

Study of anterior capsule staining with Trypan blue dye for Capsulorrhesis in mature and hypermature cataract

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Abstract

Introduction: Cataract is the commonest cause of avoidable blindness worldwide and cataract surgery is the commonest procedure performed in ophthalmology.² Improvements in surgical accessories paved the way for Extracapsular cataract extraction (ECCE) to be recognized. ECCE was based on creating an opening "capsulotomy" in the anterior capsular bag through which the lens nucleus could be "prolapsed". The Continuous Curvilinear Capsulorrhesis (CCC) technique has improved significantly the safety of cataract extraction and in-the-bag intraocular lens (IOL) implantation.³ Inadequate visualization of the capsule in cases carries a high risk of peripheral extension of the advancing edge towards or beyond the lens equator with its attendant complications. This can be obviated if the anterior capsule can be temporarily stained with any contrasting dye.⁴ Of the numerous dyes encountered only Trypan blue is US Food and Drug Administration (FDA) approved. The most common technique of staining involves injection of Trypan blue under an air bubble and subsequently washing the excess dye out.⁵ **Aims and Objectives:** The present study was carried out to evaluate the efficacy and safety of 0.1% Trypan blue dye for enhancing visualization of anterior capsule during Small incision cataract surgery (SICS). To observe various complications both intra-operative and postoperative due to incomplete Capsulorrhesis. **Material and Methods:** The present study was conducted on patients admitted in the Department of Ophthalmology from August 2012 - July 2014. The study comprised of 100 patients. In this study Trypan blue dye (0.1%) was used for visualization of anterior capsule to perform CCC. All the cases of mature and hypermature cataracts with minimum visual acuity of perception of light (PL) and projection of rays (PR) and Patient above the age of > 40 years were included. **Results:** It was found that maximum numbers of cases (61%) were between 60- 69 years of age. 44% of the patients were males while 56 % were females. Maximum numbers of cases were of mature cataract (78%). Capsulorrhesis was completed in 96 of the Patients. 4 had extension of Capsulorrhesis margin. Intra-operatively 4 cases had PC tear and one patient had vitreous loss. Hyphaema was seen in 3 cases. While striate keratopathy was seen in 2 cases and mild iritis was seen in 5 cases on first day postoperatively. Decentration of lens was seen in 3 cases and all these cases had intraoperative PC tear. 3 cases had Cystoid macular oedema. BCVA, of all the patients 78 % cases had 6 / 6 - 6 / 12 and 16 % cases had 6/18 - 6 / 36. **Conclusion:** It was concluded from the present study that techniques of anterior capsule staining with Trypan blue 0.1 % dye is very safe and provides excellent visualization of anterior capsule during CCC. The dye can also be useful when training residents in the technique of CCC.

Keywords: Cataract, Capsulorrhesis, Trypan blue.

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Received Date: 16/01/2016 Revised Date: 14/02/2016 Accepted Date: 10/03/2016

Access this article online

Quick Response Code:



Website:

www.statperson.com

DOI: 12 March 2016

INTRODUCTION

Cataract is the commonest cause of avoidable blindness worldwide¹ and cataract surgery is the commonest procedure performed in ophthalmology.² Cataract surgery is a rapidly evolving area in ophthalmology. Several decades ago, the most commonly performed surgical intervention for cataract was lens removal (in its entirety) through a large limbal incision. This technique, later named as Intracapsular cataract extraction (ICCE) involved severing of zonular attachments (either

mechanically or enzymatically) in an attempt to remove the entire lens through a large corneo-scleral incision. Improvements in surgical accessories paved the way for Extracapsular cataract extraction (ECCE) to be recognized by ophthalmologists worldwide. ECCE was based on creating an opening "capsulotomy" in the anterior capsular bag through which the lens nucleus could be "prolapsed". A critical step in ECCE (either ECCE by Phacoemulsification or the conventional ECCE) is making a window in anterior capsule wall (i.e. anterior capsulotomy). Techniques employed for this task have undergone sustained evolution. The Continuous Curvilinear Capsulorrhexis (CCC) technique has improved significantly the safety of cataract extraction and in-the-bag intraocular lens (IOL) implantation.³ The red fundus reflex produced by coaxial light of the microscope is essential to visualize the capsule while performing Capsulorrhexis. Hence when this retro illumination is absent, such as in the mature and hypermature cataracts, it is difficult to identify the propagating edge of the Capsulorrhexis. There is considerable difficulty to distinguish the advancing edge of the anterior capsule from the underlying white lens matter. Inadequate visualization of the capsule in such cases carries a high risk of peripheral extension of the advancing edge towards or beyond the lens equator with its attendant complications. This can be obviated if the anterior capsule can be temporarily stained with any contrasting dye.⁴ Of the numerous dyes encountered in the Capsulorrhexis literature (including Indocyanine green (ICG), Trypan blue, Fluorescein, Crystal violet, Gentian violet and Brilliant Blue G (BBG), only Trypan blue is US Food and Drug Administration (FDA) approved. The most common technique of staining involves injection of Trypan blue under an air bubble and subsequently washing the excess dye out.⁵ The dye can also be applied beneath an OVD (Ophthalmic Viscoelastic Device),⁶ with OVD in a mixture form,⁷ through a three steps method [(in which Trypan blue stains anterior capsule via a BSS (Balanced salt solution) shell that forms on the anterior capsule after applying OVD)]⁸ or by dispersing a dye droplet on the anterior capsule by a delicate spatula which hinders dye diffusion into the anterior chamber.⁹ Recently Melles *et al* reported the use of 0.1% Trypan blue to perform CCC in cataracts without red reflex. They advocated the use of an air bubble in the anterior chamber with injection of the stain between the air and the anterior capsule to prevent its dilution.⁵ This study aimed to evaluate the use of Trypan blue dye for enhancing visualization of anterior capsule during Small incision cataract surgery (SICS).

