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Persistently Vitreous Culture-Positive Exogenous Bacterial Endophthalmitis

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Abstract

Purpose—To report the clinical settings, bacterial isolates, antibiotic sensitivities, and visual outcomes of patients with persistently positive vitreous cultures after intravitreal antibiotics.

Design—Consecutive, non-comparative case series.

Setting: Tertiary care center

Patient Population: 29 eyes of 29 patients with exogenous endophthalmitis with the same bacterial organism identified on at least two consecutive vitreous cultures

Observation Procedures: Vitreous culture with intravitreal injection of antibiotics and pars plana vitrectomy with intravitreal antibiotics

Main Outcome Measures: Bacterial isolates, antibiotic sensitivities, visual outcomes

Results—Twenty-nine eyes of 29 patients met the study criteria. The mean follow-up was 28.7 months. The most common clinical settings were after cataract extraction (15/29, 51%) and glaucoma surgery (9/29, 31%). The mean initial visual acuity was 2.21 ± 0.74 logMAR (Snellen equivalent $\approx 20/3200$), and there was no statistically significant change at the final evaluation (1.98 ± 1.1 logMAR, $\approx 20/1900$, $P = 0.32$). The most common bacteria were *Staphylococcus* (10/29, 34%) and *Streptococcus* (7/29, 24%). Gram-positive bacteria were sensitive to vancomycin (22/22, 100%); Gram-negative bacteria were sensitive to amikacin (3/3, 100%). The antibiotic sensitivities were the same on repeat cultures in 25 of 27 patients (93%). The initial treatment was a vitreous tap and intravitreal injection of antibiotics in 22 of 29 patients (76%). The vision at the last follow-up was 20/200 or better in 11 patients (38%) and no light perception in 10 of 29 patients (34%).

Conclusions—The most commonly identified organisms in the current series were Gram-positive bacteria. There was good concordance in the antibiotic sensitivities between initial and subsequent cultures. Patients with persistently vitreous culture-positive endophthalmitis had poor visual outcomes.

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Introduction

Bacterial endophthalmitis can cause severe inflammation. Although most patients respond adequately to one injection of intravitreal antibiotics, there are case series of patients with endophthalmitis that remain culture-positive after antibiotic treatment.^{1, 2} *Staphylococcus*, *Streptococcus*, *Mycobacterium*, *Achromobacter*, *Pseudomonas*, and *Bacillus* species have been isolated in persistent cases.^{3–7}

The purpose of this study is to determine the co-morbidities, clinical settings, bacterial isolates, antibiotic sensitivities, and visual outcomes of patients with persistently positive vitreous cultures after intravitreal antibiotics.

Methods

The microbiological records for all patients with positive vitreous cultures obtained at the Bascom Palmer Eye Institute from 1981 to 2011 were reviewed. Patients with the same bacterial organism identified on at least two consecutive vitreous cultures obtained on separate days after receiving at least one injection of intravitreal antibiotics were included. Patients with fungal or viral organisms, polymicrobial cultures, endogenous endophthalmitis, and incomplete medical records were excluded. The microbiological isolates and sensitivities were compared between patients with persistent infections and those with only one positive vitreous culture over the same time period. The consecutive, non-comparative case series was approved by the Institutional Review Board of the University of Miami Miller School of Medicine and was compliant with the Health Information Portability and Accountability Act of 1996. The described research adhered to the tenets of the Declaration of Helsinki.

The treatment regimen was determined by the physician based on the individual patient's clinical course. There was no preset protocol for the timing or type of the second treatment. Patients were retreated if there were clinical signs of deterioration or no improvement in their vision, pain, hypopyon, fibrin, or vitritis. After 1995, patients who developed cataract surgery-related endophthalmitis were treated according to the recommendations of the Endophthalmitis Vitrectomy Study (EVS).⁸

Statistical calculations were performed using the Statistical Package for the Social Sciences software (SPSS Inc., Chicago, Illinois, USA), with a *P*value less than 0.05 being considered statistically significant. Snellen visual acuity was converted to its logarithm of Minimal Angle of Resolution (logMAR) equivalent as previously described, with counting fingers being assigned a value of 1.85, hand motion 2.3, light perception 2.7, and no light perception 3.0.⁹ The best corrected visual acuities (BCVA) are presented as the mean logMAR $\pm$ standard deviation (SD), followed by the approximate Snellen chart equivalent. The visual acuities were analyzed using student's *t*-test, one-way analysis of variance with Tukey post-hoc analyses, and Fisher's exact tests.

