Ultrasound Immersion Technique in the Management of Intra-lenticular Foreign Body in Low Resource Setting: A Case Series

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ABSTRACT

Introduction: The eye hospitals of low-income countries including Nepal are not equipped with imaging modalities including CT scan, UBM and Pentacam but most of them have ophthalmic ultrasound. We evaluate the utility of routine ultrasound for proper localization and confirmation of the intra-lenticular foreign body along with detection of the status of the posterior capsule using immersion technique.

Case: Four consecutive cases with intra-lenticular foreign bodies presenting to the vitreo-retina department of Lumbini Eye Institute were included in the study. Ultrasound immersion technique was used to detect the ILFB along with x-ray. Planned ILFB removal with phacoemulsification or lens aspiration and foldable IOL implantation as a single-stage procedure was done in all the patients. They were followed up to 3 months after the surgery.

Observations: Intra-lenticular location of IOFB was confirmed by ultrasound immersion technique in all 4 eyes. Intactness of the posterior capsule was also detected preoperatively in all 4 eyes. ILFBs were removed with Utrata's capsulorrhexis forcep in all cases following capsulorrhexis. Phacoemulsification was performed to remove cataract in 2 cases whereas lens aspiration with Simcoe canula was performed in other two cases. Single piece acrylic foldable intraocular lens was implanted in all cases. Posterior capsule was intact in all 4 cases intra-operatively. Features of siderosis were observed in one case. Mild postoperative uveitis was seen in all cases and was controlled with topical steroids. Best corrected visual acuity at the last examination was 6/9 or better in all cases.

Conclusions: Ultrasound immersion technique is very useful tool in management of intra-lenticular foreign body at least in low resource setting. Phacoemulsification /lens aspiration with ILFB removal and IOL implantation provides good visual outcome in these eyes.

Key words: Intra-lenticular foreign body, Low resource setting, Phacoemulsification, Ultrasound immersion technique.

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INTRODUCTION

Intra-lenticular foreign bodies (ILFB) account for 5 to 10 % of intraocular foreign body (IOFB) (Arora et al, 2000). According to Ehlers et al (2008), the risk factors of ILFB include male sex and not wearing eye protection while hammering and welding. The presence of corneal wound and iris hole direct the possibility of IOFB. They can be either metallic or nonmetallic. Cilia, glass, stone, vegetable matter and coal may be non-metallic ILFBs, while metallic ILFBs often contain iron and copper (Arora et al, 2000). Retained ferrous ILFB can cause siderosis bulbi. Siderosis bulbi manifests as iris heterochromia, mydriasis, cataract, chronic uveitis, secondary glaucoma, retinal degeneration, and swelling of the optic nerve (Lee et al, 2007).

In slit-lamp microscopy, few IOFBs can be detected. Imaging, like ultrasound, x-ray or computed tomography (CT), must be performed to confirm and locate it. CT scan is the gold standard to rule out IOFB and its localization. Ultrasound bio-microscopy [UBM] uses high-frequency (50 MHz) sound waves to detect IOFBs in the angle, ciliary body, lens, and retrolental space. These imaging modalities are not available in all settings (Loporchio et al,2016). Low frequency (15MHz) ultra-sonography is widely available even in low resource settings to screen posterior segment in media opacity. It can only image the structure posterior to the posterior lens capsule, due to the dead zone around the tip of the probe (Fisher, 1979). The ultrasound immersion technique reveals anterior segment structures with photos of good quality as it eliminates dead zone holding probe at the right distance from the eye in the sound spreading medium (Pastena et al, 1998 & Coleman et al, 1979). The Scheimpflug image is also used to display the ILFB image and the posterior capsule status (Singh et al,2015 & Grewal et al, 2005).

In view of sight-threatening complications, including siderosis bulbi, endophthalmitis and cataract, the majority of ophthalmologists prefer early surgical intervention in ILFB. .Currently, phacoemulsification with intraocular lens implantation (IOL) and ILFB removal has become the standard of treatment in the absence of posterior capsular rent(Singh et al,2015 & Grewal et al, 2005).

