pupillary block glaucoma- typically presents with peripheral
2. shallowing, iris bending and non uniform AC depth. Iridectomy may be present or not. If the former pupillary block is unlikely. If the patency is questionable a second iridectomy can be done by laser.
3. Choroidal detachment- highly confusing with malignant glaucoma, as during cataract or glaucoma surgery. When the eye become suddenly hypotonic, this diagnosis made on table.
4. Suprachoroidal haemorrhage- causes pain and elevated IOP manifested hours or days after surgery. Eye is usually inflamed like that choroidal detachment.

Management and follow up- practical evidence based approach

Imaging studies- previously ultrasound bio microscopy (UBM) was being used to both diagnose and therapeutic response to



AS-OCT of a post-operative eye showing iridocorneal adhesion



Schematic depiction of a surgically created route for aqueous flow in the therapy of malignant glaucoma. Multiple techniques may create this route including laser, vitrector and needle based procedures

the eyes with malignant glaucoma, where the UBM clearly delineated the anterior rotation of ciliary body, forward displacement of IOL haptic (and /or optic) with apposition of iris[11]. With the advent of non-invasive diagnostic tools like AS-OCT is now the tool for diagnose and monitor the cases. Wilbauer *et al*[12] corroborated the AS-OCT findings with UBM findings and also substantiated the role of AS-OCT even after surgical intervention.(figure 3)

Therapeutic protocol- as the understandings of pathophysiology of malignant glaucoma has evolved so too have the approaches of medical therapy. Currently the aim is to restore physiological condition of ciliary body, vitreous, IOL and establishment of more normal posterior chamber by passing the trapped aqueous in to the AC. Chandlar first postulated the use of cycloplegics and mydriatics in this setting[13]. Atropine sulphate drops 2 to 4 times with phenylephrine 4 times daily were commonly used. Aqueous suppressants (e. g. intravenous mannitol or oral glycerol) can shrink the vitreous and help to drain the aqueous in surgical way. Nevertheless, steroids remain the inevitable choice as an adjunctive tool. Overall medical therapy found to be successful in about 50 % cases with resolution often requiring up to 5 days of treatment [14,15,16].

Newer surgical approach- The mainstay of surgical approach is to conquer the AC physiology by either laser or incisional technique.

Laser, especially Nd-YAG laser can be employed tocreate a large peripheral iridectomy or iridotomy, or a trans pupillary passage may be set up a hyaloidectomy with concomitant capsulotomy[17].The passage created in this way facilitates drainage of aqueous from retrolental space in to the AC (figure 4). If the laser technique fails, then the incisional procedures come into play. Chandlar's classical approach has a vivid step wise manoeuvres starting from ensuring the PI, its patency, draining the suprachoroid effusion (if present). After the stabilisation pars plana vitrectomy (PPV) is done to remove the posterior chamber fluid. Re-establish the normal aqueous flow pattern [18]. However, PPV may fail and the vitreous may remain in the anterior chamber. Some surgeon prefer to use a vitrector to create a "zonulohyaloidectomy" and PI as apart of PPV in pseudophakic eyes[19].

Its familiar to the vitro retinal surgeon that choroidal effusion induces angle closure that can go unnoticed and frequently precipitates malignant glaucoma. Large effusion may not cause hypotony. Chandlar *et al* suggested for posterior sclerotomy to drain the fluid.

Recently laser photocoagulation also employed to ablate the ciliary process through PI. This adjunctive therapy gained popularity in western world and on trial due to rapid shrinkage and fast reversal of AC physiology. Alternatively laser applied on CB also shrink the retained vitrous.

CONCLUSION

India's largest blind population that owing to cataract, the surgery frequently faces posterior capsular tear as a mishap, that can create avenue for several post-operative glaucoma's. Among them malignant glaucoma indeed a sight threatening situation, as the understanding if it progressed so as the newer treatments ensuring better visual outcomes. Meticulous intra

operative suspicion, thorough post-operative evaluation, serial imaging by AS-OCT delineates the disease entity. Finally, we have a number of laser and surgical interventions in our armamentarium that allow a defined approach for effective therapy.

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