Results

During the 30-year study period, twenty-nine eyes of 29 patients met the study criteria. The average age was 69.6 years old (median: 73, range: 17–87). There were 17 males (59%) and 11 right eyes (38%). The most common systemic co-morbidities were hypertension (15/29, 52%) and diabetes mellitus (5/29, 17%). Two patients (7%) were immunocompromised from chronic systemic steroids. Ocular co-morbidities included glaucoma (9/29, 31%) and macular degeneration (1/29, 3%).

The clinical histories and demographics are summarized in Table 1. The most common clinical settings were after cataract surgery (15/29, 51%), glaucoma surgery (9/29, 31%), trauma (3/29, 10%), intravitreal injection (1/29, 3%), and penetrating keratoplasty (1/29, 3%). Two patients who had combined surgery (cataract extraction and trabeculectomy) were categorized in the glaucoma group because they presented two years post-operatively with clinical features consistent with bleb-associated endophthalmitis. Twenty-seven of 29 patients (93%) had hypopyons and pain on initial examinations; all patients had vitritis. Excluding the 3 patients with delayed-onset endophthalmitis (presenting more than 6 weeks after surgery or trauma), the mean time from the inciting event to the clinical diagnosis was 6.29 ± 11 days. The mean follow-up after the initial treatment was 28.7 months (range: 2 weeks to 157 months).

The clinical management is summarized in Table 2. All 29 patients received intravitreal vancomycin, and 26 of 29 patients (89%) received an additional intravitreal antibiotic on the day of their diagnoses: ceftazidime (22/29, 76%), tobramycin (2/29, 7%), amikacin (1/29, 3%), and gentamicin (1/29, 3%). Ten patients (35%) also received intravitreal dexamethasone with their initial intravitreal antibiotics.

Following the initial treatment, patients underwent additional procedures when their infections were deemed to be worsening or not improving. The mean visual acuity did not change significantly at the time of the second treatment compared to the initial visit ($P=0.79$). The mean time between the first and second treatments was 8.2 ± 17 days, and the average number treatments was 2.6 ± 0.8 . A vitreous culture and injection of intravitreal antibiotics (tap/inject) was performed as the first treatment in 22 of 29 patients (76%), eight of whom (36%) underwent a subsequent tap/inject and 14 of whom (64%) had a subsequent pars plana vitrectomy (PPV). Seven patients (24%) had an initial PPV with intravitreal antibiotics, of whom 3 (43%) had a subsequent vitrectomy with intravitreal antibiotics. A second dose of intravitreal antibiotics was administered in 28 of 29 patients (97%); all received intravitreal vancomycin, and 21 (75%) also received ceftazidime. One patient improved with a tap/inject followed by a pars plana vitrectomy without additional intravitreal antibiotics. A pars plana vitrectomy was performed in 27 of 29 patients (93%). There were no adverse events directly attributed to repeated injections of intravitreal antibiotics.

All patients received adjunctive topical antibiotics with their initial treatment. These included fortified topical vancomycin (21/29, 72%), tobramycin (15/29, 52%), gentamicin (2/29, 7%), ceftazidime (2/29, 7%), neomycin/ polymyxin B sulfate/ dexamethasone (2/29,

7%), moxifloxacin (2/29, 7%), and ofloxacin (2/29, 7%). Topical steroids were used within 24 hours of initiating antibiotics in 27 of 29 patients (93%). Systemic antibiotics were used in 13 of 29 patients (45%).

The microbiology data is summarized in Table 3. Gram-positive bacteria comprised 86% (25/29) of all persistently culture-positive bacterial endophthalmitis. The most common bacteria were *Staphylococcus* (10/29, 34%), *Streptococcus* (7/29, 24%), *Enterococcus* (5/29, 17%), and *Pseudomonas* (2/29, 7%). The bacterial organisms were isolated from undiluted vitreous cultures in 67% (43/64) and from vitreous washings or vitreous cassettes in 33% (21/64).