In our hospital we don't have facilities of UBM, scheimpflug imaging and CT scan. Thus, to confirm the diagnosis of ILFB and detect the status of posterior capsule we use Low frequency (15 MHz) Ultrasonography with an immersion technique. Same Low frequency (15 MHz) Ultrasonography with contact technique was used to rule out other IOFB.

MATERIALS AND METHODS

This is a prospective interventional case series conducted at the vitreo-retina department of Lumbini Eye Institute and Research center, Bhairahawa, Nepal from June 2019 to December 2019. Ethical approval from the institutional review committee was obtained and the study

was conducted in full accord with the tenets of the Declaration of Helsinki.

All consecutive cases with intra-lenticular foreign bodies were included in the study. Informed consent for the study and treatment was obtained from each patient. Cases with IOFB elsewhere (detected on slit lamp examination, X-ray orbit or ultrasonography B-scan with contact technique), initial visual acuity of No perception of light and not willing to give consent were excluded. Demographic data, circumstances of trauma, clinical findings including visual acuity, status of entry wound, iris finding, foreign body characteristics (size and chemical composition), lens status (clear or cataractous) and time of presentation were collected in each case. Ultrasound immersion technique, x-ray orbit and anterior segment photography were done in each case. Ultrasound immersion techniques were performed by a single Ophthalmologist (vitreo-retina Fellow). Planned ILFB removal with phacoemulsification or lens aspiration and foldable IOL implantation as a single-stage procedure was done in all the patients. All the surgeries were performed by a single ophthalmologist (Vitreo-retina surgeon). ILFB was removed after the completion of capsulorrhexis by Utrata's forcep before hydrodissection. They were followed up for 3 months after the surgery. The follow up schedule was on the first postoperative day, 7th postoperative day, 30th postoperative day and at 3 month of surgery. Visual acuity, Intraocular pressure, status of anterior chamber, IOL status, status of posterior capsule and posterior segment examination were performed in each visit. Retinoscopy was performed at the 30th day postoperative visit and needed refractive correction was provided. Each patient received a 5 day course of oral Ciprofloxacin 500 milligram twice a day, topical Ofloxacin (0.3%) 6 times a day for 2 week, Topical Prednisolone (1%) 6 times a day for 7 days followed by tapering dose till 1 month and topical Tropicamide (1%) at bedtime for 7 day.

OBSERVATIONS

A total of 4 eyes of 4 patients with ILFB who underwent ultrasound immersion technique evaluation and phacoemulsification or lens aspiration surgery were evaluated. The mean age of the study participants was 29.75 years (20–42 years). All 4 patients were male. Two patients were carpenters, one was an electrician and one was a construction site worker by occupation. Trauma occurs to all patients at the workplace while hammering in 3 cases and while grinding in 1 case. Three patients had ILFB in the right eye while one had in the left eye. The duration between trauma to the day of presentation ranged from 1 month to 6 months (mean = 3 months). None of the patients had used protective goggles at the time of trauma.

All of our patients received some eye drops following trauma from a local health care provider without any documentation for a few days.The presenting visual acuity ranged from Hand movement (HM) to 6/36 in Snellen's

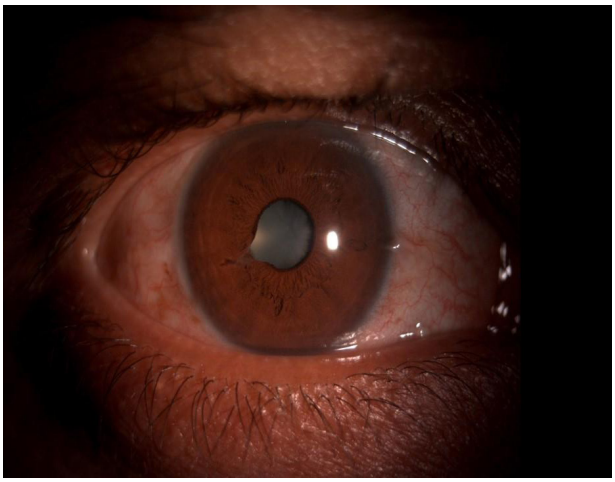

Figure 1: Anterior segment photograph showing corneal self sealed entry wound, sphincter tear in iris and cataractous lens and intralenticular foreign body.

