

Trypan Blue Dye as an Adjunct to Cataract Surgery

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Abstract

The current study was done to evaluate the utility and safety of Trypan Blue staining of the anterior capsule for enhancing visualization of capsulorrhexis in mature and hypermature cataracts. This study included 100 eyes of 100 patients with a unilateral mature or hypermature cataract. In all these cases 0.2ml of 0.1% Trypan blue dye was used to stain the anterior capsule in cataract surgery. In all 100 eyes the Continuous Curvilinear Capsulorrhexis (CCC) was completed. Successful cataract surgery with intraocular lens (IOL) implantation was performed in all eyes. Adverse reactions related to the dye such as raised intraocular pressure or anterior chamber inflammation was not observed in the immediate postoperative period or at the end of mean follow-up of 3 months. Trypan blue dye staining of the anterior capsule was found to be an effective and safe technique that helps in completion of Continuous Curvilinear Capsulorrhexis (CCC) in mature and hypermature cataracts.

Key Words

Cataract, Mature Cataract, Hypermature Cataract, Capsulorrhexis, Trypan Blue Dye

Introduction

Many non toxic ophthalmic dyes have been extensively used in Ophthalmology. (Table 1). Staining of ocular tissue makes differentiation and manipulation of tissues easier during surgery. The creation of a Continuous Curvilinear Capsulorrhexis (CCC) in the anterior capsule is a critical step in cataract surgery and it facilitates in the bag intraocular lens (IOL) implantation. Visualization of the capsule flap is important to maintain control of the tear as it is being made to ensure that it is continuous. A tear that has non-continuous components is likely to develop radial extensions, when stressed during surgery (1). The red fundus reflex produced by coaxial light of the microscope is essential to visualize the capsule while performing capsulorrhexis. Hence when this retroillumination is absent, such as in the mature and hypermature cataracts, it is difficult to identify the propagating edge of the Capsulorrhexis (2,3,4). In such cases, the anterior capsule can be temporarily stained with any vital dye e.g. Fluorescein Sodium (5,6), Indocyanine Green (7,8), Trypan Blue (9). (Table 2) We used 0.1% Trypan blue to stain the anterior capsule for ease of visualization during capsulorrhexis in mature and/or hypermature cataract.

Materials and Methods

This prospective study comprised 100 eyes of 100 patients who had unilateral senile mature or hypermature cataract. Preoperative visual acuity in each patient was light perception with accurate projection. Mean follow-up period was 3 months (range 2-4 months). In addition to routine preoperative work up for cataract extraction, ultrasound B-scan examination was done to rule out any posterior segment pathology.

In every case, cataract surgery was performed through a clear corneal incision. The anterior chamber was completely filled with air. Through a 26-gauge cannula, 0.2 ml of 0.1% Trypan blue was injected into the anterior chamber (Fig-1). After 5-10 seconds, the anterior chamber was thoroughly irrigated with balanced salt solution (BSS) to wash out the excess dye. Hydroxypropylmethylcellulose (HPMC 2%) was injected into the anterior chamber to counter the effects of raised IOP. Capsulorrhexis was performed with a bent 26 gauge needle. Because of the blue stain of the anterior capsule, the outline of the capsulorrhexis was clearly visible; this could easily be distinguished from the underlying grayish-white lenticular tissue (Fig - 2). Throughout the surgical procedure, the view was not hampered. Subsequently, the patients were examined on day 1, 7 and at the end of

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1 and 3 months postoperatively. At every visit, visual acuity assessment, slitlamp biomicroscopy, (with special emphasis on anterior chamber reaction), IOP measurement and fundus evaluation were done. Evaluation of the safety of the dye was performed on the basis of intraoperative and postoperative observations.

Results

In this study, this technique was used in 100 patients with mature and hypermature senile cataract. Fifty five patients were males, and the age range was 48 - 89 years (mean 61.3 ± 9.2 years). Forty five patients were females and the age range was 52 - 81 years (Mean 64.1 ± 4.3 Years). In all 100 patients, the capsulorrhexis was completed. Successful cataract surgery and in-the-bag IOL implantation was performed in all the cases. No intraoperative complications were encountered. The intraoperative observations indicating the safety of the dye were: the dye could be easily washed out with BSS; the dye stained only the anterior capsule; and it did not hamper the surgical view through the microscope during surgery either by coating the endothelium or by causing corneal haze.

On the first postoperative day, visual acuity ranged from 6/9 to 6/18. Slitlamp examination did not show residual staining of the anterior capsule. Five eyes (5%) had corneal oedema localised to the area of the incision which resolved at the end of one week. The anterior chamber reaction, ranged from 1+ to 2+ cells and 0 to 1+ flare; this subsided at the end of one week with topical 1% prednisolone acetate. None of the eyes had raised IOP postoperatively.

All these patients were followed up for a mean period of 3 months. At the end of three months, all eyes had a best corrected visual acuity of 6/6. Thus, intra-or postoperative adverse effects from the use of Trypan blue dye were not observed.

Discussion

Mature and hypermature cataracts constitute a significant volume of the cataract surgical load in ophthalmic practice in developing countries. A number of methods have been described in the past decade to enhance the visualization of the anterior capsule during CCC in advanced, white, intumescent, or hypermature cataracts (10-16).

Bis-azo dyes such as trypan blue, stain poorly hydrated tissues better than well hydrated ones. Trypan blue selectively stains the basement membrane of the anterior lens capsule adjacent to the epithelial cell layer. The lens cortex consisting of lens fibers has high water content and so remains unstained, resulting in marked color contrast between these two structures (17).