Over the same time period, there were 1019 patients with bacterial endophthalmitis who had only one positive vitreous culture. Gram-positive bacteria were the most common (935/1019, 92%). The most common isolates were *Staphylococcus* species (474/1019, 47%), *Streptococcus* species (100/1019, 10%), *Enterococcus* species (41/1019, 4%), and *Pseudomonas* species (35/1019, 3%). There was no statistically significant difference in the proportion of Gram-positive or Gram-negative bacteria between persistent and non-persistent bacterial endophthalmitis ($P = 0.45$, Fisher's exact test). However, there was a higher proportion of non-*Staphylococcus* Gram-positive bacteria in the persistently culture-positive group, including *Streptococcus* and *Enterococcus* (Fisher's exact test $P = 0.028$ and $P = 0.030$, respectively). There was no statistically significant difference in the proportions of *Pseudomonas* ($P = 0.23$), *Serratia* ($P = 0.318$), or *Stenotrophomonas* ($P = 0.18$) in patients with repeat vitreous culture-positive endophthalmitis.

The antibiotic sensitivities were available in 27 patients (Table 3). Of the Gram-positive bacteria tested, all were sensitive to vancomycin (22/22, 100%) and most to ceftazidime (10/13, 77%). The three *Enterococcus* isolates were all resistant to ceftazidime. For the Gram-negative bacteria tested, all were sensitive to amikacin (3/3, 100%). The *Stenotrophomonas* isolate was resistant to ceftazidime. The bacteria in all cases of persistent endophthalmitis were sensitive to at least one of the initial empirically selected intravitreal antibiotics.

The clinical outcomes are summarized in Table 4. The mean presenting visual acuity was 2.21 ± 0.74 logMAR (Snellen equivalent $\approx 20/3200$). The pre-infection visual acuity was known in 13 patients, and declined from an average of 0.75 ± 0.87 logMAR ($\approx 20/110$) to 2.00 ± 1.1 logMAR ($\approx 20/2000$, $P < 0.01$) at the last follow-up. Only 15% of patients (2/13) recovered vision within 1 line of their pre-infection visual acuity. Patients with endophthalmitis presenting 6 or more weeks after the inciting event had worse final visual acuities than those who presented more acutely (2.67 ± 0.35 logMAR, $\approx 20/2400$, vs. 1.84 ± 1.2 logMAR, $\approx 20/1400$, $P = 0.025$).

The mean final BCVA for all 29 patients was 1.98 ± 1.1 logMAR (Snellen equivalent $\approx 20/1900$), which was similar to the initial vision ($P = 0.32$). The final vision was 20/40 or better in 4 patients (14%), was 20/200 or better in 11 patients (38%), and was no light perception in 10 patients (34%). The four patients (14%) who were enucleated had light perception on initial presentation and underwent a tap and inject as their first treatment. Two

of these patients had a history of trabeculectomies; the other two had developed cataract-related endophthalmitis before the results of the EVS were published. One patient was systemically immunocompromised due to oral prednisone for rheumatoid arthritis.

There was no difference in the final visual acuity between those who had an initial tap and inject and those who had an initial pars plana vitrectomy (1.81 ± 1.2 logMAR, Snellen equivalent $\approx 20/1300$, vs. 1.91 ± 1.4 logMAR, Snellen equivalent $\approx 20/1600$, $P = 0.86$). There was a trend for non-vitrectomized eyes to have better final visual acuities than eyes with a history of previous vitrectomies (1.89 ± 1.1 logMAR, $\approx 20/1600$, vs. 2.43 ± 0.23 logMAR, $\approx 20/5400$, $P = 0.056$); however, it did not reach statistical significance.

There was no difference in the final visual acuities based on Gram-positive or Gram-negative bacteria (1.98 ± 1.1 logMAR, $\approx 20/1900$, vs. 1.94 ± 1.1 logMAR, $\approx 20/1700$, $P = 0.99$), the clinical scenario ($P = 0.16$), the different species of bacteria ($P = 0.69$), the *Staphylococcus* species isolates ($P = 0.78$), the *Streptococcus* species isolates ($P = 0.57$), or having a ruptured or intact posterior capsule (1.94 ± 1.0 logMAR, $\approx 20/1700$, vs. 2.00 ± 0.7 logMAR, $\approx 20/2000$, $P = 0.81$). Patients who received initial intravitreal steroid injections had similar final visual acuities as those who did not (1.87 ± 1.2 logMAR, $\approx 20/1500$, vs. 2.34 ± 1.0 logMAR, $\approx 20/2400$, $P = 0.23$). There was no statistically significant difference in the final visual acuities based on whether the second treatment was performed within 2 days of the initial treatment or later (1.87 ± 1.2 logMAR, $\approx 20/1500$, vs. 2.33 ± 0.89 logMAR, $\approx 20/4300$, $P = 0.27$), within 4 days or later (1.72 ± 1.2 logMAR, $\approx 20/1000$, vs. 2.26 ± 0.95 logMAR, $\approx 20/3600$, $P = 0.23$), or within 7 days or later (1.25 ± 1.2 logMAR, $\approx 20/360$, vs. 2.32 ± 0.87 logMAR, $\approx 20/4,200$, $P = 0.067$).

