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A Five-year Review of Patients Admitted with the Diagnosis of Bacterial Endophthalmitis

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ABSTRACT

We conducted a retrospective, hospital-based study of patients who were diagnosed with bacterial endophthalmitis on admission to the Department of Ophthalmology, Hiroshima University Hospital, between January 1999 and December 2003. Thirty eyes of 30 patients were identified. Of these patients, 19 eyes had postoperative endophthalmitis, 8 eyes had penetrating trauma and 3 eyes were infected from an endogenous source. All of the patients underwent immediate three-port pars plana vitrectomy. Vitreous specimens of diabetic patients demonstrated a significantly higher incidence of positive bacterial culture. Diabetic vitreous appeared to be a good medium for culture. Visual acuity of hand motion or less at the latest follow-up visit was associated with the presence of diabetes. Prompt treatment with vitrectomy and intravitreal antibiotics is crucial for patients with bacterial endophthalmitis, especially if they are diabetic.

Key words: *Bacterial endophthalmitis, Pars plana vitrectomy*

Most ocular infections tend to be isolated to a single location or layer of the eye. For example, conjunctivitis is an infection of the conjunctiva, and keratitis is an infection of the cornea. Vision remains reasonable with medical treatment for most of these infections. However, infectious endophthalmitis, which involves the intraocular contents of both the anterior and posterior segments of the eye, predominantly the vitreous, can be very serious and difficult to treat[10)].

The source of bacterial endophthalmitis may be the external environment (exogenous bacterial endophthalmitis), a surgical wound (postoperative endophthalmitis), or a perforating globe injury (posttraumatic endophthalmitis) or bacterial keratitis. Bacterial endophthalmitis can also result from an endogenous source (endogenous bacterial endophthalmitis), whereby the organisms enter the eye through the blood[1)].

We conducted a hospital-based, retrospective study of patients who were admitted with the diagnosis of bacterial endophthalmitis and treated between January 1999 and December 2003. The objectives of our study were to determine the visual outcome of bacterial endophthalmitis in relation to its cause and/or background and to evaluate the frequency of bacterial endophthalmitis following ocular surgery in our hospital.

METHODS

We conducted a retrospective chart review of patients who were diagnosed with bacterial endophthalmitis on admission to the Department of Ophthalmology, Hiroshima University Hospital, between January 1999 and December 2003. All case notes of patients with endophthalmitis were retrieved. The inclusion criteria were patients with a history of ocular trauma, surgical procedure, keratitis, or systemic disorders who were admitted with loss of vision, redness of the eye, hypopyon, or vitreous opacities and exudates. The exclusion criteria were those with a history of

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fungemia, and cases in which aqueous or vitreous specimens amplified DNA of herpes simplex virus, varicella-zoster virus, or cytomegalovirus DNA. Other exclusion criteria included Behçet's disease, phacoanaphylaxis, phacolytic glaucoma, and HLA-B27 syndromes. Thirty eyes in 30 patients were included in the study. There were 8 women and 22 men, ranging in age from 12 to 86 years (mean ± standard deviation, 67 ± 15 years).

All of the patients underwent immediate three-port pars plana vitrectomy under visualization of an operating microscope. Initially, an undiluted vitreous sample for bacteriology was obtained. Vitreous opacities, vitreous membranes, and fibrinous exudates in the anterior chamber were removed. In all eyes following cataract surgery with implantation of an intraocular lens, lens removal and posterior capsulectomy were performed. In eyes following penetrating ocular trauma due to intraocular foreign bodies, the foreign body was removed during the procedure. Follow-up after vitrectomy ranged from 6 to 65 months (mean, 18 months).

Statistical analysis was performed with Statview software (SAS Institute Inc.). Decimal visual acuities were converted to logarithm of minimal angle of resolution (LogMAR) values for the analyses. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Etiology (Table 1)

The largest group (19/30 eyes; 63%) was composed of patients with postoperative endoph-