MATERIAL AND METHODS

The present study was conducted on patients admitted in the Department of Ophthalmology from August 2012 - July 2014. The study comprised of 100 patients. In this study Trypan blue dye (0.1%) was used for visualization of anterior capsule to perform CCC in all 100 patients that underwent Small incision cataract surgery (SICS) with in the bag IOL implantation by Phaco sandwich technique of Dr Luther L. Fry.

Inclusion Criteria

1. All the cases of mature and hypermature cataracts with minimum visual acuity of perception of light (PL) and projection of rays (PR)
2. Patient above the age of > 40 years

Exclusion Criteria

1. Cases with immature, complicated, traumatic, congenital / developmental cataract
2. Cases with corneal opacity, strabismus, glaucoma or history of glaucoma surgery or lens induced glaucoma.

Preoperative Evaluation

All the patients selected for the study according to above criteria were subjected to detailed ocular examination:

1. Thorough torch light examination of the anterior segment, Assessment of visual acuity, Slit lamp examination for examination of corneal status, anterior chamber depth, iris details, pupillary reactions, type of cataract.
2. IOP measurements by Schiötz tonometer, Sac syringing to rule out dacryocystitis, Keratometry for K1 and K2 values, 'A' scan to calculate the axial length. (AL), IOL power calculation by modified SRK formula.

Baseline investigations

Blood sugar level (Random), Urine sugar level (Random), ECG and blood pressure monitoring with medical fitness for asthma, systemic hypertension, diabetes mellitus, ischaemic heart disease. Preoperative mydriatic eye drop Topical plus for dilatation of pupil- Good mydriasis was achieved in all cases with a combination of tropicamide and phenylephrine eye drops. Flurbiprofen eye drops were used four times one hour prior to surgery. All operations were performed under peribulbar anaesthesia using 6 ml of 2 % xylocaine with 1:200000 adrenaline mixed with hyalarunidase and bupivacaine 0.5% for ocular anaesthesia and globe akinesia. Digital pressure was applied for achieving hypotony.

Follow up

All patients were followed up at 1st post-operative day, 1 week, and 40 days after surgery. All patients received topical 1 % prednisolone eye drops and ofloxacin eye drops postoperatively for forty days. Follow-up

examinations included a complete biomicroscopic examination, naked eye visual acuity, best correctable visual acuity, IOP examination, Fundus examination at 1, 7 and 40 days respectively.

RESULTS

The data of total 100 patients was analyzed and presented in tabular form.

Table 1: Distribution of patients according to Age and Sex

| Age (Years) | Male | Female | Total |
|--------------|-----------|-----------|------------|
| <50 | 03 | 02 | 05 |
| 50-59 | 11 | 14 | 25 |
| 60-69 | 28 | 33 | 61 |
| >70 | 02 | 07 | 9 |
| Total | 44 | 56 | 100 |

Table shows that out of 100 cases, maximum numbers of cases (61%) were between 60- 69 years of age. 44% of the patients were males while 56 % were females.

Table 2: Distribution of patients according to the type of Cataract

| Type Of Cataract | Number Of Patients |
|------------------|--------------------|
| Mature | 78(%) |
| Hyperature | 22(%) |
| Total | 100 |

Table shows that maximum numbers of cases were of mature cataract (78%) while the rest were hyperature cataract (22%).

Table 3: Distribution of patients according to the fate of capsulorrhexis

| Fate Of Capsulorrhexis | Cases With Completion Of CCC | Cases With Extension Of CCC | Total |
|------------------------|------------------------------|-----------------------------|------------|
| Mature cataract | 77(%) | 01(%) | 78(%) |
| Hyperature Cataract | 19(%) | 03(%) | 22(%) |
| Total | 96 | 04 | 100 |

Table shows that Capsulorrhexis was completed in 96 of the Patients. Of the 96 patients, 77 were of mature cataract and 19 were of hyperature cataract. 4 had extension of Capsulorrhexis margin of which 1 was mature cataract and 3 of hyperature cataract.

