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Ophthalmology | Retrospective Study

Three-year epidemiological analysis of penetrating ocular traumatic endophthalmitis

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Abstract

Aims
To analyse the epidemiology of endophthalmitis cases related to penetrating ocular trauma among the Chinese population in the Northeast.

Methods
This retrospective study analysed patients diagnosed as penetrating ocular traumatic endophthalmitis between January 2016 to January 2019 at a hospital, Liaoning province, China. Epidemiological data including age, gender, traumatic agents, time from trauma to endophthalmitis onset, culture results, treatment, visual acuity and prognosis. Risk factor analysis was used to compare presented data.

Results
During the 3-years period, A total of 201 patients with antecedent penetrating ocular trauma and prophylactic antibiotics were evaluated. 42 (20.9%) patients presented a clinical course compatible with acute infectious endophthalmitis. 39 (92.86%) patients were male; 15 (35.71%) patients had intraocular foreign body (IOFB), the rate of endophthalmitis with IOFB was 7.46%, lower to the rate (13.43%) without IOFB. The time interval between trauma and endophthalmitis onset and collection of vitreous and aqueous material was 1 day in 10 (23.80%) patients; 2–7 days in 31 (73.80%) patients; 7–14 days in 1 (2.38%) patient ;16 (38.09%) patients had positive cultures. One year after trauma, visual acuity (VA) was better than 20/400 in 15 (35.71%) patients, counting fingers and hand motion in 17 (40.48%) patients, light perception in 5 (11.9%) patients and no light perception in 5 (11.9%) patients, Considering presence of IOFB, time from trauma to endophthalmitis onset, culture results and initial VA, only initial VA showed as better prognostic factor ($p < 0.001$) in final VA.

Conclusion
Endophthalmitis is a severe ocular infectious condition that may lead to irreversible vision loss. Prophylactic antibiotics is not effective enough in the prevention of endophthalmitis. The incidence of post-traumatic endophthalmitis may not be related to IOFB. A greater attention must be paid to penetrating ocular traumatic endophthalmitis.

Keywords: Endophthalmitis, Penetrating ocular trauma, Prophylactic antibiotics, Intraocular foreign body

Introduction

Penetrating ocular trauma is one of the most devastating attacks to visual acuity (VA), especially if complicated with endophthalmitis and intraocular foreign body (IOFB) [1]. Endophthalmitis is a severe infectious ocular disease with profound vision loss and requires immediate treatment [2, 3]. According to etiology, endophthalmitis is further classified as endogenous when the infectious agent originates from the patient via hematological spreading [4] or exogenous when the etiological agent originates externally from the eye by direct inoculation. Endophthalmitis presents clinically a decrease in visual acuity, conjunctival injection and hyperemia, ocular pain, eyelid edema, and intraocular inflammatory signs, such as anterior chamber reaction, hypopyon, fibrin and vitreitis [5]. The pathogen is typically related to the periocular cutaneous microbiota. There are also some atypical agents reported, such as Bacillus cereus [3, 4]. Endophthalmitis is classified as acute when symptoms occur within 6 weeks after a procedure or late when symptoms occur more than 6 weeks after a procedure [1, 3]. The incidence rate of post-traumatic endophthalmitis can reach 16.5% [6, 7], and the causative agent is normally related to the periocular cutaneous microbiota, but in post-penetrating trauma endophthalmitis, atypical agents have been reported, such as *Bacillus cereus* [2]. The current treatment for post-traumatic endophthalmitis (PTE) is early treatment with intravitreal antibiotics, however, there is still a high incidence of PTE [5, 6], and few studies have previously indicated factors that significantly influence visual prognosis in patients with PTE [7, 8].Our study objective was to evaluate the epidemiology of endophthalmitis cases related to penetrating ocular trauma, the source of ocular trauma, visual acuity during and 3 year after endophthalmitis, and method of treatment. Through retrospective analysis of patients with penetrating ocular trauma in our hospital in the past 3 years, we reveal the risk factor of endophthalmitis and VA prognosis in penetrating ocular trauma.