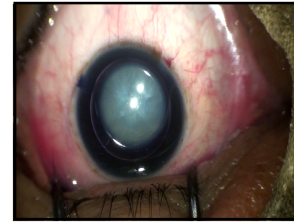


Fig 1. Shows Trypan blue Dye Injected into the Anterior Chamber

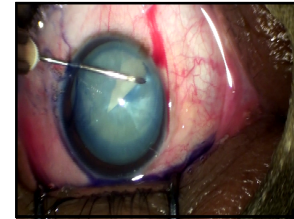


Fig 2. Shows Marked Color Contrast Between Capsule and Cortex of Lens During Capsulorrhexis

Use of 0.5% trypan blue was described in the literature in 1966 (18), and the clinical safety was proved in 1970 (19). It was initially suggested as a simple, practical, and safe method for evaluating donor corneas prior to grafting. Harmful effects on endothelium were not observed either in experimental tests and clinical trials. 0.1% Trypan blue has been used clinically to examine endothelial cell damage after cataract extraction without adverse effects even at 8 years of follow-up (20). Trypan blue 0.3% is also routinely used to examine the endothelial cell layer of the donor corneoscleral buttons prior to corneal transplantation at the Dutch National Eye Bank (21) and endothelial toxicity is not reported in 32,000 organ cultured corneas. Hence, when used in a concentration of 0.1%, Trypan blue is unlikely to cause any toxicity to the endothelium or other intraocular structures. The chances are less likely since the excess dye can be washed out soon after it is applied to the lens capsule.

Two surgical techniques have been used for anterior capsular staining viz. 1) staining under an air bubble and 2) intracameral subcapsular injection. (Table 3).

In our study, quick and homogeneous staining of the anterior capsule was obtained in all cases. We observed that a uniform large single air bubble is essential for staining of the anterior capsule. Multiple, small air bubbles cause irregular staining of the anterior capsule. The air in the anterior chamber causes the dye to spread over the anterior capsule, bordered by the pupillary rim of the iris, thus preventing a direct endothelial contact. The air also prevents dilution of the dye by the aqueous (9) so that the lowest effective concentration could be used. In hypermature cataracts, escape of the milky cortex on

Table 1. Use of Dyes in Ophthalmology

Segment	Structure Stained	Use	Dye
Anterior	Cornea	Epithelial defects	Fluorescein Sodium
		Contact Lens Fitting	Fluorescein Sodium
		Seidel's Test	Fluorescein Sodium
	Iris	Dry Eye	Fluorescein Sodium, Rose Bengal
		Diagnosis of Keratitis	Fluorescein Sodium, Rose Bengal
		Endothelial cell count	Trypan Blue
	Lens	Neovascularisation	Fluorescein Sodium, Indocyanine Green
		Capsulorhexis (Poor or no red reflex)	Fluorescein Sodium, Indocyanine Green, Trypan Blue
		Dye enhanced cataract	Indocyanine Green, Trypan Blue
Posterior	Retina	Angiography	Fluorescein Sodium, Indocyanine Green.
	Vitreous	Vitrectomy	Fluorescein Sodium, Indocyanine Green.
	Vitreoretinal	Internal limiting membrane peeling	Indocyanine Green, Trypan Blue

Table 2. Characteristics of Three Dyes Used for Anterior Capsule Staining

Dye	Concentration	Advantages	Disadvantages
Fluorescein Sodium	2 %	Blue light enhancement can be used	Low molecular weight : vitreous leakage, staining of the cornea . Probability of allergic reaction.
Indocyanine green	0.5%	High molecular weight : No vitreous leakage	Cost may be prohibitive. Needs to be reconstituted. Shelf life only 10 hours.
Trypan blue	0.1%	Economical. High molecular weight : No vitreous leakage, no corneal staining.	Not indicated in pregnant/ fertile females and children

the nicking of anterior capsule did not affect the staining of the capsule. In such cases we removed as much of the milky cortex as possible before proceeding with the capsulorhexis. An additional benefit of staining the anterior capsule with Trypan blue was that the peripheral anterior capsule rim remained clearly visible during surgery. This is advantageous and helps avoid damage to the capsule

in cases with capsulorhexis of small diameter or in those with small pupils. As an additional advantage it also aids in-the-bag IOL placement. Apart from assisting in visualization of rhexis in mature and hypermature cataracts, this technique can also be utilized by surgeons who plan to convert their technique of capsulotomy from can-opener type to Capsulorhexis (3). Intraoperatively

Table 3. Characteristics of Two Techniques Used for Anterior Capsule Staining

Staining under an air bubble				Interacamer al subcapsular injection			
Advantages		Disadvantages		Advantages		Disadvantages	
Technically less invasive	less	Air-filled anterior chamber is unsteady.	is	Dye remains trapped in the subcapsular space	Technically more invasive		
Staining of the peripheral capsular rim, providing good visibility while performing phacoemulsification.	of the anterior rim, good while performing phaco-	Progressive dilution of the dye by aqueous.		Good staining of the posterior surface of the capsular flap	Tear of the anterior capsule if excessive injection of dye		
Safer in intumescent and hypermature cataracts.	intumescent and hypermature			Technically more invasive			
				Injection hole can be used for initiating capsulotomy.	Anterior capsule tear in intumescent cataracts.		

this dye was easily washed out with BSS. It stained only the anterior capsule and did not hamper the surgical view either by coating the endothelium or by causing corneal haze. There was no anterior chamber inflammation or rise in IOP postoperatively.

Conclusion

Use of Trypan blue is a useful and safe technique, which simplifies Capsulorrhesis in mature and hypermature cataracts.

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