Table 1. Clinical summary

Patient	Age, yr	Gender	Bacteriology	Pre-op VA	Final VA	Comorbid conditions
Exogenous (n = 27)						
postoperative (n = 19)						
cataract surgery						
1	70	M	(–)	HM	0.05	CRF
2	86	M	(–)	HM	0.06	
3	74	M	*Pseudomonas stutzeri*	LP	NLP	DM
4	42	M	*Pseudomnas aeruginosa*	CF	0.4	DM
5	76	M	(–)	HM	0.03	
6	66	M	(–)	0.04	0.3	HT
7	79	F	*Staphylococcus epidermidis*	LP	0.1	HT
8	84	F	(–)	CF	1.2	DM
9	80	M	(–)	0.03	0.2	HT
10	67	F	(–)	HM	0.1	DM
11	77	M	(–)	HM	LP	DM, HT
12	71	F	(–)	0.01	1.2	HT
vitreoretinal surgery						
13	74	M	*Pseudomonas aeruginosa*	HM	LP	HT
14	72	M	*Staphylococcus epidermidis*	0.04	0.6	DM
15	54	M	GNB	0.01	0.4	DM
16	66	M	(–)	0.6	1.0	
glaucoma surgery						
17	71	M	alpha-streptococcus	HM	0.3	pulmonary tuberculosis
18	69	M	(–)	LP	0.7	HT
19	64	M	*Streptococcus oralis*	LP	NLP	
posttraumatic (n = 8)						
20	12	M	(–)	CF	0.03	
21	44	M	GNB	HM	NLP	DM
22	57	M	GNB	0.03	0.04	
23	63	M	(–)	LP	0.1	hepatitis
24	62	F	(–)	HM	0.2	HT
25	46	F	*Streptococcus mitis*	CF	HM	DM
26	82	M	(–)	LP	0.03	HT
27	75	M	*Enterococcus faecalis*	HM	1.0	
Endogenous (n = 3)						
28	75	F	*Krebsiella pneumoniae*	CF	0.2	DM, pyothorax
29	73	M	*Krebsiella pneumoniae*	LP	HM	DM, liver abcess
30	74	F	*Staphylococcus warneri*	0.1	LP	DM, liver abcess

Abbreviations: GNB = gram-negative bacilli, pre-op VA = pre-operative visual acuity, final VA = final visual acuity, LP = light perception, HM = hand motion, CF = counting fingers, NLP = no light perception, CRF = chronic renal failure, DM = diabetes mellitus, HT = hypertension.

thalmitis, for whom cataract surgery with phacoemulsification and intraocular lens (IOL) implantation predominated (12 eyes). There was an inexplicable male predominance (M : F = 15 : 4) in this group. Penetrating trauma was the reason for endophthalmitis in 27% (8/30 eyes) of the patients. Male predominance (M : F = 6 : 2) was consistent with previous reports of penetrating ocular trauma[4]. In another 10% (3/30 eyes), patients with endogenous endophthalmitis were treated.

Systemic antibiotics

All patients had received intravenous antibiotics before undergoing vitrectomy. The antibiotics were imipenem/ cilastatin sodium (IPM/CS) in 16 patients, VCM in 4 patients, and cefmetazole sodium (CMZ) or other cephalosporins in 10 patients.

Intravitreal antibiotics

Infusion fluid for the maintenance of intraocular pressure was routinely added with 20 μg/ml of vancomycin hydrochloride (VCM), and occasionally with 40 μg/ml of gentamycin (11 eyes).

Table 2. Association between bacterial endophthalmitis and diabetes

	Diabetic (%)	Non-diabetic (%)	p value*
culture positive	9/12 (75)	6/18 (33)	0.03
Final VA ≤ HM	6/12 (50)	2/18 (11)	0.03

*Fisher's exact probability test
Abbreviations: final VA = final visual acuity, HM = hand motion

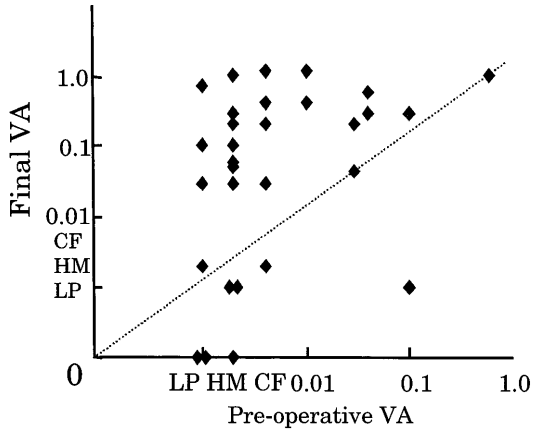

Fig. 1. Scatter graph comparing pre-operative and final visual acuity (VA).
VA of light perception (LP) was arbitrarily defined as 0.001, hand motion (HM) was 0.002, and counting fingers (CF) was 0.004.

