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Comparison of post-cataract surgery endophthalmitis rates using syringing or regurgitation on pressure over the lacrimal sac as a preoperative screening tool for nasolacrimal duct obstruction: An impact assessment of protocol alteration due to the COVID-19 pandemic

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Purpose: To compare the post-cataract endophthalmitis (PCE) rates among eyes undergoing syringing or regurgitation on pressure over the lacrimal sac (ROPLAS) test prior to cataract surgery. **Methods:** We performed a single-center, retrospective, comparative analysis of eyes developing PCE who underwent syringing prior to cataract surgery (group A) in the pre-COVID-19 era between November 1 2019 and January 31, 2020 and the eyes that underwent ROPLAS test prior to cataract surgery (group B) in the COVID-19 era between November 1, 2020 and January 31, 2021. **Results:** A total of 87,144 eyes underwent cataract surgery during the two time periods of the study. Syringing was performed in 48,071 eyes, whereas ROPLAS was performed in 39,073 eyes. In group A, 19 eyes (0.039%) developed PCE, whereas 20 eyes (0.051%) developed PCE in group B ($P = 0.517$). Between the two groups, the grade of anterior chamber cellular reaction ($P = 0.675$), hypopyon ($P = 0.738$), and vitreous haze ($P = 0.664$) were comparable. Gram-positive organisms were detected in 4 eyes in group A and 6 eyes in group B; 2 eyes in group A had gram-negative bacilli. The presenting visual acuity (Group A: LogMAR 1.42 and Group B: LogMAR 1.30) and final visual acuity (Group A: LogMAR 0.52 and Group B: LogMAR 0.5) were comparable between the two groups. ($P = 0.544$ and 0.384, respectively). **Conclusion:** The rates of PCE were comparable among the eyes undergoing either syringing test or ROPLAS prior to cataract surgery.

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Endophthalmitis remains one of the most dreaded sequelae of cataract surgery and its prevention remains the crux of meticulous preoperative, intraoperative, and postoperative protocols.[1] The foundation of these preventive measures remains centered on the principle of reducing the bacterial flora in and around the eye.

The lacrimal system forms an essential component of ocular anatomy helping in tear production and drainage. Pathologies of the system, especially the nasolacrimal duct (NLD), hinder drainage and act as a reservoir for bacterial growth. These bacteria, in turn, have access to the ocular surface and can thus be the precipitating factor for the development of endophthalmitis post-cataract surgery.[2] This forms the basis of checking the sac patency before performing cataract surgery. Regurgitation on pressure over the lacrimal sac (ROPLAS) and syringing remain the two methods most commonly practiced for checking sac patency.[3] ROPLAS and syringing have been compared to assess their sensitivity and specificity in detecting NLD obstruction.[4,5] However, they have not been compared for their role in preventing post-cataract endophthalmitis (PCE).

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The COVID-19 pandemic has brought about multiple changes in surgical protocols.[6] Our institute performed sac syringing prior to cataract surgery in the pre-COVID-19 era. To minimize aerosol generation from syringing during COVID-19 times, we shifted to the ROPLAS test before cataract surgery. In our study, we primarily aimed to compare the PCE rates in the pre-COVID-19 era, where syringing was done, and in the COVID-19 era, where ROPLAS was performed. We also analyzed the presenting features, treatment required, visual outcomes, and microbiological profiles of the patients developing PCE between these two time periods.

Methods

We conducted a retrospective, comparative analysis of the eyes developing acute endophthalmitis who underwent cataract surgery between November 1, 2019 and January 31, 2020 with those undergoing cataract surgery between November 1, 2020 and January 31, 2021 at our institution. The study was approved by the institutional review board and adhered to the tenets of the Declaration of Helsinki.

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We performed a case sheet review of all consecutive cases of acute postoperative endophthalmitis who had undergone cataract surgery during the said period. Case sheet numbers pertaining to the cases of endophthalmitis were retrieved from the hospital management system and were tallied with the endophthalmitis register maintained in the vitreo-retina department. Acute endophthalmitis was defined as those developing endophthalmitis within six weeks of cataract surgery. Eyes with complicated cataracts or traumatic cataracts were excluded from the analysis. Patients who had undergone cataract surgery elsewhere, those with a history of undergoing prior sac surgery, or any other periocular surgery performed one month before the cataract surgery were also excluded. The case sheets were analyzed for the date of surgery, intraoperative complications, clinical features, and time duration between cataract surgery and development of endophthalmitis. The anterior chamber was evaluated for the cellular reaction (SUN classification), fibrin, and hypopyon. Corneal infiltrates (if any) were noted and the vitreous haze was classified as per the SUN classification.[7] The clinical features between the two groups were then compared. The best-corrected visual acuity (BCVA) was recorded using Snellen's charts and was converted to LogMAR for statistical analysis.

