Prospective Clinical Research Report

Journal of INTERNATIONAL MEDICAL RESEARCH

Journal of International Medical Research
2022, Vol. 50(12) 1–6

DOI: 10.1177/03000605221138482
journals.sagepub.com/home/imr
SAGE

Microbiological study on foreign body and vitreous samples of patients with intraocular foreign body

Seyed Ali Tabatabaei[1], Kazhaal Sheikhi[2], Reza Ghaffari[1], Mohammad Soleimani[1], Mansoor Shahriari[3], Kosar Esmaili[1], Sara Hobaby[4] and Kasra Cheraqpour[1]

Abstract

Objective: To evaluate the relationship between the microbiological results of the vitreous humor and those of foreign body specimens in patients with intraocular foreign body (IOFB).

Methods: Seventy-one patients with an IOFB were included in this descriptive prospective case series. All patients underwent immediate IOFB removal. Vitreous sampling was performed during vitrectomy. Foreign bodies were placed directly into culture media for microbiological study.

Results: Thirteen (18.3%) patients developed endophthalmitis. The results of microbiological analysis of IOFB and vitreous humor specimens were negative in nine patients and positive in four. Fifty-eight (81.6%) patients with an IOFB had no evidence of endophthalmitis. Among them, seven patients showed positive microbiological results of foreign bodies with no manifestations of endophthalmitis. In five patients, a *Staphylococcus epidermidis* strain was observed in the culture of the IOFB specimen. Two patients had only positive smear test results of their vitreous humor specimen.

Conclusion: A correlation appears to be present between the microbiological results of the vitreous humor and IOFB specimens in patients with clinical findings of endophthalmitis but not in patients with a pure IOFB without clinical features of endophthalmitis. This may justify early use of intravitreal and intravenous antibiotics before the development of endophthalmitis.

[1]Eye Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences, Tehran, Iran
[2]School of Medicine, Tehran University of Medical Sciences, Tehran, Iran
[3]Imam Hossein Medical Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran
[4]School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Corresponding author:
Mohammad Soleimani, FICO, Ophthalmologist, Fellowship of Anterior Segment, Eye Research Center, Farabi Eye Hospital, Tehran University of Medical Sciences, Qazvin Square, South Kargar Street, Tehran 1336616351, Iran.
Email: Soleimani_md@yahoo.com

Keywords
Microbiology, vitreous, foreign body, intraocular foreign body, endophthalmitis, trauma

Date received: 21 July 2022; accepted: 21 October 2022

Background

Post-traumatic endophthalmitis secondary to a retained intraocular foreign body (IOFB) is one of the most serious complications of open-globe injuries. This condition is generally associated with poor visual outcomes requiring rapid management.[1–4] Affected patients present with hypopyon, loss of the red reflex, fibrin reaction, and vitritis. Intraocular damage is significant and may result in impaired visual function.[2]

The prevalence of post-traumatic endophthalmitis reportedly ranges from 4% to 8%, and it can increase to 30% in patients with an IOFB.[5] In addition, an IOFB is present in 43% of patients with post-traumatic endophthalmitis.[6] The anatomical location of the IOFB can play an important role in the prognosis. In patients with IOFBs located in the posterior of the globe, injury is more severe and the prognosis is worse.[7]

In cases of post-traumatic endophthalmitis, vitreous humor sampling and a microbiological study should be considered.[6,8] Several microorganisms may cause endophthalmitis following trauma. Bacteria, especially Gram-positive species, are the leading cause of post-traumatic endophthalmitis.[9]

The main purpose of this study was to evaluate the relationship between the microbiological results of vitreous humor and those of foreign body specimens in patients with an IOFB.

Materials and Methods

This descriptive prospective case series involved patients who presented to the emergency department of Farabi Eye Hospital with a diagnosis of an IOFB from 2015 to 2017. The study was approved by the institutional review board of Tehran University of Medical Sciences (approval number: 94-47268, date of approval: 12/01/2015). All procedures conformed to the tenets of the Declaration of Helsinki. Written informed consent was received from all participants. All patient details were de-identified.

This study included 71 consecutive patients (71 eyes) with an open-globe injury and posterior segment IOFB. A complete ophthalmological examination was performed and recorded for all patients. All patients' visual acuity at the time of discharge was also measured.

The patients underwent pars plana vitrectomy (PPV) as soon as possible to remove the IOFB. Patients with corneal infiltration and severe keratitis, which may interfere with visualization of the posterior segment, were scheduled to undergo keratoprosthesis implantation concurrently with PPV. Sampling was performed during PPV. Undiluted vitreous fluid (0.2 mL) was obtained at the beginning of vitrectomy. The IOFBs were placed directly into culture media for microbiological studies upon removal and before contamination. Blood agar, chocolate blood agar, and Sabouraud dextrose agar were used as primary culture media. In patients with positive primary cultures, this was followed by culture on more specific media to determine the exact strain.

