

Clinical and Microbiological Features of Pediatric Endophthalmitis After Open Globe Injury in the North of Viet Nam

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Abstract

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BACKGROUND: Pediatric endophthalmitis after open-globe injury had its clinical features, microbiological profile different from those in adults. In Viet Nam, there was no report on the clinical and microbiological characteristics of pediatric posttraumatic endophthalmitis. Therefore, we conduct this study.

AIM: To describe clinical features, ultrasound results, gram stain and culture results of endophthalmitis in pediatric open globe injuries.

METHODS: Prospective non-controlled study. Case series of 30 eyes presenting with post-traumatic endophthalmitis between 2015 and 2016 were reviewed.

RESULTS: Mean age was 8.03 ± 3.99 years. Metallic and organic etiologies were the most common causes for injuries ($n = 11$). 27 cases had penetrating corneal trauma. Dense opaque vitreous was seen in 25 eyes. Retinal necrosis < 1 quadrant and chorioretinal abscess > 1 quadrant were the most common fundus lesions. Dense vitreous opacity on ultrasound was most common ($n = 28$). Gram stain bacteria positivity was 93.3%, gram-positive was isolated in 63.3%. Vitreous samples were more often positive than aqueous ($P = 0,002$).

CONCLUSION: Posttraumatic endophthalmitis in children is more common in boys aged 6-10 years and most often caused by injury with metallic and organic matters. Culture results were very low. Vitreous samples were more often positive than aqueous. Gram-positive bacteria were the most common causative organism.

Introduction

Post-traumatic endophthalmitis is one of the severe complications of open globe injuries. It is the infection of the intraocular tissues and intraocular fluids, including hypopyon, vitreous cavity, retina, and the uvea. The pathogens enter intraocular cavities through a corneal wound and/or scleral wound. Post-traumatic endophthalmitis is usually acute with clinical manifestations mainly with symptoms: hypopyon, loss of red pupil reflex, and progressive vitritis. The disease causes intraocular structure damages leading to visual impairment, and severe cases may even require enucleation. Endophthalmitis was estimated at 5%-14% of cases of open globe injuries [1], [2]. In children, according to some recent studies, this rate is

much higher. The prevalence of post-traumatic endophthalmitis in children could increase up to 54.1% of all open globe injury cases [3]. In a study by Thordsen et al., post-traumatic endophthalmitis was the most common cause of pediatric endophthalmitis [4]. Regarding pediatric open globe injury, endophthalmitis is considered as the most severe complications. It can occur in very diverse circumstances and causes sight-threatening leading to blindness in many children. On the other hand, because of the physiological characteristic of the age group, the disease situation is complicated with the strong inflammation reaction, the diagnosis and treatment are much difficult with a high sequelae rate. Early diagnosis and treatment can improve prognosis, but it is often delayed because the children do not cooperate well during the examination, the symptoms

of endophthalmitis were covered by signs of open globe injury, and their parents/ guardian do not notice a pain, red eye or visual loss. There are many reports of post-traumatic endophthalmitis, but few reports on the pediatric group. Most of these reports focus on the outcome and factors that influenced it. In Viet Nam, there are some studies of post-traumatic endophthalmitis, but all of them have executed on both adults and children [1], [5], [6], [7]. However, pediatric endophthalmitis after open-globe injury had its clinical features, microbiological profile such as the late hospital presentation leading to delayed primary repair, lack of information about the nature of injury. The spectrum of pathogens seems different from those in adults. *Staphylococcus epidermis* and *Bacillus* species are the two most common organisms which cause post-traumatic endophthalmitis, whereas *Streptococci* are the preference pathogen in children [2], [8]. It is necessary to conduct a separate research on children to understand further accurate clinical data and microbiological characteristics. Therefore, this study aims to identify the clinical and microbiological features of post-traumatic endophthalmitis in children.

