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Research Article

Superior Mini Scleral Tunnel Approach for Cataract Surgery and its Association with Endophthalmitis

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ABSTRACT

Objective: Analyze 145,088 patients who received superior Mini Scleral Tunnel Incision (MSTI) phacoemulsification cataract surgery and their associated endophthalmitis incidence *via* a chart query methodology.

Methods: The electronic medical record of a single private practice with 6 surgical center locations was queried from 2013-2018 for all patients who received superior MSTI cataract phacoemulsification. Pre and post-surgery protocols were standardized across the six care delivery sites. Infection prevention included pre-operative 5% betadine application and post-operative topical antibiotics. The number of patients that developed cataract surgery-associated endophthalmitis, anterior/posterior capsular rupture, need for clear corneal/pars plana anterior vitrectomy, capsular stain usage and zonular pathology findings were evaluated *via* both International Classification of Diseases (ICD) code logs and follow-up note documentation.

Results: Three cases out of 145,088 (0.002%) patients who underwent phacoemulsification with a superior MSTI technique developed post-operative infectious endophthalmitis.

Conclusion: This multi-site private practice retrospective review represents the largest described group of patients undergoing phacoemulsification with a superior MSTI showcasing one of the lowest reported rates of cataract surgery-associated endophthalmitis known.

Keywords: Cataract; Retrospective analysis; Phacoemulsification; Antibiotics; Surgery

Abbreviations: CSAE: Cataract Surgery-Associated Endophthalmitis; CCI: Clear Corneal Incision; IE: Infectious Endophthalmitis; IC: Intracameral; MSTI: Mini Scleral Tunnel Incision.

INTRODUCTION

Cataract surgery is the most commonly performed ocular surgery in the world, and as such, the prevention of Cataract Surgery Associated Endophthalmitis (CSAE) is a top priority. Previous research has shown a rate of post-operative Infectious Endophthalmitis (IE) ranging between 0.02% and 0.07% [1-4]. Older age, male sex, diabetes mellitus, immunocompromised state, existing ocular infectious etiologies, posterior capsular rupture, vitreous loss, silicone Intraocular Lenses (IOLs), intravitreal injections, large incision extracapsular cataract extraction and wound dehiscence have all been identified as risk factors [5-7].

There is a lack of consensus regarding which phacoemulsification incision type is best to prevent infectious endophthalmitis. Some studies suggest that Clear Corneal Incisions (CCIs) may be a risk factor [8-11], whereas others report no higher infectious endophthalmitis incidence compared to scleral tunnel incisions [12,13]. The purpose of this study is to report the rate of cataract surgery-associated endophthalmitis in a large series of patients who underwent phacoemulsification with a Mini superior Scleral Tunnel Incision (MSTI).

MATERIALS AND METHODS

This study was approved by the Western Institutional Review Board (WIRB) and Copernicus Group Institutional Review

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Board (CGIRB) and all tenets of the Declaration of Helsinki were upheld. A retrospective chart review of all patients who underwent phacoemulsification with a superior MSTI approach between 2013-2018 in a private multi-site practice was completed. All patients included in the review had povidone iodine 5% applied to the ocular surface and eyelids five to ten minutes before surgery and ofloxacin or tobramycin topical antibiotics prescribed post-operatively, four times daily for one week. No Intracameral (IC) antibiotics were utilized. In rare cases, if a patient was allergic to iodine, they received IC moxifloxacin and were excluded from this analysis.

The mini-scleral tunnel incision was started with a small superior conjunctival peritomy, after which hemostasis was achieved with wet-field eraser-tip cautery. Next, a diamond paracentesis blade was used to make a partial thickness incision, typically 0.5 mm-1.0 mm posterior to the surgical limbus, approximately 3 mm in length. Last, a diamond keratome blade with a width of 2.75 mm-3.00 mm was used to complete the incision. The patient then underwent phacoemulsification cataract extraction and subsequent interocular lens placement. The conjunctival peritomy was placed back into its original position without the use of suture or cautery.

Post-operatively, patients were treated with a fluoroquinolone antibiotic, usually ofloxacin, four times daily for one week. If the patient was allergic to the fluoroquinolone class of antibiotics, tobramycin was prescribed.

RESULTS

Of the 145,088 patients who underwent phacoemulsification with a superior MSTI technique, only 3(0.002%) developed post-operative infectious endophthalmitis. Additional complication rates included anterior capsular tears 0.233% (338/145,088), posterior capsular rupture 0.397% (576/145,088), anterior vitrectomy 0.312% (452/145,088), small pupils requiring use of pupil-expansion devices (e.g. capsular hooks, Graether, or Malyugin devices) 1.48% (2,151/145,088), trypan blue capsular staining 1.54% (2,229/145,088) and weak or torn zonules 0.71% (1,029/145,088). All complications evaluated are displayed (Table 1).

Table 1: Superior Mini Scleral Tunnel Incision (MSTI) cataract surgery complication rates.

	n	%
Anterior capsular tear	338	0.233
Anterior vitrectomy (clear corneal/pars plana)	452	0.312
Endophthalmitis	3	0.002
Posterior capsular rupture	576	0.397
Small pupils	2151	1.48
Use of capsular stain	2229	1.54
Weak/torn zonules	1029	0.71

Microbiological work-up of the 3 endophthalmitis cases yielded, Aspergillus fumigatus, Burkholderia species (possible contaminant) and Streptococcus pneumoniae respectively.

DISCUSSION

This study evaluated the charts of 145,088 patients and found one of the lowest documented rates of cataract surgery-associated endophthalmitis in the literature at 0.002%. All patients underwent phacoemulsification with a superior mini-scleral tunnel incision with pre-operative betadine and post-operative topical antibiotics.