In the pre-COVID-19 era, syringing was performed prior to all cataract surgeries. The procedure was performed by trained optometrists in all cases on the day prior to the cataract surgery. The procedure was explained to the patient and informed consent was obtained. The patient was made to lie supine and a topical anesthetic (0.5% proparacaine) was instilled. Initially, the lower punctum was dilated using the Nettleships's punctum dilator. Gentle lateral traction was applied on the lower lid to straighten the canaliculus and syringing was performed using saline from the lower punctum using a lacrimal cannula (24–25 G) attached on a 2-ml syringe with the patient looking upward and outward. This was followed by injection of saline and any reflux of fluid or purulent material was observed from the upper or the lower punctum. After injecting, the patient was asked for the sensation of a salty taste at the back of the throat. When the patient perceived a salty sensation, the duct was considered patent. In case of absence of sensation or reflux of fluid, the patient was referred to the Oculoplasty department for further assessment. Surgery for lacrimal drainage obstruction was advised depending on the level of block, followed by cataract surgery after four weeks. Patients with a partial block were referred to the Oculoplasty department for repeat probing and syringing.

During the COVID-19 era, syringing was replaced by the ROPLAS test to minimize aerosol generation. Before initiating the ROPLAS test, we conducted video sessions for the ophthalmologists to orient them regarding the procedure so as to ensure standardization of technique. Initially, the inferior orbital margin was traced medially and superiorly. The point of contact was identified as the anterior lacrimal crest. Using two cotton bud-swabs, the pressure was applied on the sac area behind the located crest in a posteromedial direction. This enabled expression of the sac contents into the conjunctiva. The reflux of fluid or any purulent material from the punctum was noted, and when present, an Oculoplasty referral was sought. During the COVID-19 period, all the patients were inquired about the relevant history for COVID-19 symptoms and were thermally screened. The doctors wore personal protective equipment and the revised COVID-19 guidelines were followed.[6] Additionally, the patients were instructed to wear masks during the surgical procedure in the COVID-19 era. The other preoperative and postoperative protocols remained unchanged during both time periods.

All the patients underwent surgery under peribulbar anesthesia. The eye to be operated was instilled with a drop of 5% povidone-iodine before the block. Following the block, the surgical field around the eye was cleaned with 10% povidone-iodine solution followed by draping and speculum application under aseptic precautions. After concluding the surgery, 0.1 ml of a topical ophthalmic solution containing 0.5% weight by volume of moxifloxacin (Vigamox®, Alcon Pharmaceuticals Ltd.) was administered intracamerally. Postoperatively, all patients were prescribed topical prednisolone-moxifloxacin combination in a tapering dose over one month.

The diagnosis of endophthalmitis was made clinically based on the presence of anterior chamber reaction, hypopyon, and vitreous exudates/vitritis. The findings and diagnosis were confirmed by a Vitreo-retina consultant of our institute. The patients underwent vitreous biopsy and intravitreal antibiotics (IVAB) (intravitreal vancomycin 1 mg/0.1 ml and ceftazidime 2.25 mg/0.1 ml) with or without pars plana vitrectomy (PPV), depending on the severity of endophthalmitis, based on the treating consultant's judgment.[8] Vitreous biopsy was performed using a 25-G vitrector attached to a plastic syringe and an undiluted 0.4-ml vitreous sample was obtained. While maintaining all the aseptic precautions, the sample was divided into two 0.2-ml parts; one part was transported in a vial and the other part was inoculated in nutrient broth and sent for microbiological testing. The vial was used for Gram staining and potassium hydroxide (KOH) mount, while the inoculated nutrient broth was incubated in the BACT/ALERT® (BioMerieux,® North Carolina, U.S.A), 3D Microbial Detection System. Once the growth was identified by the BACT/ALERT® (BioMerieux,® North Carolina, U.S.A), the sample was recultured and incubated on sheep blood agar, chocolate agar, and potato dextrose agar plates in a biological oxygen demand incubator (YSI-440, © YORCO. Yorco sales pvt. ltd., India) at 37°C. The growth was also subjected to Gram stain, KOH stain for identification. The samples that showed no growth were incubated for 14 days before being labeled as culture negative. After the procedure, all patients were started on hourly topical moxifloxacin 0.5%, tobramycin 0.3%, prednisolone acetate 1%; atropine eye drop 1% three times a day; and oral tablet ciprofloxacin 500 mg twice a day empirically for five days. The patients were initiated on oral corticosteroids if the KOH mount was negative for fungi.