Material and Methods

It is a descriptive prospective, single-center, interventional case series analysis on 30 eyes of 30 patients under 16 years, diagnosed and treated endophthalmitis following open globe injuries in Vietnam National Institute of Ophthalmology from August 2015 to August 2016. The exclusion criteria were a history of any ocular surgeries up to 3 months prior to trauma, sepsis, or any systemic sources of infection. Informed consents were obtained from parents or guardians of all participating subjects, the epidemiological data of each patient was documented including age, gender, type and mode of trauma, initial visual acuity, the interval between the trauma and the closure of the wound. Regarding pre-school children, visual acuity was evaluated with Allen card test. All patient underwent comprehensive ophthalmic examinations in which some cases needed to be examined under general anesthesia if they were unable to cooperate with the examination. Clinical examination will detect the following lesions: location and size of the wound, corneal edema, hypopyon, lens the rupture of lens, vitreous opacity grade and retinal lesions such as vessel occlusion, retinal necrosis, retinal abscess through microscopic examination or observation during surgery. Ultrasound was only performed in case an initial surgery was done to close the wound. Plain-film radiology or orbit CT scan should be done when suspected of intraocular foreign body (IOFB). An aqueous or/and the vitreous tap was carried out in all patients, then Gram stain or wet mount preliminarily identifies the microorganisms and culture isolated into appropriate

environments to identify the causative agents.

Evaluation criteria: Wound locations were cornea, sclera, and corneosclera. There were three wound sizes including < 5 mm, 5-10 mm, > 10 mm. Associated lesions consisted of lens rupture, IOFB, retinal detachment, retinal tear, and choroidal detachment. The fundus lesions such as vessel occlusion, retinal necrosis, and retinal abscess were documented in quadrants. Vitreous opacity had five grades clinically based on the visibility of retinal details: 1. All the retinal blood vessels are well visible; 2. Only are observed the retinal blood vessels in the 2nd division or above; 3. Only is still observed the large root vessels; 4. All the retinal blood vessels are not visible but the red reflex; and 5. Absent reflex due to dense pus on the vitreous cavity. On ultrasound, the vitreous opacity had three grades: 1. Scatter small dots opacities ≤ 2 mm small; 2. Spreading opacity with dots/ areas, in which a large turbid glass with 3-8 mm, spreading; and 3. Dense opacity.

Microbiological results are divided into groups of microorganisms: Gram (+) bacteria, Gram (-) and fungi.

The statistical analysis of our data was analysed with the SPSS program version 20.0 (SPSS Inc, Chicago, IL, USA).

Results

The mean age of our patients was 8.03 ± 3.99 (ranging from 2 years to 15 years). Children aged 1-3 years old, 3-6 years old, and 10-15 years old accounted for 10%, 20% and 26.7% of cases, respectively. Notably, primary school-aged 6-10 years is the most common age group in the study, with 43.3% of cases. The number of male children is higher than that of female children with a ratio of 6.5 / 1 ($P = 0.000$).

Rural trauma is one of the common risk factors causing endophthalmitis after open-globe injuries. The proportion of injuries occurring in rural areas accounts for the majority (76.7% of cases), only 23.3% of injuries occur in urban areas; the difference is statistically significant ($P = 0.003$) (Table 1).

Table 1: Baseline characteristics

The mean age	8.03 ± 3.99
The most common age group	6-8 years old (43.4%)
Male/Female children ratio	6.5 / 1
Rural trauma / Urban trauma	76.7% / 23.3%

Corneal wounds occupy the highest rate, with 90%. 80% of injuries are less than 5 mm in size (Table 2). Five children had a wound length of 5-10 mm (16.7%) and one child with a corneal wound over 10 mm (3.3%). There is no perforating and rupture

wound in our study. 50% of the eyes had the iris prolapse; only 26.7% of eyes did not have intraocular tissue incarceration.