Patients who had an initial visual acuity of hand motion or better were more likely to recover 20/200 or better at the last follow-up (odds ratio 14, 95% confidence interval, 1.43–137, Fisher's exact test, $P = 0.014$). Patients who had a history of uncomplicated phacoemulsification were the only group to experience a statistically significant improvement in vision after treatment (2.27 ± 0.5 logMAR, $\approx 20/3700$ initially, vs. 0.65 ± 0.12 logMAR, $\approx 20/90$ on final examination, $P = 0.008$).

Discussion

The incidence of endophthalmitis after open globe injuries is approximately 2.1%, after trabeculectomies is 1.3%, after cataract surgeries is 0.035%, after intravitreal injections is 0.053%, and after vitrectomies is 0.028%.^{10–14} Persistent infection after intravitreal antibiotics is rare. In the Endophthalmitis Vitrectomy Study, only fourteen of 420 patients (3%) had positive cultures on repeat vitreous aspirations.¹⁵

The most common clinical settings for patients with persistent endophthalmitis in the current study were after cataract extraction (15/29, 51%) and glaucoma surgery (9/29, 31%), which may reflect the frequency of cataract surgeries and the higher rates of complications associated with glaucoma surgeries. The three patients who presented with endophthalmitis more than 6 weeks after their glaucoma surgeries had had worse final visual acuities compared to the 26 patients who presented more acutely, within a week of surgery.

Gram-positive bacteria were the most commonly isolated organisms (86%, 25/29), particularly *Staphylococcus* species (34%, 10/29) and *Streptococcus* species (24%, 7/29). Similar results were reported in one of the largest previously-published studies focusing on persistent endophthalmitis.¹⁶ There was no difference in the proportion of Gram-positive and Gram-negative bacteria between patients whose endophthalmitis resolved after 1 intravitreal injection of antibiotics and those whose did not; however, patients with persistent endophthalmitis had a higher proportion of non-*Staphylococcus* isolates.

The majority of the patients in the current series (76%) had an initial vitreous culture with injection of antibiotics (tap/inject). The final visual outcomes were similar in patients who received an initial tap and inject and those who received an initial vitrectomy with intravitreal antibiotics. All patients received at least 1 dose of an intravitreal antibiotic to which their causative organism was sensitive. Gram-positive bacteria were all sensitive to vancomycin, and Gram-negative bacteria were all sensitive to amikacin. The lower antibiotic sensitivity to ceftazidime (12/16, 75%) was due to the three *Enterococcus* isolates and the *Stenotrophomonas* isolate being resistant to ceftazidime.

The overall antibiotic sensitivities on repeat cultures were identical in 93%. There was no conversion of antibiotic susceptibility from sensitive to resistant in repeat cultures. The high concordance between the initial and repeat MICs suggests that the initial antibiotic sensitivities may be relied upon to guide antibiotic therapy while awaiting the results of repeat cultures.

In human and animal studies, the concentration of intravitreal antibiotics has been found to be significantly higher than the minimum inhibitory concentrations (MIC) for most bacteria. Intravitreal vancomycin 1mg/0.1ml has a peak concentration greater than 200–250µg/ml, which is more than 50 times higher than the 1–5µg/ml MICs for most Gram-positive microorganisms.¹⁷ The half-life of vancomycin is approximately 25 hours in phakic eyes with endophthalmitis, and the concentration remains above 5µg/ml for 3–4 days after injection.^{15,18} Since the generation time for most bacteria ranges from 1–6 hours, intravitreal antibiotics may remain in the eye long enough and in high enough concentrations to adequately treat most intraocular infections after the initial injection.^{19–21} Additional treatments may be considered if the endophthalmitis does not improve within a few days.