Table 4: Distribution of patients according to the Intra-operative complications

| Type Of Complication | Number of patients |
|------------------------|--------------------|
| Hyphaema | 03(%) |
| Posterior Capsule tear | 04(%) |
| Vitreous loss | 01(%) |
| Extension of CCC | 04(%) |

Table shows that 4 patients had extension of CCC, 4 had PC tear and one patient had vitreous loss. Hyphaema was seen in 3 cases.

Table 5: Distribution of patients according to the Postoperative Complications

| Type Of Complication | Number Of Patients |
|------------------------|--------------------|
| Striate keratopathy | 02(%) |
| Iritis | 05(%) |
| Decentration of lens | 03(%) |
| Cystoid macular oedema | 03(%) |

Table shows striate keratopathy was seen in 2 cases and mild iritis was seen in 5 cases on first day postoperatively. Decentration of lens was seen in 3 cases and all these cases had intraoperative PC tear. 3 cases had Cystoid macular oedema. Two of which had posterior capsule tear intra-operatively and one had posterior capsule tear as well as vitreous loss.

Table 6: Best corrected visual acuity (BCVA) at 40 Days

| Visual Acuity | Number Of Patients |
|---------------|--------------------|
| 6/6 - 6/12 | 78(%) |
| 6/18 - 6/36 | 16(%) |
| < 6 / 36 | 06(%) |

Table shows that BCVA, of all the patients 78 % cases had 6 / 6 - 6 / 12 and 16 % cases had 6/18 - 6 / 36.

DISCUSSION

The present study was undertaken in the Department of Ophthalmology between the period of August 2012 to July 2014. Trypan blue, a vital stain, is taken up only by dead or damaged endothelial cells, and the normal cells remain unstained. Use of 0.5% Trypan blue was described in the literature in 1966,¹⁰ and the clinical safety was proved in 1970.¹¹ 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.⁴ The present study comprised of 100 patients of mature and hyperature cataract. In the present study we observed that, out of 100 cases, most numbers of cases (61%) were seen in the age group of 60 - 69 years of age which is within the range of 40 -70 years which is the normal age of senile mature and hyperature cataract. Majority of our patients i.e. 56 % were females while males constituted 44% of the patients in our study. The results of present study are in accordance with the following studies. Chakrabarti *et al*¹² (2008), Ziakas *et al*¹³ (2009) studied the impact of Trypan blue on CCC in various grades of cataract in 200 consecutive patients whose anterior capsules were stained by Trypan blue. In their study the average age of patients was 65 (range 38 to 83) which was comparable to our study. They concluded that, use of Trypan blue should be strongly considered for Capsulorrhexis in white cataracts. Out of the 100 patients in the present study, maximum number of cases i.e. (78%) were of mature cataract while the rest i.e. (22%)

were hypermature cataract. Venkatesh *et al*¹⁴ studied 100 cases of white cataracts with Trypan blue staining where 67 cases were mature and 17 cases were hypermature cataract which is comparable to our study. In the present study after performing CCC on all the 100 patients whose anterior capsule was stained with 0.2 ml of (0.1 %) Trypan blue it was observed that Capsulorrhesis was completed in 96 % of the patients while extension of Capsulorrhesis with posterior capsule tear was noted in 4 % patients. In all the 4 patients in whom extension of Capsulorrhesis margin was observed, CCC was converted into can openers capsulotomy. Out of the 4% cases of extension of Capsulorrhesis with posterior capsule tear, 3% patients were of hypermature cataract where in spite of good staining with Trypan blue dye, inherently weak zonules and high intralenticular pressure might have led to extension of CCC and posterior capsule tear. Jacob *et al*¹⁵ (2001), Melles *et al*⁵ (1999) studied 52 eyes In all the cases, Trypan blue was used under air to stain the anterior lens capsule. The CCC was completed uneventfully in 96.15% eyes; 3.85% of cases had to be converted to a conventional extraction technique because of the loss of the CCC. Present study is in consistence with these studies. In the present study on all the 100 cases, SICS with posterior chamber IOL by phacosandwich technique was performed after staining anterior capsule with Trypan blue and various intraoperative complications were observed. Posterior capsular tear and extension of CCC were complications seen during Capsulorrhesis in 4 % of patients. All the four patients having extension of CCC had posterior capsule tear. Of the four patients with extension of CCC, three were found to be in hypermature cataract. This could have been because of the high intralenticular pressure and the zonular weakness inherently seen in hypermature cataracts. Extension of CCC occurred in one case of mature cataract. Out of these four patients one had vitreous loss, but as the tear was small in the bag IOL implantation was possible in all cases. Hyphaema was seen in three cases which were due to bleeding vessels in the scleral wound but it was corrected on the table by aspiration and none had postoperative hyphaema. Of the various postoperative complications seen in our study senate keratopathy was seen in two cases due to intraoperative injury to endothelium by wire vectis in our phacosandwich technique of SICS, however this striate keratopathy resolved completely at 7 days follow up after treatment with multivitamins and natural healing process. Mild iritis was seen in five cases on first day postoperatively however this iritis resolved completely at 7 days follow up after treatment with topical antibiotic and steroid eye drops. Decentration of lens was seen in three cases and all these cases had intraoperative posterior capsule tear. hree