Table 2: Clinical characteristic lesions

Characteristics	Number of eyes (n = 30)	Ratio (100%)
Cornea	Edema	27
	Abscess	3
Hypopyon		28
Vitreous opacity	Grade 4	5
	Grade 5	25
Vessel occlusion	≤ 1 quadrant	21
	> 1 quadrant	9
	No	3
Retinal necrosis	≤ 1 quadrant	26
	> 1 quadrant	1
	No	2
Retinal abscess	≤ 1 quadrant	12
	> 1 quadrant	16
Retinal detachment		6

The leading cause was sharp metal objects (36.7%) such as knives, scissors, nails ... and wood (36.7%) such as wooden sticks, tree branches ... Other causes included animals (fish and stork) bites (10%), plastic toy (6.6%). The remaining three children (10%) could not identify traumatic cause because the children did not remember, and the family members were not present when the child was injured.

The average interval between injury and closure repair was 31.88 ± 30.96 hours (ranging from 3 hours to 120 hours). 60% of the wound was repaired early in the first 24 hours, 30% were closed within 24-72 hours, 10% were delayed after 72 hours.

Visual acuity at presentation was very low: 70% of eyes had VA of LP (+) to HM, VA better than HM accounted for only 6.6% (n = 2). There was no eye with no light perception and only 1 eye with VA better than 20 / 200. Visual acuity could not be tested in 23.4% of eyes due to children's non-cooperation.

Penetrating wound without IOFB accounted for the highest percentage of 93.4% (28 eyes). The IOFB was detected in 2 cases, in which there was one case of metal located in the anterior segment, causing cataract rupture (3.3%). In the other case, the wooden piece was in the vitreous cavity (3.3%).

The infection in anterior chamber expressed by corneal edema and abscess. 90% of eyes presented corneal edema, 10% of eyes (n = 3) appeared corneal abscess. 93.3% of the children in the study had hypopyon with different levels from a little to filling all anterior chamber.

We recorded vitreoretinal lesions and associated lesions by microscopic examination or observation during surgery with intraocular endocamera. Our research has 83.3% of children with vitreous opacity of grade 5. Vascular occlusive inflammation was seen in all patients; retinal necrosis occurs in 90% of cases. However, the area of vascular occlusive inflammation and retinal necrosis is usually less than a quadrant (70% and 86.7%). 10% of cases do not suffer from retinal necrosis. In

contrast, retinal abscesses tend to spread over one quadrant in 53.3% of cases. The difference between retinal necrosis and the retinal abscess was statistically significant (p = 0.006). Retinal tears and retinal dialysis were seen in 12 cases (40%).

Endophthalmitis after open globe injury is mostly accompanied by lens rupture with the rate of 63.3% of cases (n = 19), 13.3% of cases (n = 4) had cataract with intact anterior capsule, 23.3% (n = 7) of cases had clear lens.

Evaluating during surgery and on ultrasound, we also reported that 20% of cases (n = 6) had a retinal detachment.

Some associated factors have been reported to have a greater risk of post-traumatic endophthalmitis. They are retained IOFB, the rupture of lens, delayed timing of initial repair surgeries more than 24 hours, large wound sized over 10 mm and rural trauma. The number of patients with two risk factors accounted for the highest proportion of 46.7%, followed by the case of 1 risk factor (33.3%). There is one eye with all five risk factors. Two children had endophthalmitis without any risk factors.

Microbiological characteristics

In all cases, we collected aqueous or/and vitreous sample for direct wet mount and direct microscopic then a culture to isolate bacteria/ fungi (Table 3). The microorganism was found in 93.3% (n = 28) of eyes with direct wet mount or direct microscopic. Two eyes (6.7%) had negative microbiological results, but the clinical manifestations of acute infections as well as dense vitreous opaque on ultrasound B helped diagnose endophthalmitis.

Table 3: Microbiological results

Microbiological results	Number of eyes (n)	Ratio (%)
Gram-positive Cocci	8	26.7
Gram-positive Bacilli	11	36.7
Gram-negative Bacilli	9	30
Fungii	5	16.7
Negative	2	6.7

Gram-positive was accounted for 63.3% (n = 19) of cases, followed by Gram-negative bacteria with 30%. Fungii was identified in 16.7%. In the bacteria group, Bacilli got the highest rate (66.7%) followed by Cocci at 26.7%. In which, 16.7% had multiple organisms found.