In patients with persistent inflammation, a vitrectomy may be considered to decrease the bacterial load, remove inflammatory debris and chemokines, and remove the lens capsule, which may shield bacteria from the effects of antibiotics.²² Certain bacteria, such as *Propionibacterium acnes*, are sequestered in capsular bags while bacteria like *Streptococcus* and *Staphylococcus* can form biofilms to protect themselves against antibiotic penetration.³ On the other hand, antibiotics like vancomycin have been shown in animal models to be eliminated faster in aphakic, vitrectomized eyes.²³ In the EVS study, the authors speculated that a vitrectomy may be more effective in sterilizing eyes with endophthalmitis due to the lower re-culture rates after vitrectomies compared to after tap and injects.¹⁵ In the current study, twenty-seven patients (93%) underwent a vitrectomy during the course of their treatment.

Due to the retrospective nature of the current study and the relatively small number of cases of persistent endophthalmitis, it is difficult to suggest specific guidelines for re-treatment. In the Endophthalmitis Vitrectomy Study, patients with worsening inflammation or infection could be considered for additional treatment after 36 hours.¹⁵ Based on empirical data and clinical experience, patients with no improvement or worsening vision, increased pain, or more virulent infections (such as Gram-negative bacteria) may be considered for retreatment 36–48 hours after the initial intravitreal antibiotics. In the current study, there was a non-statistically significant trend for patients who received a more delayed second treatment to have worse final visual acuities. Future large randomized, prospective studies may help determine the exact timing and nature of additional treatments in patients with persistent endophthalmitis.

Repeated administration of intravitreal antibiotics has raised concerns about medication safety. Multiple injections of vancomycin with gentamicin or vancomycin with amikacin have been associated with retinal toxicities; however, prolonged infection can also cause severe inflammation and permanent ocular damage.^{24, 25} There was no chorioretinopathy directly attributed to repeated intravitreal antibiotics in the current series.

The use of adjuvant steroids may decrease ancillary inflammation and may inhibit the production of proteins associated with biofilms in endophthalmitis; however, steroids may also suppress the immune response to an infection.³ A randomized controlled trial did not demonstrate worse visual outcomes in patients with endophthalmitis who received intravitreal steroids.²⁶ Furthermore, the intravitreal levels of vancomycin were not decreased in eyes that concurrently received dexamethasone.¹⁸ There was no statistically significant difference in the final visual acuities between those who did and did not receive an initial intravitreal injection of dexamethasone in the present study.

Patients with persistent endophthalmitis have generally poor visual outcomes.^{15, 16} The visual acuity did not differ significantly from the initial and final visits (20/3200 vs. 20/1900, $P = 0.32$). Only 14% (4/29) of patients achieved 20/40 or better, and a third (10/29) had final visual outcomes of no light perception or were enucleated. Likewise, Shaarawy, et al. reported that 25% (3/12) of their repeat culture-positive endophthalmitis patients had final visual acuities of no light perception. The four eyes (14%) that were enucleated in the current series all had light perception on presentation. While these four patients all had initial tap and injects, patients in general who underwent an initial tap and inject were not more likely to undergo enucleation or have final visual acuities of no light perception in the current series.

A comparison of the initial and final visual acuities are summarized in Table 4. The only group to experience improvement in the visual acuity after treatment were patients with a history of uncomplicated phacoemulsification surgery. Patients with hand motion or better vision were more likely to recover 20/200 or better at the final visit.

The limitations of this study include the retrospective design and the relatively small number of patients. Only patients with at least two positive vitreous cultures were included in the study in order to confirm an infectious etiology of persistent intraocular inflammation. Due

to changes in the antibiotics available over the course of the study period, the sensitivities for isolates to all of the same antibiotics were not available. Despite these limitations, this study provides important prognostic and antibiotic sensitivity data for patients with persistently culture-positive endophthalmitis.

