Endophthalmitis following penetrating eye injuries

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ABSTRACT. Postinjury endophthalmitis is the eye infection with the worst prognosis. A retrospective 9-year study was made of penetrating eye injuries, with an analysis of the incidence of infection and its relation to the type of wound and the presence of intraocular foreign bodies. There were 403 cases of penetrating eye injury; of these, 233 affected the cornea and 170 involved the posterior pole. Intraocular foreign bodies were present in 40 cases. Endophthalmitis developed in 4.2% of cases (17/403), and was more common in patients with posterior pole involvement (7%) than in purely corneal trauma (2.1%) (p = 0.03, Chi-square). Infection was in turn more frequent in the presence of intraocular foreign bodies (15%) (p = 0.17, Chi-square). Staphylococcus epidermidis was the most common cause (23.4%), while in three cases (17.6%) mixed infection was detected. The visual results were evisceration or non-perception of light in 82.3% of cases.

Key words: eye trauma - traumatic endophthalmitis - intraocular foreign bodies - penetrating eye injury.

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Penetrating eye injuries constitute acute ophthalmologic situations, since total destruction of the eye or functional loss may result (Levin & D'Amico 1991). These injuries may lead to endophthalmitis, caused by a specific spectrum of microorganisms. Despite advances in the use of intraocular antibiotics, prognosis is very poor (Hemady et al. 1990). The precise diagnosis may pose problems, due to confusion in the early stages with inflammation attributable to the wound itself. The early identification of the organism responsible, with early treatment, are the only options available to improve the prognosis.

The present study reviews the cases of endophthalmitis following penetrating eye injury treated in our hospital during the last 9 years, and analyzes the factors that influence the development of infection.

Material and Methods

A review was made of the 403 cases of penetrating eye injury treated in the Service of Ophthalmology (La Fe University Hospital, Valencia, Spain) between January 1983 and September 1992. The type of wound was analyzed along with involvement of the posterior pole and the possible presence of intraocular foreign bodies.

Intravenous antibiotic prophylaxes were administered to these patients, using a first-generation cephalosporin in combination with an aminoglycoside for 3-5 days following surgical repair.

Postinjury endophthalmitis developed in 17 cases. In each of these we established patient age, sex, affected eye, cause of injury, the type of injury and the presence or absence of intraocular foreign bodies, the isolated microorganism, and final functional outcome.

The data were statistically analyzed using the Chi-square test.

Results

Between January 1983 and September 1992 a total of 403 patients were seen for penetrating eye injuries in our Service. Of these, 233 affected only the cornea, while the remaining 170 involved the posterior pole to varying degrees (including corneoscleral and scleral wounds, as well as corneal injuries penetrating to the posterior pole). Intraocular foreign bodies were present in 40 cases: 18 in the anterior pole and 22 lodged in the posterior pole.

Endophthalmitis developed in 17 patients (4.2%) (Table 1), 13 males and four females (ratio 3.25:1). Mean patient age was 36.05 years (range 13-70). The left eye was involved in 9 cases, and the right in 8. The mean incubation period was 6.3 days (range 1-25).

On relating the type of injury to the incidence of endophthalmitis, we found the latter to be less common when only the anterior pole was affected (2.1%; 5/233) than when the posterior pole was involved (7%; 12/170) (p = 0.03). The presence of intraocular foreign bodies was likewise associated to a higher incidence of endophthalmitis (15%; p = 0.17), especially when the posterior pole was affected (Table 2).

Regarding the causes of injury, 8 were work-related (2 in the rural setting), and three were the result of violence; three were caused by traffic accidents, two by fireworks, and one by a tree branch (Table 1).

The cultures were positive in 10 of the 17 cases (59%), with mixed infection in three. The most commonly isolated microorganism was Staphylococcus epidermidis (29.4%; 5/17), followed by two cases of Bacillus sp., two of Pseudomona sp., and two cases of Clostridium sp. (Table 3).

All patients received extraocular (parenteral, fortified topical and subconjunctival) antibiotics (EOABs). Intravitreal administration of both a cephalosporin and an aminoglycoside was undertaker in 3 cases (cases 1, 4 and 6) (IOABs)

Table 1. Etiological data on the 17 patients with endophthalmitis following penetrating eye injuries.