Our study has only 1 case (3.3%) that successfully cultured, isolated Pneumococci from both aqueous and vitreous samples.

In our study, only 13 cases were tested for microbiology from both aqueous and vitreous samples. The positive rate in aqueous and vitreous samples were 92.3% and 100% respectively. Statistical tests showed that the ability to detect microorganism of the aqueous sample is lower than that of the vitreous sample with P = 0.002.

Discussion

The average age in our study is similar to the reports of Alfaro, Rishi, Sheng, and Jin respectively, 8, 9.2, 7 and 7.84 years old [9], [10], [11], [12]. The primary age group from 6 to 10 years of age accounts for the highest proportion, similar to the results of some recent studies [12], [13], [14]. Because the percentage of boys with penetrating eye is higher than that of girls, the rate of boys with endophthalmitis after penetrating eye also was higher than that of girls [3], [10], [11], [12], [14], [15]. Our report shows that the number of injuries occurring in rural areas was a majority; this result was similar to other reports [3], [13]. The reason for this difference was that compared to the city, rural children were likely to lack of the supervision or care of their parents and teachers, while they were exposed to many agents, especially sharp objects in the environment that contaminated with soil and sand (bamboo sticks, twigs, pieces of metal).

Moreover, their parents did not fully understand how to prevent these accidents. Therefore, it explains the reason for the increased incidence of ocular injuries in rural areas.

In our study, the pure corneal tear wound occupied the majority of cases. Reports of endophthalmitis after penetrating eye injuries in children of Junejo (2010) and Wu (2016), Sheng (2017), have similar results with the percentage of corneal tear injuries being respectively 62.7%, 86, 7% and 81.4% [11], [13], [14].

Traumatic agents are mainly sharp metal objects (36.7%) such as knives, scissors, nails, and plant agents (36.7%) such as wooden sticks, twigs. Narang and Wu, Sheng, Jin, Zhang also indicated that the cause of injury is mainly metal agents, especially in the report of Sheng, the primary etiology was syringe needle [3], [11], [12], [14], [15]. In contrast, Rishi studied 143 children with endophthalmitis after penetrating eye injury in India found that organic agents such as broomsticks and pencils accounted for the highest proportion with 55.3%, while that sharp metal objects accounted for only 10% of cases [10]. We believed that the rate of plant agents in our study and those of Indian authors such as Narang and Rishi is probably higher than other studies because the rate of children living in rural areas is quite higher while these agents are mainly seen in rural injuries.

The delay in primary repair of the wound was considered as one of the most risk factors for endophthalmitis. Especially, closing the wound after 24 hours after the injury is one of the factors that increase the risk of endophthalmitis after penetrating eye injuries. In our study, 40% of injured eyes were closed after 24 h which is similar to the study of Junejo and Zhang that 46.6% and 53.3% of children came to the hospital after 24 hours [13], [15]. Alfaro

(1995) reported an average time from injury to the primary repair higher than our study of 4 days and this time in the report of Sheng (2017) was 9.3 days [9], [11]. In a series of other authors about the pediatric open-globe injury, there was also a high rate of patients who had primary repair late after 24 hours and who got endophthalmitis [16], [17], [18].

The initial VA was very low in our series. The eyes with VA of LP to HM accounted for 70% (n = 21) and VA better than HM was only 6.6% (n = 2). Meanwhile, only 3.3 % of cases had a presenting VA of 20/200 or more. This result was similar to other reports about pediatric endophthalmitis posttraumatic. Wu also showed that the majority of children had very low initial VA, with 73.3% of cases with VA of LP to HM [7]. Junejo reported that, 51.2% patients had VA of LP to HM, 16.3% was NLP or not co-operated; Sheng had 78% of eyes with initial VA < 5 / 200 in which 9.9% was NLP, 25.5% was LP and 25.6% was HM and 67.1% of eyes in Zhang's report had VA at presentation of LP to HM [11], [13], [15].