Subjects and Methods

This retrospective study analysed epidemiological data of patients with diagnosis of penetrating ocular trauma treated in the emergency department from January 2016 to January 2019 at Shenyang the fourth people hospital, Liaoning province, China, and followed for 1 year. The epidemiological data including age, gender, traumatic agents, time from trauma to endophthalmitis onset, culture results, treatment, VA and prognosis were collected. For penetrating ocular trauma, our hospital followed a principle of immediate admission for emergency surgery if the patients' systemic state allowed. Before surgery, all patients underwent orbital 3D computed tomography to assess the presence of IOFB. Primary wound closure was performed, vitrectomy and silicone oil filling was undertaken if necessary, and we tried out best to remove the IOFB during the first surgery. Intravitreal antibiotics were used at the end of the surgery [7]. The standard intravitreal injection in our hospital is 0.05 mL of Vancomycin (1 mg) and 0.05 mL of Ceftazidime (2.25 mg). The patients received intravenous antibiotics to prevent endophthalmitis after hospitalization, Patients who were allergic to this treatment or had renal insufficiency received alternative antibiotics of adequate doses. We didn't prescribe systemic antibiotics after discharge. The symptoms of endophthalmitis included a decrease in VA, chemosis, hyperaemia, ocular pain, eyelid oedema and intraocular inflammatory signs, such as anterior chamber reaction, hypopyon, fibrin, and vitreous opacity [3, 7] (Figure 1). When patients presented clinical symptoms and signs of endophthalmitis, we collected 0.2 ml vitreous and aqueous for examination before the second operation. The code of the positive culture was decided by time sequence. Intravitreal antibiotics were used again to treat gram-positive and gram-negative bacteria before the culture results reported.

We evaluated the existence of IOFB, time from trauma to endophthalmitis onset, culture results, and initial VA as prognostic factors; obtained vitreous and aqueous specimen analysis data from the records of the Ophthalmology and Microbiology Laboratory; and collected epidemiological and ophthalmological data from medical records.

SPSS 23.0 statistics software was used to analysis the data. We applied multivariate logistic regression analysis for risk factor analysis and $P < 0.05$ was considered statistically significant. To apply linear regression, we used R software version 3.6.0 and affected Endophthalmitis Vitrectomy Study (EVS) VA score.

The study was conducted according to the Declaration of Helsinki. The ethics committee of Shenyang fourth people hospital approved this study (0030/2019).

Results

We evaluated 201 patients with penetrating ocular trauma during three years with or without an IOFB in the emergency ophthalmologic department in our hospital. In these 201 patients, 42 (20.9%) presented a clinical course compatible with acute infectious endophthalmitis. The mean age of the patients was 49.67 years, with a standard deviation of 10.38, a minimum of 23 years, and a maximum of 73 years. 39 (92.86%) patients were male. 15 patients (35.71%) presented an IOFB after ocular trauma. The traumatic agents responsible for penetrating ocular trauma were metal in 7 (46.67%) patients, wood in 1 (6.67%) patient, stone in 5 (33.33%) patients, plastic in 1 (6.67%) patient, and caterpillar in 1 (6.67%) patient. The rate of endophthalmitis with IOFB in penetrating ocular

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trauma patients was 7.46%, and the rate without IOFB was 13.43% (Table 1 and 2).

The time between trauma and endophthalmitis onset was one day in 10 (23.80%) patients, 2 to 7 days in 31 (73.80%) patients, 7 to 14 days in 1 (2.38%) patient, and there was no patient more than 15 days (Table 1).

Of the 42 patients diagnosed as acute infectious endophthalmitis, 16 (38.09%) patients presented positive cultures results. Three of these cultures were positive only in aqueous culture (18.75%), 11 only in vitreous culture (68.75%), and 2 in both aqueous and vitreous culture (12.5%). The responsible etiological agents were coagulase-negative staphylococci in 7 cultures (43.75%) and streptococcus sanguis in 2 cultures (12.5%). Other cultures were positive for enterococcus aureus 1 (6.25%), acinetobacter Rubens 1 (6.25%), pseudomonas aeruginosa 1 (6.25%), bacillus cereus 3 (18.75%) and corynebacterium 1 (6.25%) (Table 1).