Patient	Age	Sex	Eye	Cause	Setting	Wound type	IOFB
1	54	M	RE	Laboral	Urban	Corneal, hematic hypopyon (75%)	
2	25	M	RE	Laboral metallurgy	Urban	Scleral, vitreous hemorrhage	PP
3	51	M	RE	Laboral construction	Urban	Corneal cataract	PP
4	29	M	LE	Tree branch	Urban	Corneal 25% hypopyon	
5	31	M	LE	Traffic	Urban	Corneoscleral AC eyelash	PP
6	45	F	RE	Agression A infilt.*		Vitreitis, non-visible entry point	
7	13	F	RE	Agression dart	Urban	Scleral	
8	56	M	LE	Laboral construction	Urban	Corneoscleral cataract	
9	70	F	LE	Agression scissors	Urban	Corneal	
10	35	M	LE	Laboral	Rural	Corneal	AP
11	13	M	RE	Fireworks	Urban	Corneoscleral 75% hyphema	PP
12	15	M	LE	Traffic	Rural	Corneal, sphincter rupture, cataract, vitreous loss	
13	60	M	LE	Laboral	Urban	Scleral	PP
14	32	M	RE	Laboral	Urban	Corneal	
15	25	M	RE	Traffic	Urban	Double corneal & scleral wound	
16	40	M	LE	Fireworks	Urban	Corneoscleral cataract	
17	19	M	LE	Laboral	Rural	Scleral	

M: male, F: female, IOFB: intraocular foreign body, RE: right eye, LE: left eye, PP: posterior pole, AP: anterior pole.
* Accidental intraocular injection by dentist.

Table 2. The incidence of postinjury endophthalmitis in terms of the type of wound and presence or absence of intraocular foreign bodies.

	Wound in AP	PP involvement	Total
Non-IOFB	1.86% (4 de 215)	4.7% (7 of 148)	3% (11 of 363)
IOFB	5.5% (1 de 18)	22.7% (5 of 22)	15% (6 of 40)
Total	2.14% (5 de 233)	7% (12 of 170)	4.2% (17 of 403)

AP: anterior pole, PP: posterior pole, IOFB: intraocular foreign body.

Table 3. Microorganisms isolated from the 17 patients with endophthalmitis following penetrating eye injuries.

Patient	IP	Germ isolated	Cultures EC/AC/V	PVA	Treatment	FR FVA
1	9	S. epidermidis	+/+/+	LP	EOABs + IOABs	Evisc
2	3	-	-	Amau	EOABs	Evisc
3	1	-	-	LP	EOABs + L + EFB	NoRD Amau
4	3 - 4	S. epidermidis	+/+/+	LP	EOABs + IOABs	Evisc
		Pseudomona aeruginosa	+/+/−			
		Candida parapsilosis	+/−/−			
5	5	Pseudoma stutzery	+/+/+	LP	EOABs + V + L	LP
		S. epidermidis	−/−/+			
6	7	S. epidermidis	+/+/−	HM	EOABs + IOABs	Phthisis
		Streptococcus sp.	+/−/−			
7	5	-	-	HM	EOABs + V	Phthisis
8	25	-	-	Amau	Evisc	Evisc
9	5	Bacillus sp.	+/+/+	HM	EOABs + V + ICCE	0.05
10	1	Clostridium welchii	+/+/+	Amau	Eviscer	Evisc
11	4	-	-	Amau	Eviscer	Evisc
12	1	Clostridium sp.	+/+/−	Amau	EOABs + V	Phthisis
13	2	-	-	HM	EOABs + V + L	Phthisis
14	3	S. epidermidis	+/−/+	HM	EOABs + V	LP
15	4	S. epidermidis	+/+/−	LP	EOABs	Phthisis
16	4	-	-	LP	EOABs + V + L	NoRD Amau
17	2	Bacillus sp.	+/+/+	LP	EOABs	Evisc

IP: incubation period (in days). Cultures: EC: eyelid and conjunctiva, AC: anterior chamber, V: vitreous. PVA: previous visual acuity, FR: final anatomic result, FVA: final visual acuity: HM: hand movements, Amau: amaurosis, LP: light perception, Evisc: evisceration, NoRD: non-operable retinal detachment, L: lensectomy, V: vitrectomy (with perfusion antibiotic), EFB: extraction of foreign body, ICCE: intracapsular cataract extraction.