In conclusion, persistently vitreous culture-positive exogenous bacterial endophthalmitis most commonly occurred after cataract and glaucoma surgery. *Staphylococcus* and *Streptococcus* were the most commonly isolated organisms. The most common ocular co-morbidity was glaucoma. Most patients underwent an initial tap and inject of antibiotics. When the clinical signs of endophthalmitis did not improve, the patients underwent a second procedure; the majority of patients had a vitrectomy during the course of their treatment. The antibiotic sensitivities were similar between the initial and repeat cultures. The results of the current study support the use of intravitreal vancomycin and one other broad-spectrum antibiotic as part of the antibiotic regimen for acute-onset and delayed-onset endophthalmitis with persistently positive vitreous cultures. The data suggested that patients with persistent positive cultures after an initial treatment may not have inherently more antibiotic resistant bacteria. Patients with persistent endophthalmitis generally had poor visual outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Demographics and clinical summaries of patients with persistent vitreous culture-positive endophthalmitis, categorized by inciting event

Table 1

Clinical Presentation	# Patients (%)	Mean Age (years)	Time from inciting event to treatment (days)	# Anti-biotics	Time to 2 nd treatment (days)	Subsequent Complications
Cataract Surgery	All Cataracts	76	3	2	10.6	
	Uncomplicated	77	3.1	2	14.6	1 ERM, 1 pupillary membrane, 1 pupillary block, 1 choroidals
	Complicated	76	0.37	2	6	2 RD, 1 ERM
Glaucoma Surgery	All Glaucoma	73	32	2	7.3	
	Trabeculectomy	71	34	2	8.1	1 choroidals
	GDI	89	12	2	1	
Trauma/ Ruptured Globe	3 (10)	40.7	0.25	2	2.3	1 PVR/recurrent RD, 1 RD, 1 ERM, 1 iris bombe, 1 PBK
Intravitreal Injection	1 (3)	73	0.25	2	7	1 choroidals, 1 RD
Corneal Surgery	1 (3)	56	7	2	7	
Totals/ Averages	29	69.6	11	2.0	8.2	

Key: Choroidals= serous or hemorrhagic choroidal detachment; Complicated cataract surgery= posterior capsular rupture, vitreous prolapse, anterior vitrectomy, wound leak, or retained lens fragment; ERM= epiretinal membrane; GDI= glaucoma drainage implant; PBK= pseudophakic bullous keratopathy; PVR= proliferative vitreoretinopathy; RD= retinal detachment; Uncomplicated cataract surgery= no posterior capsule rupture, no anterior vitrectomy performed

Initial and subsequent treatments for patients with persistent vitreous culture-positive endophthalmitis

Table 2

Clinical Scenario (# patients)	Initial Treatment (# patients, %)				Additional Treatments (# patients, %)			
	Tap/ Anti- biotic	PPV/ Anti- biotic	Dexa- methasone	Tap/ Anti- biotic	PPV/ Anti- biotic	Enucleation/ Evisceration	Other Procedures	
Cataract Surgery (15)	Uncomplicated (11)	7	4	2	4	7	1	3 IOL exchanges, 2 IOL removals, 2 capsulotomies
	Complicated (4)	4	0	3	1	3	1	1 wound revision, 1 RD repair, 1 membrane peel, 1 IOL removal
Glaucoma Surgery (9)	Trabeculectomy (8)	6	2	4	1	7	2	1 choroidal drainage, 1 RD repair, 1 bleb amputation, 1 BGI implant
	GDI (1)	1	0	0	0	0	0	GDI removal
Trauma/ Ruptured Globe (3)		2	1	1	0	3	0	3 RD repairs, 1 Membrane peel, 1 PKP
Intravitreal Injection (1)		1	0	0	1	0	0	IOL removal
Cornea Surgery (1)		1	0	1	1	0	0	Corneal glue
Totals (29)		22 (76)	7 (24)	10 (34)	8 (28)	20 (69)	4 (14)	

Key: GDI= glaucoma drainage implant, IOL = intraocular lens, Tap= vitreous culture, Phaco= phacoemulsification, PKP= penetrating keratoplasty, PPV= pars plana vitrectomy, RD= retinal detachment

Table 3

Antibiotic resistance in patients with persistent vitreous culture-positive endophthalmitis