For the 42 patients, 41 received cornea wound suture and 1 had a self-sealed wound. We usually use intravitreal antibiotics previously in endophthalmitis suspects. 26 patients (61.9%) received vitrectomy and 21 eyes were filled with silicon oil during the surgery. The others received anterior chamber irrigation and intravitreal antibiotics injection without vitrectomy. Four patients received the eye enucleation because of cornea dissolved and the microbial culture results were Bacillus cereus (2 patients) and staphylococcus epidermidis (2 patients).
Initial VA during endophthalmitis was between 20/20 and 20/1000 in 8 (19.05%) patients, counting fingers (CF) and hand motion (HM) in 12 patients (28.57%), light perception (LP) in 18 (42.86%) patients and no light perception (NLP) in 4 (9.52%) patients. The four patients experienced eye enucleation. One year after endophthalmitis, VA was better than 20/1000 in 15 (35.71%) patients, CF and HM in 17 (40.48%) patients, LP in 5 (11.9%) patients and NLP in 5 (11.9%) patients, and four patients underwent enucleation with NLP (Table 1).
Considering presence of IOFB, time from trauma to endophthalmitis onset, culture results and initial VA, only initial VA showed as better prognostic factor ($p<0.001$) in final VA (Table 3).

Discussion

Endophthalmitis caused by exotoxin is a severe inflammatory ocular disease with profound vision loss that may become irreversible and requires immediate treatment [2, 3]. An epidemiological analysis is essential to better understand the associations among the traumatic agents, time from trauma to endophthalmitis onset, culture results and VA and to establish a visual prognosis, treatment method and appropriately treat similar cases. This study is the first Chinese study to evaluate cases of endophthalmitis after penetrating ocular trauma in a hospital.

Our prevalence of post-penetrating trauma endophthalmitis is 20.9% over three years, higher to the variable prevalence rates of 1–17% having been reported in the literatura [8, 9]. This higher prevalence may due to the environment when the patients be injured. In our hospital, we inject prophylactic intravitreal antibiotics at the end of the first suture surgery. The high prevalence of endophthalmitis also reveals that prophylactical use of vancomycin does not reduce the incidence of endophthalmitis effectively after penetrating ocular trauma. Meanwhile, postoperative haemorrhagic occlusive retinal vacuities associated with prophylactical use of intracameral vancomycin were reported during cataract surgery [10, 11]. More advanced management is needed urgently to prevent endophthalmitis after penetrating ocular trauma. Only three patients with acute endophthalmitis were female in our study, corroborating previous reports of higher prevalence in male patients [12]. In all case, endophthalmitis symptoms started acutely, within 14 days after the ocular trauma and within 7 days in majority of the patients (73.8%). Infectious endophthalmitis after penetrating ocular trauma has higher virulence and severity, which should be paid attention to within 2 weeks after trauma.

Only 15 (35.71%) had IOFB among all patients with symptoms of endophthalmitis and the rate of endophthalmitis with IOFB was 7.46%, lower to the rate (13.43%) without IOFB, and IOFB did not increase the percentage of endophthalmitis in penetrating ocular trauma patients. When considering patients with IOFB, the rate of NLP was even higher (20%) after 1 year of endophthalmitis. The incidence of post-traumatic endophthalmitis may not be related to IOFB, but to traumatic characteristics and the agents were related to ocular trauma.

Nearly 61.9% of our 42 patients presented negative culture results, which was incompatible with the results of the EVS, which is a distinct disease compared to trauma-related endophthalmitis [6]. The low rate of positive culture test results maybe contributed to the antibiotics used at the first surgery and the culture method. Four patients whose culture results were Bacillus Cereus (2 patients) and Staphylococcus Epidermidis (2 patients) exhibited VA of NLP with cornea dissolved and received eye enucleation. The sensitivity of vitreous culture was higher than aqueous culture (30.95% vs. 11.90%), which is same with the study by Nakayama [13], and in contrast to the survey by Baza [14], probably due to difference in the characteristics of trauma-related endophthalmitis and the material collected. Our patients' positive culture results indicated only one pathogen in 38.09% of our patients, same with acute endophthalmitis after cataract

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surgery [3] and post-intravitreal anti-VEGF injection [2], which were also characterized by a single pathogen. But penetrating ocular trauma may be associated with much more virulent and severe infections and the trauma agent is also the reason for the irreversible vision loss.