Patients with painful, totally blind eyes underwent primary evisceration.

The functional outcomes were: evisceration in 7 cases (41.1%), evolution to phthisis bulbi in 5 (29.4%), non-perception of light in two cases, perception of light in two cases, and one patient with a visual acuity of 0.05. This represents progression to amaurosis in 82.3% of the cases (Table 4).

Discussion

In the present study, 4.2% of patients with penetrating eye injuries subsequently developed endophthalmitis. The incidences reported in other series vary considerably, from 2.4% according to Fisch et al. (1991) and Salvanet-Bouccara et al. (1992), to 17% in the series by Boldt et al. (1989). Such variability could be attributed to the circumstances of injury. Thus, some authors distinguish between endophthalmitis in the rural and urban settings (Boldt et al. 1989), with incidences reaching 30% in rural areas.

We found the incidence of endophthalmitis to be higher in the presence of intraocular foreign bodies (15%) than in their absence (3.03%) ($p = 0.17$). This agrees with the results reported by others (Mieler et al. 1990). Accordingly, Levin & D'Amico (1991) observed a 10.7% incidence in the presence of intraocular foreign bodies, versus 5.2% in their absence.

In our series, endophthalmitis was most frequent when posterior pole was involved (7%) than when only the anterior pole was affected (2.1%), and we

Table 4. Functional outcomes compared with the results in other types of endophthalmitis in our experience.

	Total	Evisceration amaurosis	LP	≥ 0.05
Postinjury	17	14 82.3%	2 11.7%	1 5.8%
Other surgery Hurtado-Sarrió et al. (1993)	13	9 69.2%	1 7.69%	3 23%
Post-cataract surgery Duch-Samper et al. (1993)	28	10 35.7%	10 35.7%	8 28.5%

LP: light perception.

found this to be of statistical significance ($p = 0.03$). This may be explained by the greater growth of contaminating microorganisms in the vitreous gel, where the germ-clearing capacity is limited (Dickey et al. 1991; Menezo et al. 1993) and antibiotic penetration of the blood-retina barrier proves difficult.

The most commonly isolated microorganism was Staphylococcus epidermidis (29.4%). This agrees with the results of other authors (Levin & D'Amico 1991). Thirty percent of the positive cultures were mixed infections, this incidence being much higher than after cataract surgery (9.09%) (Duch-Samper et al. 1993). Similar observations have been reported by other authors (Levin & D'Amico 1991).

The functional results are poorer than following cataract surgery. Thus, nonperception of light occurred in 82.3% of cases versus 41.6% after endophthalmitis due to cataract surgery (Duch-Samper et al. 1993) (Table 4). These poor visual outcomes have also been described elsewhere (Levin & D'Amico 1991; Stovecipher et al. 1994) - a final visual acuity of 20/400 being regarded as an important success.

In view of the poor prognosis for endophthalmitis following penetrating eye injuries, we believe that adequate prophylaxis of the infection may be helpful.

There is extensive literature on the poor intraocular penetration of most antibiotics given systemically, which places in doubt their utility in ocular traumatisms (Axelrod et al. 1985; Gardner 1991). However, the development of new generations of antibiotics, such as the second-generation quinolones, has made it possible to achieve therapeutic vitreous concentrations after systemic administration (El Baba et al. 1992). Unfortunately, however, these agents are of scant efficacy against germs of the genus Streptococcus (Neu 1991), and so the association of a second antibiotic is required. Thus Alfaro & Ligget (1994) employed experimental models to demonstrate therapeutic vitreous levels in traumatized eyes following the systemic dosing of cefazolin but not gentamycin. Alfaro et al. (1993) subsequently found cefazolin to be useful in the prophylaxis of traumatic endophthalmitis.

Well-designed and executed studies with concurrent prospective comparison of the endophthalmitis rate with one prophylactic regimen versus another have not been done (Starr et al. 1995).

Although data derived from animal models are difficult to extrapolate to the clinical setting, we believe that in the absence of adequate alternatives in systemic prophylaxis, the association of ciprofloxacin and cefazolin should be evaluated.

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