

## PSEUDOMONAS AERUGINOSA-INDUCED ACUTE EXOGENOUS ENDOPTHALMITIS POST-CATARACT SURGERY

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### ABSTRAK

**Introduction:** The Endophthalmitis Vitrectomy Study revealed that only a small percentage of endophthalmitis cases, specifically 4.1%, were caused by Gram-negative organisms, and the most frequent of these was *Pseudomonas aeruginosa*. Moreover, poor visual outcomes were consistently linked to this bacterium.

**Objective:** To provide knowledge regarding *Pseudomonas aeruginosa* as a cause of exogenous endophthalmitis and its management.

**Case Illustration:** A 65-year-old male was admitted to the Emergency Department due to pain and blurred vision in his left eye. These symptoms had been present for four days and occurred three days following cataract surgery. The patient's visual acuity in the affected eye was extremely poor, with no light perception, conjunctival redness, corneal edema, and posterior synechia of the iris. A B-mode ocular ultrasound detected an abnormal echo in the left eyeball and moderate vitreous opacity, which suggested that the patient had endophthalmitis. The patient underwent emergency surgery immediately, including Pars plana vitrectomy (PPV), Silicon oil, IOL extraction, and intravitreal antibiotics injection. The vitreous was also tested with a smear test and culture, which revealed the presence of *Pseudomonas aeruginosa*. On the first day after the surgery, the patient's vision improved to light perception but with incorrect projection. A Fundus exam showed an attached retina with silicon oil and no macular edema. After one month, the patient's visual acuity improved to 2/60.

**Conclusions:** Identifying the causative organisms in infectious endophthalmitis is critical in determining treatment and visual results. Pars Plana Vitrectomy (PPV) followed by intravitreal injection of antibiotics as the "gold standard" treatment for acute postoperative endophthalmitis.

**Keywords:** endophthalmitis, postoperative, *pseudomonas aeruginosa*

### INTRODUCTION

Endophthalmitis is an uncommon but severe type of eye inflammation caused by intraocular infection. The majority of ocular incidences of exogenous endophthalmitis (approximately 60%) arise during intraocular surgery.<sup>1</sup>

The most frequent cause of exogenous endophthalmitis is *S. epidermidis*, a normal flora of the skin and conjunctiva. Pijl et al. reported that gram-positive coagulase-negative *Staphylococcus* (70% of cases) is the main bacteria responsible for postoperative endophthalmitis. The incidence of endophthalmitis in developed countries is between 0.012% and 0.053%. In Indonesia, a multicenter study

conducted across six hospitals between 2017 and 2018 reported an incidence of 1.2% for endophthalmitis following cataract surgery. While endophthalmitis occurs infrequently, it can lead to profound and irreversible visual damage in many cases.<sup>1-4</sup>

Gram-negative organisms made up only 4.1% of the isolates in the Endophthalmitis Vitrectomy Study (EVS) study as the cause of endophthalmitis. *Pseudomonas aeruginosa* is the most frequently isolated bacterium in gram-negative endophthalmitis patients; that progresses quickly and can cause severe vision loss and poor clinical results.<sup>5</sup>

This case report aims to provide knowledge regarding *Pseudomonas aeruginosa* as a cause of exogenous endophthalmitis and its management.

### CASE ILLUSTRATION

A 65-year-old male was admitted to the Emergency Department with pain and blurred vision of the left eye that had been presented for four days. Approximately seven days before admission, he had cataract surgery of the left eye (OS) with an intraocular lens (IOL) implantation performed at the district hospital. Three days after the surgery, he started to feel pain and blurred vision in the left eye. Four days later, he went to the district hospital for a check-up and was transferred to our hospital due to his current condition.

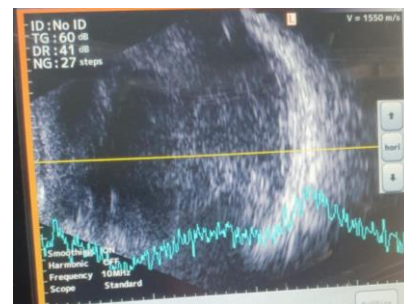
The OS visual acuity was at no light perception on the initial physical examination. A slit lamp examination showed conjunctival redness, corneal edema, and posterior synechia of the iris. IOP was normal. The posterior segment was difficult to observe with funduscopy. B-mode ocular ultrasound showed an abnormal echo in the left eyeball and moderate vitreous opacity, suggesting endophthalmitis caused by microbial infection.