Through risk factor analysis, we know that the prognosis of endophthalmitis after penetrating trauma is only related to initial VA, after one year, one more patient showed VA of NLP. Only 20% had VA better than 20/1000, further indicating severe infection with a poor prognosis. We report the poor prognosis of visual acuity in endophthalmitis after penetrating trauma, with an evaluation of the causative agents and microbiological analysis. Our results confirm that even with aggressive treatment, acute infectious endophthalmitis has a severe prognosis and the prognosis is even poorer in penetrating ocular trauma.

This study has limitations, such as its retrospective character and the inclusion of a single hospital's experience. The lack of access to prompt ophthalmological emergency care in the areas with low medical coverage contributes to the time lapse between trauma and evaluation. More studies are needed to evaluate antibiotic efficacy and improve antibiotic treatment to reduce infectious endophthalmitis after ocular penetrating trauma.

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Table 1. Epidemiological and trauma parameters of the 42 endophthalmitis patients after penetrating ocular trauma

Variable	No. of patients (%)
Sex	
Male	39(92.86%)
Female	3(7.14%)
Total	42 (100%)
Composition of intraocular foreign body	
Metal	7(46.67%)
Stone	5(33.33%)
Plastic	1(6.67%)
Wood	1(6.67%)
Caterpillar	1(6.67%)
Total	15 (100%)
Time from trauma to endophthalmitis onset	
Less than 1 day	10(23.80%)
Between 2 and 7 days	31(73.80%)
Between 7 and 14 days	1(2.38%)
Results of positive cultures	
Staphylococci	7(43.75%)
Streptococcus.sanguis	2(12.5%)
Enterococcus aureus	1(6.25%)
Acinetobacter rubens	1(6.25%)
Pseudomonas aeruginosa	1(6.25%)
Bacillus cereus	3(18.7%)
Corynebacterium	1(6.25%)
Total	16 (100%)
BCVA (baseline/one year later)	
NLP	4(9.52%)/5(11.90%)
LP	18(42.86%)/5(52.38%)
CF-HM	12(28.57%)/17(40.48%)
20/1000-20/20	8(19.05%)/15(35.71%)

*BCVA: Best corrected visual acuity; CF: Counting fingers; HM: Hand motion; LP: Light perception; NLP: No light perception

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Table 2. Clinical features of 15 endophthalmitis patients with IOFB after penetrating ocular trauma

No.	IOFB	Culture result	Method of treatment	Initial VA	final VA
1	stone	no	vitrectomy and silicone oil	LP	HM
2	plastic	no	vitrectomy and silicone oil	LP	LP
3	metal	no	vitrectomy and silicone oil	HM	HM
4	metal	no	aterior chamber irrigation	LP	LP
5	stone	no	vitrectomy and silicone oil	LP	NLP
6	metal	no	vitrectomy and silicone oil	LP	FC
7	stone	epidermitis	eye enucleation	NLP	NLP
8	caterpillar	corynebacterium	aterior chamber irrigation	0.05	0.05
9	metal	no	vitrectomy and silicone oil	CF	0.04
10	metal	staphylococcus aureus	vitrectomy	LP	HM
11	stone	epidermitis	eye enucleation	NLP	NLP
12	wood	straphylococcus aureus	vitrectomy	LP	HM
13	metal	no	vitrectomy	HM	0.04
14	stone	no	vitrectomy and silicone oil	HM	HM
15	metal	no	aterior chamber irrigation	HM	0.2

* IOFB: intraocular foreign body; VA: visual acuity; CF: counting fingers; HM: hand motion; LP: light perception; NLP: no light perception

Table 3. The relationship between final VA and various indicators

Final VA	Better that 0.01	CF-HM	LP	NLP	X^2 value	P value
With IOFB	4	6	2	3		
Without IOFB	11	11	3	2		
Time from trauma to endophthalmitis onset14						
1d	3	4	1	2	0.888	0.828
2-7d	12	12	4	3		
8-14d	0	1	0	0		
cultures results						
Positive	6	5	2	3	1.554	0.670
negative	9	12	3	2		
Initial VA						
Better that 0.01	8	0	0	0	25.285	<0.001
CF-HM	5	7	0	0		
LP	2	10	5	1		
NLP	0	0	0	4		