cases had cystoid macular oedema. Cystoid macular oedema was confirmed in all the cases by vitreoretinal specialist using standard bio microscopy techniques with a fundal contact lens. Two of which had posterior capsule tear intraoperatively and one had posterior capsule tear as well as vitreous loss. Kothari K *et al*⁴ (2001) studied the efficacy and safety of 0.1% trypan Blue dye to stain the anterior capsule for Capsulorrhesis in mature and premature cataracts. They included 25 eyes of 25 patients with a unilateral mature of hypermature cataract, including one case of traumatic mature cataract. In all these cases 0.2ml of 0.1% Trypan blue dye was used to stain the anterior capsule. The efficacy and safety of the dye was evaluated on the basis of intraoperative and postoperative observations. On the first postoperative day, visual acuity ranged from 6/6 to 6/18. Slit lamp examination did not show residual staining of the anterior capsule. Five patients (20%) had corneal oedema localized to the area of the incision which resolved at the end of one week. The anterior chamber reaction, ranging 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. At the end of 1 month all eyes had a best corrected visual acuity of 6/6. Venkatesh *et al*¹⁴ (2005) assessed the safety and efficacy of Manual Small Incision Cataract Surgery (MSICS) in cases of white cataract the use of Trypan blue as an adjunct for performing continuous curvilinear Capsulorrhesis (CCC). They studied 100 consecutive eyes of 100 patients with white cataract who had undergone MSICS with Trypan blue assisted CCC. Capsulorrhesis tear was converted to can-opener type of capsulotomy in 4 cases (4%). All the four cases were intumescent and all of them developed intraoperative miosis. Immediate postoperative complications such as corneal oedema was found in 13% of the cases. However, all of them were resolved with medical therapy by the time of discharge. Final visual outcome on the 40th postoperative day was satisfactory, with 94% of patients having BCVA of 6/9 or better. Jacob *et al*¹⁵ (2001) assessed the feasibility, risks, and postoperative outcomes of phacoemulsification with posterior chamber intraocular lens (PC IOL) implantation in cases of white cataract with the use of Trypan blue as an adjunct for performing continuous curvilinear Capsulorrhesis (CCC) in the absence of a red reflex. The CCC was completed uneventfully in 96 % eyes; 4 % of cases had to be converted to a conventional extraction technique because of the loss of the CCC. Intraocular complications included incomplete Capsulorrhesis (4%) and pupillary miosis (4%). Postoperatively, 3 eyes (6%) had corneal oedema (striate keratopathy) and 1 eye (2%) had fibrin in the anterior chamber. Five eyes (9.61%) had more than

2+ cells and flare at 2 weeks. All responded well to intensive topical and subconjunctival steroids. There were no cases of endophthalmitis. The mean central endothelial cell loss, measured in 37 eyes, was 8.5%. Of the 4 eyes (7.69%) that had increased intraocular pressure (IOP) postoperatively, all responded well to medications and the IOP was normal by the second postoperative week. Fifty eyes (96%) had a final best corrected visual acuity of 20/30 or better. In 2 cases, the final visual acuity was worse than 20/200 because of pre-existing posterior segment pathology.

SUMMARY AND CONCLUSION

Following are the conclusion of the present study,

- Out of 100 cases maximum numbers of patients were in the age group of 60 - 69 years of age.
- Maximum were male patients.
- Right eye was affected more
- Mature cataract was seen in maximum patients
- CCC was completed in maximum patients with Extension of Capsulorrhexis only in 4 cases.
- Very few intraoperative complications were noted.
- Postoperative complications were managed medically.
- BCVA of all the patients was between 6/6 -6/12 in 78%cases.
- There were no complications attributable to the Trypan blue 0.1 % dye.

Thus, it was concluded from the present study that techniques of anterior capsule staining with Trypan blue 0.1 % dye is very safe and provides excellent visualization of anterior capsule during CCC. It is useful for beginner to convert extracapsular cataract extraction to small incision cataract surgery with CCC. The dye can also be useful when training residents in the technique of CCC.

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Source of Support: None Declared
Conflict of Interest: None Declared