Background illnesses (Table 1 & 2)

Diabetes mellitus was present in 40% (12/30) and hypertension was present in 30% (9/30) of patients. Visual acuity of hand motion or less at the latest follow-up visit was associated with the presence of diabetes mellitus (p = 0.03; Fisher's exact probability test), but not with hypertension (p = 0.55; Fisher's exact probability test).

Functional results (Table 1 & Fig.1)

Visual acuities were significantly improved after vitrectomy (p = 0.0004, Wilcoxon's signed rank test). However, there was no correlation between preoperative and final visual acuities.

The best functional results were achieved in the postoperative group; 73% (14/19 eyes) of this group attained visual acuity of 0.05 or better. In the posttraumatic group, 50% of patients reached 0.05 or better. Ambulatory vision was obtained in only 33% (1/3 eyes) of those with endogenous endophthalmitis.

Culture (Table 1 & 2)

All 3 eyes that had final visual acuity of no light perception had positive culture results. Seventy-three percent (11/15) of eyes with negative culture results obtained 0.05 or better vision, so also did 47% (7/15) of eyes with positive culture results. However, the difference was not significant (p = 0.13; Fisher's exact probability test). Better visual recovery (improvement in LogMAR) was suggested, but was not statistically significant (p = 0.06; Student's *t*-test) in patients with negative culture results.

Vitreous specimens of diabetic patients were culture positive in 75% (9/12) of cases, compared to 33% (6/18) in non-diabetic patients. This difference was statistically significant (p = 0.03; Fisher's exact probability test).

None of the isolated organisms was resistant to VCM among isolates from culture- positive patients.

Frequency of postoperative endophthalmitis in our hospital

Two eyes that underwent cataract surgery and 3 eyes that had vitreoretinal surgery performed at our hospital developed acute or sub-acute postoperative endophthalmitis. The incidence was 0.17% (2 / 1,181 eyes) with cataract surgery and 0.27% (3 / 1,503 eyes) with vitreoretinal surgery.

The other 14 eyes of 14 patients had been operated on elsewhere and were referred to our hospital after endophthalmitis developed.

DISCUSSION

It has been documented that patients with diabetes have an increased susceptibility to bacterial endophthalmitis[1]. The high prevalence of pathogenic organisms in the conjunctival flora of diabet-

ic patients[5], associated with the immunologic alterations described in the diabetic population, may play a role in the higher susceptibility to postoperative infection. We observed in the present series that the vitreous specimens of diabetic patients demonstrated a significantly higher incidence of positive culture. Diabetic vitreous appears to be a good medium for bacterial culture. The endophthalmitis vitrectomy study (EVS), which was a multicenter clinical trial of 420 patients with postoperative bacterial endophthalmitis, demonstrated that a patient with diabetes was 1.6 times as likely to have decreased vision compared with a patient without diabetes[10]. In the present study, visual acuity of hand motion or less at the latest follow-up visit was associated with the presence of diabetes. Therefore, prompt treatment with vitrectomy and intravitreal antibiotics is crucial for bacterial endophthalmitis, especially in diabetic patients.

Intraocular surgery was the leading predisposing factor of bacterial endophthalmitis in our series. It accounted for 63% of cases (19/30 eyes), in which cataract operations predominated (12/30 eyes). Potential sources of infection included contaminated instruments or infusion fluids, but the most common source was the patient's own ocular bacterial flora[7]. Topically given antibiotics before surgery may have reduced the ocular bacterial load. However, no conclusive scientific data have shown that use of preoperative, intraoperative, or postoperative antibiotics reduced the risk of postoperative endophthalmitis[3]. Given the low reported incidence (0.05–0.37%)[2] of postoperative endophthalmitis, it would be difficult to prove the assumption that reducing conjunctival bacterial flora decreases the risk of endophthalmitis. The incidence of postoperative bacterial endophthalmitis was comparable in our hospital, with 0.17% (2/ 1,181 eyes) after cataract surgery with phacoemulsification technique, and 0.27% (3/ 1,503 eyes) after vitreoretinal surgery. Ta et al[9] confirmed in their prospective study a recent trend of ocular colonization with multiresistant bacteria. The authors demonstrated that approximately one-fourth of patients harbor multiresistant coagulase-negative staphylococci (CNS), defined as resistant to 5 or more antibiotics tested. Moreover, the antibiotics that appeared to be most effective in eliminating multiresistant CNS were VCM, aminoglycosides (except neomycin), IPM, meropenem, cefotaxime, and levofloxacin (LVFX). In our present study and in other reports, no isolated organism was resistant to VCM. We therefore currently adopt commercially available 0.5% topical LVFX ophthalmic solution. In case the patient harbors a multiresistant organism, 10 mg/ml of topical VCM solution is added to the LVFX for the prophylaxis of perioperative endophthalmitis.