* VA: visual acuity; CF: counting fingers; HM: hand motion; LP: light perception; NLP: no light perception; IOFB: intraocular foreign body

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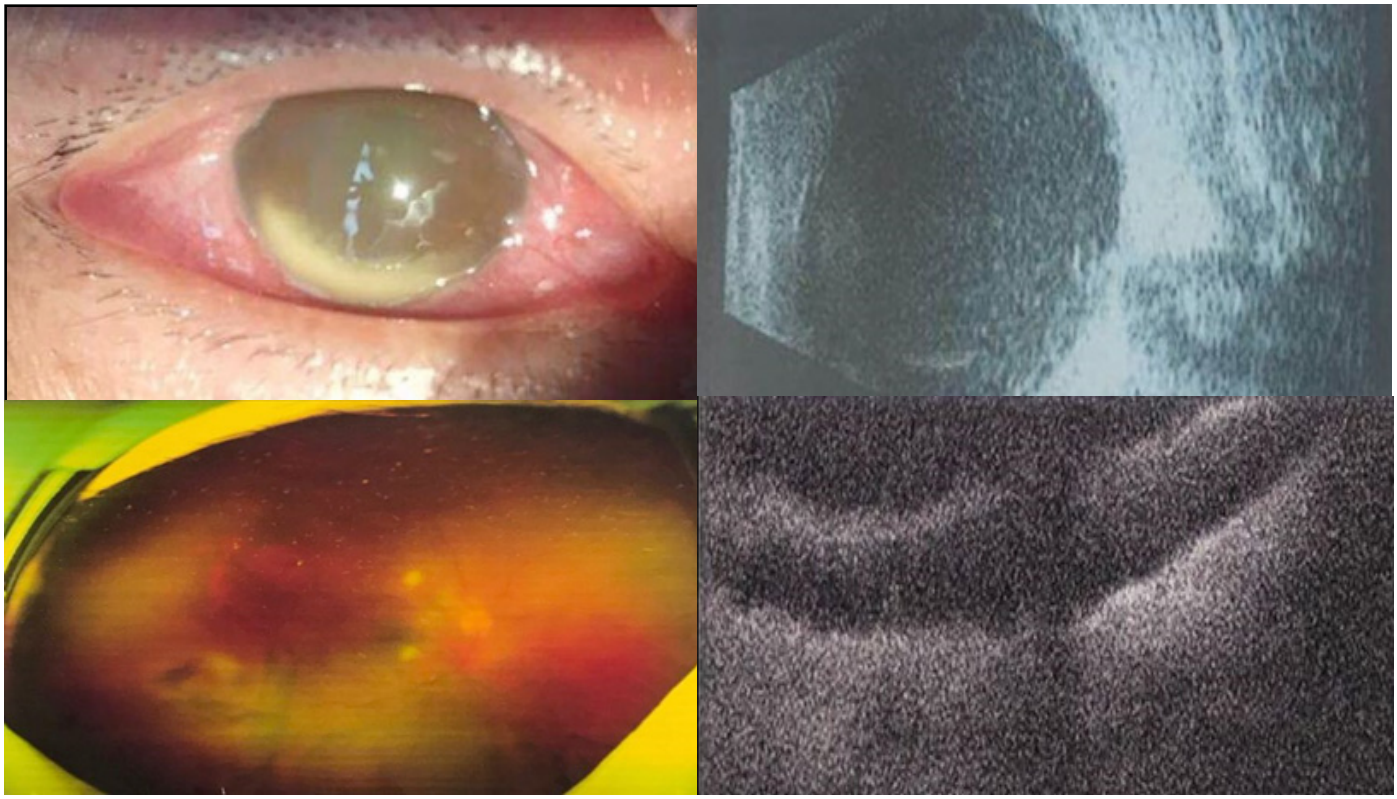

Figure 1. Clinical manifestations and imaging results of endophthalmitis

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