**Figure 1. Slit lamp examination OS**

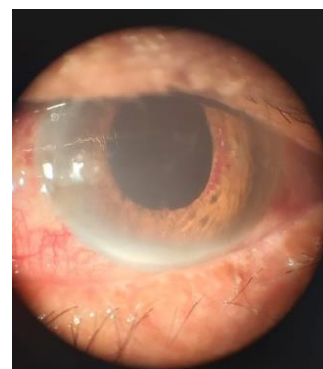
He was admitted with a diagnosis of acute-onset postoperative exogenous endophthalmitis. Emergency surgery was performed immediately, including Pars plana vitrectomy (PPV) 23G + IOL extraction + intravitreal antibiotics injection

(vancomycin 1 mg/0.1 ml + ceftazidime 2.25 mg/0.1 ml). During the surgery, retinal vasculitis was noticed. The intraocular exudate was rinsed and sent for smear examination and culture. Adjunctive antimicrobial therapy was started after surgery with vancomycin and ceftazidime eye drop every 2 hours. The analysis of the vitreous sample showed the presence of *Pseudomonas aeruginosa*, a type of Gram-negative bacilli bacteria.



**Figure 2. B-mode ocular ultrasound OS**

On Day One, after the surgery, the visual acuity was improved to light perception with wrong projection, injection of the conjunctiva and ciliary, cornea edema, and pupil dilatation. The fundus examination revealed that the retina was still attached with silicon oil and no macula edema. On the second day, the visual acuity remained the same, but the cornea's swelling, conjunctiva injection, and ciliary injection began to subside. On the third day, the visual acuity was 1/60, and the cornea, conjunctiva, and retina condition continued to improve. One month after the surgery, the visual acuity improved to 2/60.



**Figure 3. Postoperative surgery day 1**

## DISCUSSION

Endophthalmitis is a severe ophthalmological condition that results from an infection of the intraocular cavity and causes ocular inflammation. Not treated appropriately and promptly can result in irreparable vision loss. In developed nations, the prevalence of endophthalmitis ranges from 0.012% to 0.053%.<sup>3,6</sup>

Endophthalmitis is classified as endogenous or exogenous according to the route of infection. Exogenous endophthalmitis develops when infectious agents are directly inoculated into the eye, such as during intraocular surgery, by penetrating trauma, or through contiguous dissemination from nearby tissues. It is considered acute if it manifests within the first six weeks after a procedure.<sup>6,7</sup>

The patient we observed reported pain and redness in the left eye three days after their cataract surgery. Then brought to our hospital on the fourth day. Postoperative endophthalmitis has been linked with nearly all types of ocular surgery. It typically happens after cataract surgery, the most common ocular surgical procedure. 90% of infectious postoperative endophthalmitis cases can be attributed to bacteria, 8% to 16% to fungi, and 2% to protozoans and helminths. A study showed that *Staphylococcus*, a gram-positive coagulase-negative bacterium, is the primary cause of postoperative endophthalmitis and accounts for 70% of reported cases. Besides, gram-negative organisms made up only 4.1% of the isolates in the EVS study, although other research suggests a higher occurrence that varies from 10 to 24%.<sup>1,2,5</sup>

*Pseudomonas aeruginosa* is the most frequently isolated bacterium in gram-negative endophthalmitis patients. It is linked to a more fulminant clinical course and greater evisceration/enucleation rate than its gram-positive counterparts.

According to the Endophthalmitis Vitrectomy Study, only around 1% of endophthalmitis cases that tested positive for bacteria were caused by *P. aeruginosa*.<sup>5,8</sup>

*Pseudomonas aeruginosa* is a kind of gram-negative rod that is frequently found in nosocomial infections. *P. aeruginosa* can result in serious functional and structural damage due to its intrinsic enzymes. Elastases and exotoxins produced by *P. aeruginosa* have the potential to quickly and irreversibly destroy intraocular contents if they enter the cornea, anterior chamber, or vitreous cavity, causing uncontrolled inflammation and disorder of the globe. Such epidemics have occurred due to contaminated ophthalmic solutions, such as trypan blue, phaco emulsifier internal fluid, or intraocular lens solution contamination. Additionally, *P. aeruginosa* can spread to the eye's surface during surgery after contaminating air vents or other environmental sources.<sup>8</sup>

Our patient's initial visual acuity rapidly deteriorated to no light perception within three days after the previous cataract surgery. *P. aeruginosa* endophthalmitis is characterized by its fast progression and severe damage to eye tissue due to the production of various extracellular enzymes and toxins and its resistance to the body's antibacterial defenses. In the majority of cases, patients will complain of pain, eye redness, photosensitivity, and gradual vision loss. Patients with sudden onset endophthalmitis typically have poor visual acuity and cannot see clearly at 3/60 on the Snellen chart. In some cases, they can only detect light and determine the direction.<sup>7,9</sup>

Various diagnostic procedures are utilized to confirm endophthalmitis, such as b-scan ultrasound, Gram stain, and culture of the aqueous and vitreous fluid, which an ophthalmologist collects. In our patient, the analysis of the vitreous sample

showed the presence of *Pseudomonas aeruginosa*. B-mode ocular ultrasonography revealed a mild vitreous opacity and an irregular echo in the left eyeball. In addition to the ultrasound, vitreous culture, and ocular discomfort, our patient was confirmed to have exogenous endophthalmitis.<sup>1</sup>