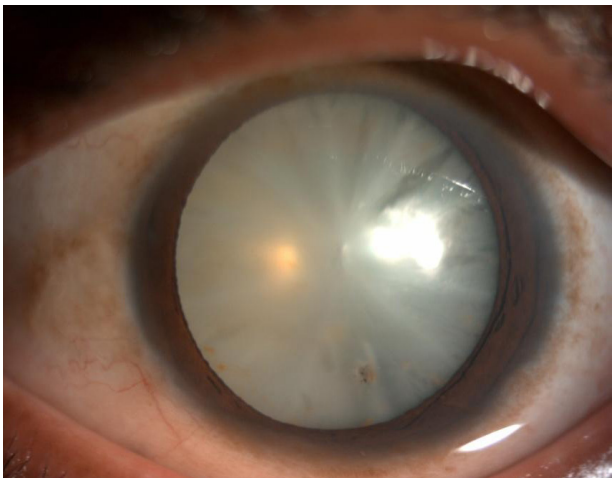

Figure 2: Anterior segment photograph showing atropinised pupil with total cataract, Ferrous ILFB and flecks of rust on lens suggestive of siderosis.

chart. Corneal entry wound was self -sealed in all cases. Iris hole was noted in 3 patients and sphincter tear in 1 patient. Total Cataract was present in all 3 eyes and localized cataract in 1 eye. Features of siderosis were detected in one case who presented after 6 months of injury. These clinical findings are depicted in figures 1 and 2.

Ultrasound immersion technique could localize IOFB within the lens in all 4 cases as high reflective hyperechoic dot echo in the lens and it also detect intact posterior capsule as continuous hyperechoic membrane with concavity anteriorly in all 4 cases (**Figure 3**). X-ray orbit showed a radiopaque tiny shadow in all cases but couldn't give any clue about the status of the posterior capsule. This finding was compared with an intraoperative finding where ILFB was within lens in all cases and posterior capsule was intact in all cases.

All patients underwent cataract surgery with extraction of ILFB and in the bag implantation

Figure 3: Ultrasound A-B scan immersion technique photograph showing high reflective dot echo within lens matter with intact posterior capsule confirming diagnosis of intralenticular foreign body.

Table 1: Summary of all the cases.

Case no	Age/ sex	eye	occupation	Time interval between injury and presentation	Mechanism of trauma/use of protective goggles	Initial VA	Entry wound/ cataract	ILFB	PC	Final VA
1.	20/M	R	carpenter	3 months	Hammering/ no	HM	Self-sealed / total cataract	Metallic (iron)	intact	6/6
2.	27/M	L	electrician	2 months	Grinding/ no	HM	Self-sealed / total cataract	Metallic (iron)	intact	6/6
3.	42/M	R	Construction site worker	6 months	Hammering/ no	6/36	Self-sealed/ localized cataract	Metallic (iron)	intact	6/9
4.	30/M	R	carpenter	1 month	Hammering/ no	HM	Self-sealed/ total cataract	Metallic (iron)	intact	6/9

Abbreviations: M=male, R= right, L= left,VA= visual acuity, HM= hand movement,
ILFB= intralenticular foreign body, PC= posterior capsule of lens

of single piece acrylic foldable IOL. ILFB was extracted successfully in all 4 cases. ILFB was iron in all 4 cases. Size of ILFB ranged from 1 mm to 2 mm. Postoperative anterior uveitis was observed in all cases which recovered with topical steroid instillation. Visual acuity at 45 days follow-up ranged from 6/6 to 6/12 in all cases despite siderosis in one eye. Summary of all the cases is shown in table 1.

DISCUSSION

The traumatic ILFB accounts for just 5-10% of all IOFB. This affects young male workers in this series, as most other writers have shown (Arora et al 2000, Coleman et al 1979, Singh et al 2015, Grewal et al 2006 & Reddy 2011). Almost all patients present late in this series, as asymptomatic minor penetrating ocular injuries with ILFB occur, similar to other studies. Before visually significant cataracts form, they may be ignored, neglected or undervalued by developing world patients (Arora et al 2000, Lee et al 2007, Singh et al 2015 & Cazabon et al 2002).