Management of posttraumatic and endogenous endophthalmitis differs considerably from that of postoperative endophthalmitis. Although definitive evidence is lacking, the consensus of opinion seems to be that systemic antimicrobial therapy is an essential component of the management[6]. No clinical studies support this assumption, and because of the substantial logistical problems in organizing a clinical trial to address this question, a definitive answer may never be available from human studies[8]. An aggressive approach, which usually involves immediate vitrectomy, with cultures and the use of systemic antibiotics, therefore, remains the standard of care for posttraumatic and endogenous endophthalmitis. In the present study, in spite of this aggressive approach, the functional results of these forms of endophthalmitis were worse than in the postoperative group.

In summary, the present study provides one hospital's experience in the management of bacterial endophthalmitis over a 5-year period. A higher incidence of positive bacterial culture in vitreous specimens and a poorer visual outcome are suggested in the diabetic population. Therefore, prompt treatment with vitrectomy and intravitreal antibiotics should be indicated for cases of bacterial endophthalmitis, especially in diabetic patients.

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REFERENCES

1. **Bartz-Schmidt, K.U., Bering, J., Kirchhof, B., Wiedemann, P., Walter, P. and Heimann, K.** 1996. Prognostic factors associated with the visual outcome after vitrectomy for endophthalmitis. Graefe's Arch. Clin. Exp. Ophthalmol. **234:** S51–S58.
2. **Callegan, M.C., Engelbert, M., Parke II, D.W., Jett, B.D. and Gilmore, M.S.** 2002. Bacterial endophthalmitis: epidemiology, therapeutics, and bacterium-host interactions. Clin. Microbiol. Rev. **15:** 111–124.
3. **Ciulla, T.A., Starr, M.B. and Masket, S.** 2002. Bacterial endophthalmitis prophylaxis for cataract surgery: an evidence-based update. Ophthalmology **109:** 13–24.
4. **Essex, R.W., Yi, Q., Charles, P.G.P. and Allen, P.J.** 2004. Post-traumatic endophthalmitis. Ophthalmology **111:** 2015–2022.
5. **Martins, E.N., Alvarenga, L.S., Höfling-Lima, A.L., Freitas, D., Zorat-Yu, M.C., Farah, M.E. and Mannis, M.J.** 2004. Aerobic bacterial conjunctival flora in diabetic patients. Cornea **23:** 136–142.
6. **Meredith, T.A.** 1999. Posttraumatic endophthalmitis. Arch. Ophthalmol. **117:** 520–521.
7. **Speaker, M.G., Milch, F.A., Shah, M.K., Eisner, W. and Kreiswirth, B.N.** 1991. Role of external bacterial flora in the pathogenesis of acute postoperative endophthalmitis. Ophthalmology **98:**

639–650.

8. **Sternberg, P.S. and Martin, D.F.** 2001. Management of endophthalmitis in the post-Endophthalmitis Vitrectomy Study era. Arch. Ophthalmol. **119:** 754–755.
9. **Ta, C.N., Chang, R.T., Singh, K., Egbert, P.R., Shriver, E.M., Blumenkranz, M.S. and Mino de Kaspar, H.** 2003. Antibiotic resistance patterns of ocular bacterial flora: a prospective study of patients undergoing anterior segment surgery. Ophthalmology **110:** 1946–1951.
10. **The Endophthalmitis Vitrectomy Study Group.** 1995. Results of the endophthalmitis vitrectomy study: a randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Arch. Ophthalmol. **113:** 1479–1496.