Immediately after the initial diagnosis, our patient underwent vitrectomy, IOL extraction, and intravitreal antibiotic injection with silicon oil. The 2013 guidelines for the prevention and treatment of endophthalmitis after cataract surgery established by the European Society of Cataract and Refractive Surgeons deemed a complete Pars Plana Vitrectomy (PPV) followed by intravitreal injection of antibiotics as the "gold standard" treatment for acute postoperative endophthalmitis with systemic antibiotic treatment often added.<sup>10</sup>

PPV is the most widely used and effective surgical method for treating endophthalmitis, and combining PPV with silicone oil can slow the condition's progression. Silicon oil may possess bacteriostatic properties, which can aid in controlling infection and reducing the risk of reinfection. Vitrectomy has various benefits for treating endophthalmitis, including removing bacteria and other harmful substances, improving the effectiveness of antibiotics, removing inflammation-causing membranes, improving the visibility of the retina, and potentially accelerating visual recovery.<sup>1,10,11</sup>

Based on the Endophthalmitis Vitrectomy Study (EVS), vitrectomy is considered an effective treatment for cases where the initial visual acuity is lower than the ability to perceive light. According to the study, initial PPV was found to have a threefold increase in the rate of achieving 20/40 or better visual acuity outcomes, compared to tap/inject.

Typically, broad-spectrum antibiotic combinations are initiated before identifying the specific pathogen and determining its sensitivity to antibiotics. One of the antibiotics should target Gram-positive organisms, while the other should target Gram-negative organisms. Once the sensitivity is determined, targeted treatment should be carried out.<sup>10,12</sup>

Our patient was given intravitreal antibiotics with vancomycin 1 mg/0.1 ml + ceftazidime 2.25 mg/0.1 ml during the surgery. Intravitreal antibiotics play a crucial role in treating endophthalmitis. This route of administration allows for quick delivery of a high, safe level of antibiotics directly into the vitreous cavity. The three most frequently utilized antibiotics for intravitreal injection are vancomycin (1.0 mg), amikacin (0.4 mg), and ceftazidime (2.2 mg). Intravitreal treatment with ceftazidime and vancomycin is currently preferred. Vancomycin is preferred for treating infections caused by Gram-positive bacteria, including methicillin-resistant *Staphylococcus* and *Bacillus cereus*, due to its non-toxicity. Ceftazidime is suggested as a substitute antibiotic to target Gram-negative organisms due to its wide-ranging therapeutic spectrum, low possibility of retinal toxicity, and in vitro antimicrobial efficacy, which is just as effective as aminoglycosides against Gram-negative bacteria.<sup>1,6,10</sup>

Despite receiving appropriate treatment, the prognosis for endophthalmitis remains unfavorable. In a study, only 39% of patients with endophthalmitis were able to achieve a visual acuity of 20/400 (6/120) or better. In the context of the Endophthalmitis Vitrectomy Study, *Pseudomonas* species were identified as the cause of endophthalmitis in 1% of cases (4 out of 420 patients). Among these, only one patient with *Pseudomonas* endophthalmitis managed to achieve a

visual acuity of 20/40 (6/12) or better after 9 to 12 months, while the remaining three patients had a final visual acuity of less than 5/200 (5/60).<sup>12,13</sup>

Studies conducted on animal models of *Bacillus* endophthalmitis have shown that infiltrating inflammatory cells, mainly polymorphonuclear leukocytes, lead to retinal vasculature occlusion. X Lu and colleagues study demonstrated that despite endophthalmitis being effectively treated, there are still changes in the retina's structure, such as disrupted inner segment ellipsoid, epimacular membrane, atrophy of the inner layer of the retina, and macular edema. The atrophy of the inner layer of the retina was found to be the most strongly linked to visual impairment in cases of endophthalmitis. The mechanism behind the morphological changes seen in endophthalmitis has yet to be fully understood. It could be attributed to the virulence of the infectious microorganism or a result of secondary immune responses.<sup>14</sup>

Our 65-year-old patient's visual acuity after 1-month of surgery was 2/60. During the surgery, retinal vasculitis was noticed. The poor visual outcome in our patient might come from retinal structural changes. Due to our equipment constraints, we cannot assess the structural aspects of the retina.

The EVS identified macular abnormalities, including epiretinal membrane, macular edema, pigmentary degeneration, and ischemia, as the leading cause of visual loss. The strongest predictor of poor visual outcome was light perception only vision. Other risk factors include older age, diabetes mellitus, corneal infiltrate or ring ulcer, compromised posterior capsule, low or high intraocular pressure, afferent pupillary defect, rubeosis, and absent red reflex.<sup>15</sup>

## CONCLUSION

Exogenous endophthalmitis can occur due to any surgical procedure that damages the continuity of the eye. It frequently leads to visual impairment if not detected and treated promptly. Identifying the causative organisms in infectious endophthalmitis is critical in determining treatment and visual results. Pars Plana Vitrectomy (PPV) followed by intravitreal injection of antibiotics as the "gold standard" treatment for acute postoperative endophthalmitis.

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