

100 μ 1, 10², 10⁴, 10⁵, 10⁶
 75%
 가 1 가
 4 (8) 100 μ PBS
 , 2 가 2 (4)
 . 2 6-0 vicryl
 100 μ PBS
 Blood agar, Thioglycollate broth, Sabouraud's agar 1 ~5
 (VITEK: BioMerieux, ofloxacin chloramphenicol
 USA) VITEK 1 가
 3
 . Blood agar Thioglycollate broth
 . Sabourauds agar 가 3
 5 (broth) (plate) 가
 가 Aculex(Atracurium besylate)
 2. 가 ml
 가 6 2~3 kg 36
 Ketamine(10 mg/kg)
 Rompun(1~2 mg/kg) Proparacaine 60 10
 hydrochloride(Alcain) 7 S. epidermidis, 3 S. aureus가
 3 mm 가
 가 (S. aureus, S. epi-dermidis) 1 가 10¹ /ml S. aureus
 100 μ Phosphate Buffered Saline(PBS) 3 4 3
 26-gauge, 2 cm 가 10 20 (40)
 1 가 S. aureus 0~30 /ml
 6-0 vicryl S. epidermidis 4 1
 가 10 (20) 2 . S. aureus 0 /ml (Table
 S. epidermidis Tryptic soy broth 1). 10⁸ /ml S. aureus 4 2 (
 Tryptic soy agar ml 가) 2
 , PBS 10 2
 nephelometer McFarland .²¹ 1 20000~21300 /ml . S. epi-dermidis 4 2 (가)
 PBS 9000~23000
 100 μ PBS 100 /ml . 10⁶ /ml S. aureus
 μ 1, 10², 10⁴, 10⁵, 10⁶ . 1 2 4 가
 . 2 (4) 140~16200 /ml . S. epidermidis
 . 2 6-0 vicryl 4 3

— : 가 —

60~2240 /ml . 10⁶ S. aureus 6-0 vicryl
 /m S. aureus 4 2 가 10¹ /ml 4
 , 10³ /ml
 120~2800 /ml . S. epidermidis 4 2 , 10⁶ /ml 3 , 10⁶ /ml 3
 2 . 10⁷ /ml
 20~1560 /ml , 2 2
 , 20~21900 /ml (Table
 1+ . 10⁷ /ml S. aureus 2). 2
 4 가 10¹ /ml PBS
 260~28900 . S.
 epidermidis 4 2 10
 , 2 1+~2+ /ml . 103/ml 43 /ml, 10⁵/ml
 2 70 /ml, 10⁶ /ml 200 /ml,
 2150~60900 /ml . 10⁷/ml 8593 /ml .
 S. epidermidis 10³~10⁷ /ml
 S. aureus 가 가
 가 , 가
 . PBS 100 μ 가 4
 (8) 3 가
 (Table 1). 가

Table 1. Endophthalmitis after Various Inoculum by Intravitreal Injection

Inoculum	Colonies/ml	No. of eyes*	Endophthalmitis	Vitritis	Colonies/ml from vitreous
<i>S. aureus</i>	10 ¹	4	0	3	0~30
	10 ³	4	2		20000~21300
	10 ⁵	4	4		140~16200
	10 ⁶	4	4		120~2800
	10 ⁷	4	4		260~28900
Controls		4	0		
<i>S. epidermidis</i>	10 ¹	4	0	1	0
	10 ³	4	2		9000~23000
	10 ⁵	4	3		60~2240
	10 ⁶	4	2	2	20~1560
	10 ⁷	4	2		2150~60900
Controls		4	0		

*Number of rabbit eyes

Table 2. Endophthalmitis after Various Inoculum by Perforation with 6-0 Vicryl Needle

Inoculum	Colonies/ml	No. of eyes*	Endophthalmitis	Vitritis	Colonies/ml from vitreous
<i>S. aureus</i>	10 ¹	4	0		
	10 ³	4	0	2	0~40
	10 ⁵	4	0	3	0~20
	10 ⁶	4	0	3	0~20
	10 ⁷	4	2	2	20~21900
Controls		4	0		