The primary aim of the study was to compare the PCE rates between the two groups; group A: eyes developing endophthalmitis who underwent syringing; group B: eyes developing endophthalmitis who underwent ROPLAS test prior to cataract surgery. Our secondary aim was to look for differences in clinical features, microbiological profile, treatment required, and visual outcomes between the two groups.

Statistical analysis

The statistical analysis was done using R Studio version 4.0.3. To check the statistical significance of the difference between the experimental variables of groups A and B, we applied the *t*-test for continuous variables and Fisher's exact test for categorical ones. Categorical variables included organism detection, treatment modality, and retreatments. Continuous variables were age, duration of symptoms, and visual acuity. The rate of incidence of endophthalmitis in the two study periods was compared using a z-test. $P < 0.05$ was considered statistically significant.

Results

A total of 87,144 eyes undergoing cataract surgery during the two time periods of the study fulfilled the inclusion and

exclusion criteria, out of which 39 eyes (0.044%) developed endophthalmitis. Syringing was performed in 48,071 cases, whereas ROPLAS was performed in 39,073 cases. The endophthalmitis rates, demography, and visual acuity details between the two groups are detailed in Table 1. Among the patients developing endophthalmitis (n = 39), one patient in each group had diabetes mellitus as systemic comorbidity. The distribution of cases according to the type of surgery performed (clear corneal phacoemulsification/manual small incision cataract surgery) is detailed in Table 2.

Among the eyes developing endophthalmitis, three eyes had intra/postoperative complications. One eye in group A had an iridodialysis during the cataract surgery. In group B, one eye had a decentered intraocular lens post-cataract surgery for which redialing was performed, while one eye had an intraoperative posterior capsular rupture managed by anterior vitrectomy and sulcus placement of the lens.

The comparison of the clinical features of the eyes developing endophthalmitis between groups A and B is described in Table 3. Organisms were isolated in five vitreous samples from each group, with two organisms isolated from one sample in each group ($P = 0.83$). Gram-positive organisms were detected in 4 eyes in group A and 6 eyes in group B; 2 eyes in group A had gram-negative bacilli. No fungal element was detected in any eye. Culture analysis isolated pseudomonas aeruginosa and Klebsiella pneumonia in one eye each in group A; with corynebacterium species detected in one eye in group B.

In group A, 7 eyes underwent primary IVAB while 12 eyes underwent primary PPV. In group B, 13 eyes underwent primary IVAB and 7 eyes underwent primary PPV ($P = 0.113$). Retreatment was performed in 4 eyes in each group ($P = 1$).

Discussion

In our retrospective analysis of endophthalmitis cases undergoing either syringing (group A) or ROPLAS (group B) test prior to cataract surgery, we observed the PCE rates to be comparable between the two groups. The age of the patients, gender distribution, and the duration of symptoms between the two groups were not statistically significant. On analyzing the clinical features, the anterior chamber reaction, presence of hypopyon, and the vitreous haze were similar between the groups. The presence of fibrinous membrane and corneal infiltrate was higher in group A. Gram-positive organisms were the most common isolates in both groups. The presenting and final visual acuity was comparable between the two groups.

Prevention of endophthalmitis remains one of the most important considerations in cataract surgery. While a myriad of factors such as older age, diabetes mellitus, and intraoperative posterior capsular rupture are known risk factors for PCE, a blocked NLD also increases the risk of development of endophthalmitis.[9-11] The incidence of NLD obstruction in the eyes with endophthalmitis has been reported to be 50% and hence preoperative screening of the NLD remains important.[11] The head-to-head study comparing syringing with ROPLAS observed that the negative predictive value of ROPLAS for detecting NLD blockage in patients undergoing cataract surgery was 99.5%.[4] They concluded that routine preoperative syringing of cataract patients was not required because a negative ROPLAS almost excludes chronic dacryocystitis. However, preoperative syringing to rule out NLDO is widely practiced in India, especially in high-volume cataract surgical centers and medical colleges. The 2011 Vision 2020 guidelines for cataract surgery in India also recommends syringing before cataract surgery.[12] In our institute, syringing was done in all patients prior to cataract surgery before the beginning of the COVID-19 pandemic in March 2020. The potential risk of COVID-19 transmission to the health care workers while doing syringing forced us to shift to ROPLAS before surgery. The findings in our study demonstrated similar endophthalmitis rates between the two groups, providing indirect evidence of comparable efficacy of the two tests in detecting NLD obstruction prior to cataract surgery. In addition, multiple factors are responsible for endophthalmitis, with a blocked NLD being only one of them.[9-11] Thus, preoperative ROPLAS and