All obtained data were recorded electronically and analyzed using SPSS Statistics 25 (IBM Corp., Armonk, NY,

USA). Categorical data were analyzed using the chi-square test. Non-parametric data were analyzed using the Wilcoxon signed-rank test, and comparisons between paired data were performed in a single test. Statistical significance was defined as a P-value of <0.05.

The reporting of this study conforms to the STROBE guidelines.[10]

Results

All 71 patients were male, and their mean age was 33.7 ± 4.3 years. The right eye was involved in 28 patients and the left eye was injured in 43. The injury was located in zone I (cornea) in 42 (59.2%) patients, zone II (extending into the anterior 5 mm of the sclera) in 25 (35.2%), and zone III (involvement of the sclera beyond 5 mm from the limbus) in only 4 (5.6%).

In 47 (66.2%) patients, the interval from trauma to surgery was only 24 hours, whereas 8 (11.3%) patients underwent surgery within 24 to 72 hours. The remaining patients underwent PPV 3 to 7 days or more after injury.

Initial visual acuity was less than 20/200 in 43 (56.2%) patients and better than 20/40 in 12 (23.9%). The remaining patients had visual acuity of 20/200 to 20/40. Twenty-three (32.4%) patients had a relative afferent pupillary defect. Capsular rupture and traumatic cataract were detected in 48 (67.6%) eyes. Retinal tear without detachment was observed in 23 (32.4%) patients. Moreover, retinal detachment was diagnosed in 22 (31.0%) patients.

All patients underwent PPV to remove the IOFB. Lensectomy was performed in 48 (67.6%) patients, 3 of whom underwent primary intraocular lens implantation. One patient also underwent enucleation surgery. Table 1 shows the descriptive data.

Thirteen (18.3%) of the 71 patients developed endophthalmitis. The results of the microbiological analyses of the IOFB and vitreous humor specimens were negative in nine patients and positive in four (Table 2). In one patient, the culture of both the vitreous and IOFB was positive for diphtheroid bacilli, and in two patients, the specimens demonstrated ocular infection associated with viridans streptococci. In the last patient with endophthalmitis, the smear test of the IOFB was positive for a Gram-positive bacillus; however, the other results were negative. In patients with endophthalmitis, there was a significant correlation between the smear and culture results of the vitreous humor and IOFB specimens ($P = <0.01$) (Table 3).

In contrast to the 13 patients with endophthalmitis, 58 (81.6%) patients had no evidence of endophthalmitis on initial examination. Among them, seven patients showed positive microbiological results of the IOFBs with no manifestations of endophthalmitis at either the initial or subsequent follow-up visits. In five patients, a positive result with a *Staphylococcus epidermidis* strain was observed in the IOFB culture. Two patients had only positive smear test results of their vitreous humor sample (Table 2). In patients without endophthalmitis, there was no correlation between the smear and culture results of the vitreous humor and IOFB specimens (Table 3).

Discussion

Extensive studies have been performed to examine the microbiology of and risk factors for post-traumatic endophthalmitis. In two different studies, the rate of endophthalmitis with negative culture ranged from 17% to 59%.[5,8] However, we detected a rate of 69% in our study. This discrepancy may be related to technical differences in sampling, laboratory equipment, or diagnostic criteria.

To include all possible culture-negative cases of endophthalmitis in the present

Table 1. Descriptive data of patients.

Parameter	
Age, years	33.7 ± 4.3
Laterality	
• Right eye	28 (43.8)
• Left eye	43 (56.2)
Zone of injury	
• I	42 (59.2)
• II	25 (35.2)
• III	4 (5.6)
Interval between trauma and surgery	
• <24 hours	47 (66.2)
• 24 to <72 hours	8 (11.3)
• ≥72 hours	16 (22.5)
Initial visual acuity	
• <20/200	43 (56.2)
• 20/200 to <20/40	12 (23.9)
• ≥20/40	16 (22.5)
RAPD	
• Positive	23 (32.4)
• Negative	48 (67.6)
Concurrent damage	
• Traumatic cataract	48 (67.6)
• Retinal tear without detachment	23 (32.4)
• Retinal detachment	22 (31.0)
Nature of foreign body	
• Metallic	59 (83.1)
• Glass	4 (5.6)
• Stone	6 (8.5)
• Wood	2 (2.8)
Endophthalmitis	13 (18.3)
• Culture positive	4 (30.8)
• Culture negative	9 (69.2)

Data are presented as mean ± standard deviation or n (%).
RAPD, relative afferent pupillary defect.

study, we clinically defined endophthalmitis as that confirmed by an experienced retina-vitreous surgeon. In addition, microbiological examinations of vitreous and foreign body specimens were performed for all patients with an IOFB regardless of the presence or absence of endophthalmitis.