Organism	Persistent Endophthalmitis					Non-Persistent Endophthalmitis	
	# Patients	Vancomycin Resistant # Patients (%)	Ceftazidime Resistant # Patients (%)	Amikacin Resistant # Patients (%)	Gentamicin Resistant # Patients (%)	# Patients	
Gram Positive	25	0	3/13 (23)	0 (0/2)	1/12 (8)	872	
<i>Staphylococcus aureus</i>	3	0/3 (0)	n/a	n/a	0/ (0)	90	
<i>Staphylococcus epidermidis</i>	7	0/7 (0)	0/2 (0)	n/a	1/6 (17)	315	
<i>Streptococcus</i> species	7	0/7 (0)	0/7 (0)	n/a	0/2 (0)	100	
<i>Enterococcus faecalis</i>	5	0/5 (0)	3/3 (100)	n/a	0/3 (0)	41	
<i>Propionibacterium acnes</i>	2	n/a	n/a	n/a	n/a	94	
<i>Serratia marcesans</i>	1	n/a	0/1 (0)	0/1 (0)	0/1 (0)	15	
Gram Negative	4	n/a	1/3 (33)	0/3 (0)	1/3 (33)	147	
<i>Pseudomonas aeruginosa</i>	2	n/a	0/2 (0)	0/2 (0)	0/2 (0)	35	
<i>Stenotrophomonas maltophilia</i>	1	n/a	1/1 (100)	0/1 (0)	1/1 (100)	7	
<i>Citrobacter freundii</i>	1	n/a	n/a	n/a	n/a	3	

Key: n/a = not applicable

Summary of visual acuities on initial and last follow-up examinations in patients with persistent vitreous culture-positive endophthalmitis

Table 4

	Presenting Visual Acuities			Final Visual Acuities		
	Mean logMAR VA±SD	Mean Snellen VA (approx.)	# Patients (%)	Mean logMAR VA±SD	Mean Snellen VA±SD (approx.)	P value
Clinical Scenario (No. of patients)						
Cataracts (15)	2.22±0.75	HM	5 (41.7)	7 (58.3)	1.63±1.3	20/850
Uncomplicated ECCE (5)	1.76±1.1	20/1200	1 (25)	3 (75)	2.08±1.4	20/2400
Uncomplicated Phaco (6)	2.27±0.5	HM	4 (100)	0 (0)	0.65±0.12	20/90
Complicated ECCE (2)	2.7±0.0	LP	0 (0)	2 (100)	3.0±0	NLP
Complicated Phaco (2)	2.5±0.28	HM-LP	0 (0)	2 (100)	2.3±0	HM
Glaucoma (9)	2.02±0.89	20/2100	2 (22)	7 (78)	2.12±0.44	20/2600
Trabeculectomy (8)	1.93±1.0	20/1700	1 (13)	7 (88)	2.30±0.49	HM
GDI (1)	2.7	LP	1 (100)	0 (0)	0.7	20/100
Trauma (3)	2.43±0.23	HM	0 (0)	3 (100)	2.77±0.4	LP
Intravitreal Injection (1)	2.7	LP	0 (0)	1 (100)	2.7	LP
Cornea (1)	2.7	LP	0 (0)	1 (100)	3	NLP
Bacterial Isolates (No. of patients)						
Gram Positive (25)	0.633±80	20/90	7 (29.2)	17 (70.8)	1.96±1.1	20/1800
Staphylococcus spp. (10)	2.34±0.27	HM	4 (40)	6 (60)	1.83±1.3	20/1400
S. aureus (3)	2.29±0.35	HM	2 (50)	2 (50)	1.66±1.6	20/900
S. epidermidis (7)	2.46±0.20	HM-LP	2 (33.3)	4 (66.6)	1.71±1.2	20/1000
Streptococcus spp. (7)	2.19±0.86	20/3100	1 (14.3)	6 (85.7)	2.2±0.69	20/3200
Enterococcus faecalis (5)	2.04±1.0	20/2200	0 (0)	5 (100)	2.57±0.50	HM-LP
Propionibacterium acnes (2)	0.75±0.78	20/110	2 (100)	0 (0)	0.3±0.28	20/40
Serratia marcescens (1)	2.7	LP	0 (0)	1 (100)	3±0.0	NLP
Gram Negative Bacteria (4)	2.57±0.23	20/7400	1 (33.3)	2 (66.6)	2.1±1.6	20/2500
Pseudomonas aeruginosa (2)	2.7±0.00	LP	0 (0)	2 (100)	3±0.0	NLP
Stenotrophomonas maltophilia (1)	2.3	HM	1 (100)	0 (0)	0.3	20/40
Citrobacter freundii (1)	2.7	LP	0 (0)	1 (100)	2.7	LP

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Key: approx= approximate, ECCE= extra-capsular cataract extraction, GDI= glaucoma drainage implant, HM= Hand motion, LogMAR= Logarithm of the Minimum Angle of Resolution, LP= light perception, NLP= no light perception, Phaco= phacoemulsification, SD= standard deviation, VA= visual acuity