Table 1: Comparison of endophthalmitis rates, demography, and visual acuity between eyes undergoing syringing or ROPLAS test prior to surgery

	Group A (Syringing)	Group B (ROPLAS)	*P*
No. of eyes with acute endophthalmitis	19 (0.039%)	20 (0.051%)	0.517
Follow-up rate (%)	80.37%	71.70%	0.00
Endophthalmitis rate after adjusting for follow-up rates	0.049%	0.071%	0.313
Age (years)	65±8.9 (range: 50-86)	62±7.6 (range: 49-75)	0.357
Gender (Male:Female)	11:8	6:14	0.152
Duration to the diagnosis of PCE (days)	11.35±11.68	11.85±8.77	0.445
Presenting visual acuity (LogMAR)	1.42±0.49	1.30±0.53	0.544
Final visual acuity (LogMAR)	0.52±0.71	0.50±0.55	0.384

PCE: Post-cataract endophthalmitis

Table 2: Division of eyes with endophthalmitis based on the type of surgery performed

Type of Surgery	Total number of cataract surgeries		Number of eyes with endophthalmitis	
	Syringing (Group A)	ROPLAS (Group B)	Syringing (Group A) (%)	ROPLAS (Group B) (%)
MSICS	35943	28303	16 (0.04%)	16 (0.05%)
Phacoemulsification	12128	10770	3 (0.02%)	4 (0.03%)
Total	48071	39073	19 (0.039%)	20 (0.051%)

MSICS: Manual small-incision cataract surgery

Table 3: Comparison of clinical features of the eyes developing endophthalmitis between the two groups

Clinical features	Group A (Syringing) *n*=number of eyes	Group B (ROPLAS) *n*=number of eyes	*P*
Anterior chamber			
Cellular reaction			
1+	3	1	0.675
2+	2	4	
3+	4	5	
4+	7	10	
Hypopyon	7	11	0.738
Fibrinous membrane	6	1	0.03
Corneal infiltrate	4	0	0.036
Vitreous			
Vitreous Haze			
1+	5	2	0.664
2+	2	5	
3+	3	4	
4+	3	4	
5+	4	5	

syringing help only in preventing sac-related endophthalmitis and have no role in the prevention of PCE otherwise.

The follow-up rates in group B were significantly lesser than in group A, which can be explained by the travel restrictions in place due to the COVID-19 pandemic. However, the endophthalmitis rates were comparable between the two groups even after adjusting for follow-ups. On analyzing the clinical features, we observed the cellular reaction, presence of hypopyon, and vitreous haze to be comparable between the two groups. Although the presence of corneal infiltrate and fibrinous membrane was significantly higher in the syringing group, the number of eyes was too small to have any meaningful comparison to explain this difference.

The most common microbes isolated in our series were gram-positive organisms, which were similar to the observation made in previous large-scale studies.[13,14] The treatment modality (need for primary PPV/IVAB), number of retreatments required, visual acuity at presentation, and final visual acuity were comparable in both groups, suggesting that the severity of the endophthalmitis was similar irrespective of the screening procedure performed.

Our study remains limited by its retrospective design and the associated biases. Moreover, we did not perform a repeat evaluation of the NLD status after diagnosis of endophthalmitis to reconfirm its patency. The role of the additional personal protective equipment worn by the surgeons and the masks worn by the patients during the COVID-19 era cannot be negated. Although the follow-up rates during the COVID-19 era were significantly lower, patients developing endophthalmitis are highly likely to follow up due to their distressing symptoms.

Our study is strengthened by the evaluation of a large number of cataract surgeries performed during the study periods with standardized preoperative and postoperative protocols along with similar operation theater settings. To the best of our knowledge, our study remains the first to compare the endophthalmitis rates between eyes undergoing syringing or the ROPLAS test prior to cataract surgery.

Conclusion

To conclude, the rate of endophthalmitis was comparable between the eyes undergoing syringing or the ROPLAS test before cataract surgery. The presence of hypopyon, grade of anterior chamber reaction, and vitreous haze between the groups was not statistically significant. The presence of fibrinous membrane and corneal infiltrate was higher in the syringing group. The most common microbes isolated in both groups were gram-positive organisms. The need for vitrectomy, retreatments required, and visual outcomes were also comparable between the two groups.

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Conflicts of interest

There are no conflicts of interest.

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