An interesting finding of our study was the observation of five positive IOFB cultures despite no clinical evidence of endophthalmitis. Although positive IOFB cultures with *Staphylococcus epidermidis* may be due to contamination during the sampling process, other hypotheses are the antimicrobial properties of the vitreous humor, immediate removal of the IOFB, and appropriate antibiotic therapy.

Immediate PPV allows for removal of the IOFB, dilution of the posterior segment with sterile fluids, elimination of the infectious agents, and finally a reduction in the incidence of endophthalmitis. Jonas and Budde[11] showed that the risk of endophthalmitis in patients who underwent

Table 2. Results of smear and culture.

Patient no.	Endophthalmitis	Vitreous smear	Vitreous culture	IOFB smear	IOFB culture
1	Yes	Negative	Diphtheroid	Negative	Diphtheroid
2	Yes	Gram+ cocci	*S. viridans*	Gram+ cocci	*S. viridans*
3	Yes	Gram+ cocci	*S. viridans*	Gram+ cocci	*S. viridans*
4	Yes	Negative	Negative	Gram+ bacilli	Negative
5	No	Negative	Negative	Negative	*S. epidermidis*
6	No	Negative	Negative	Negative	*S. epidermidis*
7	No	Negative	Negative	Negative	*S. epidermidis*
8	No	Negative	Negative	Negative	*S. epidermidis*
9	No	Negative	Negative	Negative	*S. epidermidis*
10	No	Gram+ bacilli	Negative	Negative	Negative
11	No	Gram+ cocci	Negative	Negative	Negative

IOFB, intraocular foreign body; *S. viridans*, *Streptococcus viridans*; *S. epidermidis*, *Staphylococcus epidermidis*.

Table 3. Correlation of smear and culture results between vitreous and foreign body specimens.

Endophthalmitis		P-value
Yes	Smear	<0.01
	Culture	<0.01
No	Smear	0.25
	Culture	0.52

immediate PPV within the first 24 hours was significantly lower than that in patients who underwent vitrectomy after this period (28.6% vs. 71.4%, respectively).

Interestingly, Colyer et al.[12] studied soldiers who had been wounded in the Iraq war and had a long history of IOFB. They found that delayed removal of IOFBs (mean of 21 days) combined with appropriate usage of topical and systemic antibiotics can lead to good results without an increased risk of endophthalmitis. To explain this phenomenon, they proposed that uncontaminated IOFBs may be secondary to high heat and velocity components, resulting in self-sterilization.[12]

Rubsamen et al.[13] found that positive bacterial and fungal cultures of ocular samples may not be associated with endophthalmitis. Although a positive microbial culture may be useful in treating patients with endophthalmitis, it should not change the treatment plan for patients without clinical endophthalmitis.[13] This finding is compatible with that in the present study, in which seven patients with positive microbiological results of either the IOFB or vitreous samples did not develop endophthalmitis.

The detected correlation between the microbiological results of the vitreous and foreign body specimens in patients with clinical findings of endophthalmitis in our study can be interpreted as another reason for immediate vitrectomy and IOFB removal because delay may provide a chance for proliferation of microorganisms and contamination of the intraocular cavity, even by slow-growth organisms. We speculate that in our five patients with positive IOFB specimen cultures despite negative findings of endophthalmitis, immediate action prevented the spread of bacteria from the IOFB to the vitreous.

Conclusion

A correlation appears to be present between the microbiological results of the vitreous humor and those of IOFB specimens in patients with clinical findings of endophthalmitis but not in patients with a pure IOFB without clinical features of

endophthalmitis. Because the culture positivity rate is not 100% with either source, it may be worthwhile to culture both the IOFB and vitreous to maximize the ability to identify an organism. Our findings may justify early use of intravitreal and intravenous antibiotics before the development of endophthalmitis because an IOFB can be a harbor for microorganisms.

Availability of data and materials

The data in the current case report are available from the Farabi Eye Hospital medical records. The data are available from the corresponding author on reasonable request.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ORCID iDs

Mohammad Soleimani https://orcid.org/0000-0002-6546-3546
Kasra Cheraqpour https://orcid.org/0000-0002-1273-9166

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