All injuries in this study occurred during work without the use of protective spectacle during hammering, as found in other studies indicating that the best preventive measure is the use of protective spectacle during hammering and welding by workers (Arora et al 2000, Singh et

al 2015, Grewal et al 2006, Reddy et al 2011, Daryabari et al 2018 & Cazabon et al 2002).

The chief complaint in this series is gradual loss of vision in the affected eye as reported by Arora et al and Singh et al from India (Arora et al 2000, Singh et al 2015) whereas authors from western country observed redness, pain and watering (Lee et al 2007, Daryabari et al 2018 & Cazabon et al 2002) indicating poverty, ignorance and lack of awareness regarding trauma in people of Nepal and India.

Corneal wound was self-sealed and opacified in all 4 cases in this study similar to most of the cases in other study, only few of them need primary repair (Arora et al 2000, Lee et al 1979, Singh et al 2015, Grewal et al 2006, Reddy et al 2011, Daryabari et al 2018 & Cazabon et al 2002). Iris hole was seen in all case in this study whereas other reports did not mention about it, might be due to its irrelevance on the management. Cataract is found in all 4 cases in this series, 3 of them were total cataract and one was localized whereas Arora et al showed total cataract in 50%, localized cataract in 37.5% and subluxated absorbed cataract in 12.5% of cases in their case series (Arora et al 2000). Posterior capsule was intact in all cases in this case series detected on ultrasound immersion technique whereas Arora et al (2000) detected posterior capsular defect in 25% of cases which has an important role in the decision making to choose the treatment option.

Routine ultrasound contact technique was used to screen posterior segment and search for IOFB in this study showed absence of any IOFB and posterior segment abnormality in all cases. Immersion technique was applied to search for IOFB in the lens, ciliary body and sulcus as it removes dead space around the probe, provides better resolution and lesser pressure on the already traumatized eye (Coleman et al, 1979). Intralenticular foreign body appears as a highly reflective echo of various sizes with back-shadowing on ultrasound, which can detect ILFB of as small as 0.2 mm size. The posterior capsule can be seen as a continuous concave membranous echo with high amplitude (Coleman et al, 1979). This procedure has not been used by other reports to detect ILFB and see posterior lens capsule intactness; instead, they have used costly computed tomography scans, ultrasound biomicroscopy and scheimpflug images that are not possible at low resource settings (Arora et al 2000, Lee et al 2007, Singh et al 2015, Grewal et al 2006 & Cazabon et al 2002). In this series it detects ILFB in all cases and also confirms the intactness of the posterior lens capsule. Thus, it is an equally useful, less expensive and easily available imaging modality for the detection of ILFB and a useful guide to select the treatment modality.

As the posterior capsule was intact and were younger than 30 years two patients underwent Lens aspiration using Simcoe two-way irrigation aspiration canula, ILFB removal following capsulorrhexis before hydro-dissection using Utrata's capsulorrhexis forcep and implantation

of single piece acrylic IOL in the capsular bag in a single surgical setting. Phacoemulsification was carried out in one patient who was elder than 30 year instead of lens aspiration in this series. Similar procedure was carried out by other authors ((Arora et al 2000, Singh et al 2015, Grewal et al 2006) whereas other author tried conventional extracapsular cataract extraction and small incision cataract surgery (Daryabari et al 2018 & Cazabon et al 2002).

The postoperative visual acuity in our series was better than 6/12 in all cases as seen by Arora and colleague in their study of 8 cases and other authors suggesting good visual outcome following cataract surgery and ILFB removal (workers (Arora et al 2000,Lee et al 2007, Singh et al 2015, Grewal et al 2006, Reddy et al 2011, Daryabari et al 2018 & Cazabon et al 2002).

The limitations of this study include small sample size, lack of randomization and single center hospital-based study.

CONCLUSION

Ultrasound immersion technique is a useful tool in management of intra-lenticular foreign bodies at least in low resource settings. Young working male are at risk of such trauma. Use of protective spectacle is recommended to workers at high risk work including welding, hammering etc. Phacoemulsification or lens aspiration with ILFB removal and single piece acrylic IOL implantation provides a good visual outcome in these eyes.

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