



Brief report

Risk factors for postoperative endophthalmitis caused by *Pseudomonas aeruginosa*: Possible role of environment

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This article describes an investigation to identify risk factors for postoperative endophthalmitis caused by *Pseudomonas aeruginosa*. A retrospective case-control study, including 8 cases and 24 controls operated from 2005 to 2009, was undertaken. The risk factors associated with *P. aeruginosa* infection were a particular operating room ($P = .003$) and longer phacoemulsification duration ($P = .001$), suggesting that infection was not associated with patient characteristics but rather with the surgical environment and phacoemulsification duration.

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Postoperative endophthalmitis (POE) is an infection restricted to the interior of the ocular globe often evolving to blindness and in some cases requiring the removal of the ocular globe or its internal contents.^{1,2} POE rates in cataract surgery are in the range 0.05%–0.29%,^{3–7} having as the most common pathogens gram-positive bacteria, mainly coagulase-negative *Staphylococcus*.^{3,6,8} However, in a previous study we reported a POE incidence of 0.06% ($n = 19$), with *Pseudomonas aeruginosa* accounting for 42.2% of cases.⁹

The aim of this study was to identify the probable risk factors related to endophthalmitis caused by *P. aeruginosa*.

METHODS

Setting

A case-control study was developed at Centro de Oftalmologia Tadeu Cvintal, an ophthalmologic institution that cares for public health system patients in São Paulo, Brazil. From 2004–2011 41,009 ophthalmologic surgeries were performed.

Four operating rooms were used exclusively for ophthalmic surgery among the 8 existing in the theater. Ophthalmologic instruments were washed and sterilized in an area separated for this purpose. Antisepsis of eyelids and adjacent regions of the eye

were performed using 10% polyvinylpyrrolidone-iodine aqueous solution. No standardization exists for intraoperative antibiotics prophylaxis, but many surgeons administer intraocular vancomycin from a commercial vial with lyophilized powder that is diluted into the balanced salt solution (BSS) in the operating room for phacoemulsification. The type of incision used is the clear cornea without suturing at the end of surgery. All patients are evaluated on first day after the procedure. If there are no signs of infection or other injury, patients are evaluated again on the seventh day.

Case definition and risk factors assessed

POE was defined as an infection restricted to the ocular globe within 3 months after elective cataract surgery characterized by the presence of at least 3 of the following signs or symptoms: low visual acuity, pain, hypopyon, anterior chamber reaction, vitreous turbation, and conjunctival hyperemia. The confirmation was given by positive vitreous culture or clinical diagnosis by a retinologist.

Cases were identified among all patients who developed laboratory-confirmed POE caused by *P. aeruginosa* following cataract surgery without presence of another concomitant infection. Control group members were randomly selected among those who were operated on the same day as the cases. The final sample included 8 cases and 24 controls, totaling 32 patients.

The following patient-related variables were investigated: age; sex; presence of diabetes mellitus; and presence of any eye

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Table 1Risk factors evaluated for endophthalmitis caused by *Pseudomonas aeruginosa* in cataract surgeries conducted in São Paulo, Brazil, 2012

Risk factor	Cases, n(8)	Controls, n(24)	OR	95% CI	P
Diabetes mellitus	5 (62.5%)	5 (20.8%)	6.33	0.86-53.40	.07
Mean duration of phacoemulsification, sec	158 n (7) [†]	67 n (21)*	ND	ND	.001
Duration of phacoemulsification >80 sec	7 (100%) n (7) [†]	5 (26.3%) n (19)**	ND	ND	<.001
Silicone IOL	3 (37.5%)	6 (25%)	1.80	0.24-13.35	.65
Men	3 (37.5%)	9 (37.5%)	1.00	0.14-6.77	1.00
Morning shift	4 (50%)	9 (37.5%)	1.67	0.26-11.08	.68
PCR	1 (12.5%)	1 (4.2%)	3.29	0.00-142.96	.44
Surgery performed at operating room No. 8	7 (87.5%)	6 (25%)	21.00	1.81-561.60	.003
Total surgical duration (min)	43	52	ND	ND	.47
Use of trypan blue	1 (12.5%)	3 (12.5%)	1.00	0.00-14.74	1.00
Use of adrenalin in the BSS	8 (100%)	17 (70.8%)	ND	ND	.14
Use of vancomycin in the BSS	6 (75%)	8 (33.3%)	6.00	0.78-56.52	.09
VL	0 (0%)	1 (4.2%)	0.00	0.00-58.23	1.00

OR, odds ratio; CI, confidence interval; ND, not done; IOL, intraocular lens; PCR, posterior capsule rupture; BSS, balanced salt solution; VL, vitreous loss.