Various other studies have evaluated preventing post-operative endophthalmitis. Pre-operative, intra-operative, and post-operative strategies to eliminate this disastrous complication are of utmost importance. Preoperatively, povidone iodine is commonly used in the periocular area, conjunctival fornices and the ocular surface. Povidone iodine has broad spectrum activity against gram-positive and gram-negative bacteria. Some studies have reported the use of chlorhexidine scrub, however corneal burns/ulceration have occurred when chlorhexidine is applied directly to the ocular surface [14]. Therefore, 5% povidone iodine remains the most extensively used anti-sepsis solution.

Intra-operative IC antibiotic strategies vary between cephalosporins, fluoroquinolones, vancomycin or even no antibiotic at all. The European Society of Cataract (ESC) and Refractive Surgery (RS) has recommended the use of IC cefuroxime [6]. Haripriya et al. evaluated 600,000 cataract cases at the Aravind hospital and noted IC moxifloxacin to have a protective benefit, regardless of whether phacoemulsification or manual small-incision cataract surgery was performed [15]. The rates of CSAE reported by Haripriya et al. were 0.07% without IC moxifloxacin and 0.02% with IC moxifloxacin [15,16]. Studies have shown the most common isolates in cataract surgery-associated endophthalmitis to be gram positive Staphylococci species [17,18], thus making IC vancomycin a consideration. However, vancomycin is a known precipitating factor for the rare and disastrous complication of hemorrhagic occlusive retinal vasculitis [19].

MSTIs have several distinct features that make them especially protective against infection. First, they are typically created in the superior portion of the sclera, which allows the wound to be shielded by the upper lid. Second, the overlying conjunctiva provides another barrier over the entry site. Lastly, MSTIs are created in the peripheral sclerocorneal junction which may create less wound stretch and a better seal in comparison to CCIs.

Yao et al. conducted a multi-center study in China with rates of endophthalmitis ranging from 0% to 0.1% depending on the center [20]. The site without any endophthalmitis cases conducted 21,031 cataract surgeries with a regimen of pre-operative betadine, 100 mg/mL vancomycin in irrigating solution, and 4 mg/0.1 mL subconjunctival tobramycin injection. When pooling the 8 Chinese centers (201,757 cataract surgeries), the CSAE outcomes for the CCI approach had a 95% confidence interval ranging

from 0.025% to 0.043%, whereas the 95% confidence interval for limbal and scleral tunnel pooled approaches ranged from 0.012% to 0.043% [20]. Miller et al. published a retrospective analysis in the American Journal of Ophthalmology (AJO) showcasing a 0.05% (6/11,462) endophthalmitis rate for cataract surgery *via* CCI and 0.02% (1/4,458) for surgical methods other than clear cornea phacoemulsification (P=0.681,Fisher's exact test). Olsen et al. found that the MSTI procedure had significantly less irregular astigmatism compared to the CCI approach [21]. A 2021 article by Dr. Ahmed at the Sohag Teaching Hospital in Egypt evaluated the use of scleral tunnel suturing in the context of small-incision cataract surgery. This study found no statistically significant difference in post-operative astigmatism or visual acuity between groups with and without scleral tunnel suturing [22]. Oshima et al. conducted a trial where 88 independent cataract surgery procedures were randomized between the CCI and the MSTI approach. Outcomes were worse for CCI approach patients who experienced comparatively greater post-operative astigmatism, corneal endothelial cell loss and wound stability issues [23].

Despite the advantages of superior MSTIs, some cataract surgery patients are not suitable for this technique. Patients with glaucoma may require later incisional surgery and because the MSTI requires a conjunctival peritomy, it is not an ideal approach. For these patients, the temporal CCI provides an ideal wound location to facilitate concurrent or future Micro Invasive Glaucoma Surgery (MIGS). Patients with deep-set eyes are also more anatomically challenging to operate on from a superior compared to a temporal approach.

Many well-known risk factors for CSAE have been identified in prior studies. Operative complications such as posterior capsular rupture and vitreous loss portend a higher risk of developing CSAE. While CCI risk remains unclear, further studies are needed to determine whether ocular sealants, like polyethylene glycol hydrogel, can help CCIs prevent CSAE as well as MSTIs.

Among our three cases of endophthalmitis, one occurred in a 75-year-old patient with otherwise completely uneventful cataract surgery. Another case occurred in an 85-year-old patient whose surgery was complicated by weak zonules intra-operatively with final IOL placement in the sulcus with optic capture. The third case occurred in a 58-year-old patient receiving Avastin injections for cystoid macular edema, but this patient had no complications intraoperatively. To summarize, two out of three of our cases of CSAE were in patients with uncomplicated cataract surgeries.

CONCLUSION

There are several limitations of this study that are important to note. First, this is a retrospective chart review study and thus depends on the accuracy and diligence of staff in documenting complications and follow-up. Second, the private practice providing the cataract surgeries in this study often utilized optometrist co-management, which may be a barrier to follow-up and documentation. Lastly, this ophthalmologist group is comprised of experienced attending physicians and may not represent the complication rate of another practice or less experienced surgical team.

While many studies have reported the benefits of pre-operative povidone-iodine preparation and intracameral antibiotics, much less attention has been paid to the type of phacoemulsification incision. Our study suggests that employing a superior MSTI may provide a cost-effective prophylaxis measure against post-operative infectious endophthalmitis. It would be reasonable that combining strategies of pre-operative povidone-iodine, superior MSTI, and intracameral antibiotics may optimally mitigate CSAE risk, but further study is needed.

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