In the anterior segment, the infection status is evaluated by the corneal edema and hypopyon. In our study, 90% of eyes had corneal edema, and 10% of eyes (n = 3) appeared corneal abscess, which is a sign of particularly severe infection of endophthalmitis. Rishi's study (2016) found that 15% of eyes with corneal abscess and all these eyes had poor treatment outcome at the last visit of follow-up examinations. Rishi also identified this as one of the factors that increased the rate of cases with treatment failure (P = 0.04) [10]. Our research showed that 93.3% of children had hypopyon at varying degrees from very little to all anterior chamber occupied. This result was similar to some recent studies [3], [9], [13]. However, Wu's study only observed 60% of eyes with hypopyon, and in Rishi's study this rate is only 31% [10], [14].

In our study, most cases were accompanied by cataract (63.3%) similar to other authors like Narang, Wu, Sheng [3], [11], [14]. However, Rishi and Junejo showed that the cataract rate was significantly lower at 35% and 27.9%, respectively [10], [13].

When evaluating during surgery and on ultrasound, we also recorded 20% of cases (n = 6) with retinal detachment, similar to the reports of Rishi, Sheng [10], [11]. The presence of retinal and choroidal detachment made the condition of endophthalmitis after penetrating eye more severe, and the treatment outcome was worse.

Specimens were sent to microbiological workup after taking from two procedures: aqueous tap (n = 13) and vitreous tap (n = 30). Of 30 specimens from vitreous, Gram (+) found in 63.3% (n = 19), followed by Gram (-) bacteria in 30%. The results are similar to many other studies. However, the Fungii rate in our study was higher, with the rate of 16.7% [9], [10], [11], [14], [15], [17]. In the bacteria group, bacilli were detected with the highest rate (66.7%),

and the Cocci was 26.7%. This result was quite different from most other studies in which the main causes were Cocci (Streptococcus and Streptococcus) [3], [9], [10], [11], [12], [13], [14], [15], [17]. We supposed that, in our series, the majority of injuries occurred in the rural areas where many infected wounds were caused by twigs, wooden sticks... which contained a variety of bacilli organisms. Multiple pathogens were found in 16.7% of vitreous tap specimens. This ratio was quite different between studies, the multiple pathogens rate in studies of Alfaro, Wu, Rishi and Zhang were respectively 33.3%, 13.3%, 7.3% and 18.4% [9], [10], [14], [15]. Multiple pathogens were considered as risk factors causing the poor prognosis of endophthalmitis after penetrating eye injury in children.

In many reports, the positive isolated rate of culture according to studies in developed countries was about from 41% to 75% [9], [10], [13], [14], [17], [19]. However, Narang (2004) and colleagues reported only 27% of positive cultures [3]. In our series, organisms isolated in only 1 case (3.3%) was identified as Streptococcus Pneumonia from both aqueous and vitreous samples. Thus, the positive culture rate in our study was much lower than in other studies in the world. Some reasons are a small number of available organisms or a history of long-time using an antibiotic (frequent in Viet Nam) or our technique of taking samples or culture can affect our results. Statistical analysis showed that, the aqueous samples had lower rate of bacteria positive than that of vitreous with $P = 0.002$. These results were similar to the study of Cornut in 17 cases of posttraumatic endophthalmitis [20]. The reports of Melo and Do Tan on endogenous bacterial endophthalmitis also showed a much higher rate of detecting pathogenic bacteria in vitreous specimens than aqueous specimens [21], [22].

In conclusion, pediatric endophthalmitis after open globe injuries had a higher incidence in children of primary school age boys with predominantly corneal laceration and the leading cause was sharp metal objects. It damages both anterior and posterior segments. Even 60% of wounds were closed within 24 hours, clinical and ultrasound features were very severe with very low presenting visual acuity. Gram-positive bacteria were the major causes but Bacilli were the highest pathogen detected in pediatric endophthalmitis following open-globe trauma in the North of Viet Nam.

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