[†]Number of cases evaluated=7.

*Number of controls evaluated=21.

**Number of controls evaluated=19.

conditions such as blepharitis, dacryocystitis, and corneal ulcer. Surgery-related variables included operated eye, surgeon, anesthesiologist, auxiliary operating room nurse, operating room, shift during which the surgery was performed, use of vancomycin and adrenalin in the BSS, use of trypan blue stain, use of iris hooks, intraocular lens (IOL) material used, total duration of surgery, and phacoemulsification duration. The last was defined as the length of time the ultrasound waves were used to emulsify the cataract so that it could be removed by suction.

STATISTICS

Statistical treatment of the data was performed using Epi Info version 3.5.3 (Centers for Disease Control and Prevention, Atlanta, GA). The χ^2 test or Fisher's exact test was used for categorical variables when indicated and Mann-Whitney U test for nonhomogeneous continuous variables, when indicated according to Bartlett's test. Quantitative and categorical variables were modeled using logistic regression and a stepwise variable selection method in SPSS version 19.0 (IBM Corp, Armonk, NY). Significance was set at 5% ($P < .05$) for all tests.

RESULTS

The case group consisted of 6 women and 2 men with mean age 66.4 ± 9.8 years (range 54-83 years). The control group comprised 15 women and 9 men with mean age 66.3 ± 11.9 years (range 37-83 years). The final visual acuity of the cases was light perception or worse and 2 cases (25%) evolved to evisceration.

In the univariate analysis, the following were not identified as risk factors for endophthalmitis due to *P. aeruginosa*: age, sex, type of IOL, posterior capsular rupture, vitreous loss, presence of diabetes mellitus, shift during which the surgery was performed, use of vancomycin and adrenalin in the BSS, and use of trypan blue (Table 1).

When comparing the duration of phacoemulsification, a significant difference was found between the groups ($P = .001$), with a mean duration of 67 ± 31 seconds (range 23-150 seconds) in the control group, compared with 157 ± 82 seconds (range 83-282 seconds) in the case group. However, the total duration of the surgery showed no significant difference between the groups. The use of operating room number 8 stood out as a factor associated with infection cases (odds ratio, 21.00; 95% confidence interval, 1.81-561.60; $P = .003$) (see Table 1). This operating room was

temporarily closed, thoroughly refurbished, and washed, after which no more cases occurred. Unfortunately, due to operational issues, we could not investigate which environmental element contributed to the cases.

In the logistic regression analysis, there was a lack of convergence in the numerical maximum likelihood estimation method, and the model did not adjust, possibly due to the sample size. Therefore, this analysis was disregarded.

DISCUSSION

The final visual acuity of the patients affected by POE caused by *P. aeruginosa* is usually very unsatisfactory and >40% of patients evolve to ocular evisceration^{1,2} to eliminate the patient's pain or to avoid the dissemination of the infection beyond the eye cavity. In our study, due to early diagnosis and surgical intervention by means of posterior vitrectomy plus application of intravitreal antibiotic, only 2 out of 8 cases (25%) evolved to the point in which this procedure was needed.

None of the following risk factors identified by other authors were confirmed in our study: vitreous loss,³ silicone IOL,^{5,10} or posterior capsular rupture.⁷ Nonetheless, the majority of studies elsewhere have not addressed a specific microorganism.

In our sample, the duration of phacoemulsification as a risk factor may be explained by the trauma caused by the more prolonged ultrasound energy emission. We hypothesized that the combination of an environment contamination in the operating room and the larger exposition of patients' eye contributed to the occurrence of cases of infection.

CONCLUSIONS

This study contributes to understand the etiology of POE, indicating the importance of further environmental investigation in cases of *P. aeruginosa*.

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