*Number of rabbit eyes

61 15 (24.6%)
 가
 coagulase staphylococci가 가
 Micrococcus, Diphtheroids, Bacillus species
 가
 S. aureus 5%(3), S. epidermidis
 0.3 mm 가 11.7%(7), 16.7%(10) 가
 Noel⁵ 가 Staphylococcus species가
 , Olitsky¹⁹
 0.4% 가
 , 1.4% 가
 Lyons²² 100
 7% . Parks³⁰
 Simon⁶ 가 342 , Salamon⁹ Thomas¹²
 가 가 , Olitsky¹⁹
 , (pre- (coagulase
 placement suture) staphylococci, Haemophilus species, Viridans
 Knobloch Lorenz²³ 3500 streptococci, S. pneumoniae, S. aureus, N. gonor-
 1 , Weinstein²⁴ 8000 1 , Ing⁴ rhea, C. trachomatis, P. aeruginosa)
 30000 1 (suprachoroidal space)
 가
 S. aureus, S. epidermidis가
 Olitsky¹⁹
 가
 Tucker Forster³¹ 가
 S. albus(epidermidis), S. aureus, P. fluo-
 rescens 가
 S. albus
 50×10⁴ /0.5 ml, S. aureus 2×10³ /0.5
 ml, P. fluorescens 140 /0.5 ml
 . Crompton³² 가
 1000~3000 coagulase staphy-
 lococci (panophthalmitis)
 S. aureus, Streptococcus species, Bacillus species,
 Propionibacterium species, Moraxella species,
 Alternaria species , 가
 Staphylococcus species .
 Turker Forster³¹ , Crompton³²
 가
 (virulence) , 가
 . Olitsky¹⁹
 10⁶ 16 (15%) , 가

S. aureus
 S. epidermidis
 가 S. aureus S. epidermidis
 midis가 . coagulase, -toxin, protein
 A S. aureus가 S.
 epidermidis
 . S. epidermidis
 가 가

- 1) Sprunger DT, Klapper SR, Bonnin JM, Minturn JT. Management of experimental globe perforation during strabismus surgery. *J Pediatr Ophthalmol Strabismus* 1996;33:140-3.
- 2) Morris RJ, Rosen PH, Fells P. Incidence of inadvertent globe perforation during strabismus surgery. *Br J Ophthalmol* 1990;74:490-3.
- 3) Gottlieb F, Castro JL. Perforation of the globe during strabismus surgery. *Arch Ophthalmol* 1970;84:151-7.
- 4) Ing MR. Infection following strabismus surgery. *Ophthalmic Surg* 1991;22:41-3.
- 5) Noel LP, Bloom JN, Clarke WN, Bawazeer A. Retinal perforation in strabismus surgery. *J Pediatr Ophthalmol* 1997;34:115-7.
- 6) Simon JW, Lininger LL, Scheraga JL. Recognized scleral perforation during eye muscle surgery: Incidence and sequelae. *J Pediatr Ophthalmol Strabismus* 1992;29:273-5.
- 7) Greenberg DR, Ellenberg NL, Chapman LI, et al. Posterior chamber hemorrhage during strabismus surgery. *Am J Ophthalmol* 1988;106:634-5.
- 8) Apple DJ, Jones GR, Reidy JJ, Loftfield KL. Ocular perforation and phthisis bulbi secondary to strabismus surgery. *J Pediatr Ophthalmol Strabismus* 1985;22:184-7.
- 9) Salamon SM, Friberg TR, Luxenberg MN. Endophthalmitis after strabismus surgery. *Am J Ophthalmol* 1982;93:39-41.
- 10) Unit LM, Olk RJ, Kenneally CZ, Windsor CE. Endophthalmitis after strabismus surgery with a good visual results. *Ophthalmic surg* 1988;19:42-3.

- 11) Valenton MJ, Brubaker RF. Streptococcal epidermidis endophthalmitis. *Arch Ophthalmol* 1973;89:94-6.
- 12) Thomas, JW, Hamil MB, Lambert HM. Streptococcus pneumoniae endophthalmitis following strabismus surgery. *Arch Ophthalmol* 1993;111:1170-1.
- 13) Rosenbaum AL. Endophthalmitis after strabismus surgery. *Arch Ophthalmol* 2000;118:982-3.
- 14) , , , .
1994;35:1715-22.
- 15) , , .
1996;37:961-9.
- 16) , , .
1991;32:561-8.
- 17) Speaker MG, Milch FA, Shah MK, Eisner W, Kreiswirth BN. Role of external flora in the pathogenesis of acute postoperative endophthalmitis. *Ophthalmology* 1991;98:639-49.
- 18) Bannerman TL, Rhoden DL, McAllister SK, et al. The source of coagulase-negative staphylococci in the endophthalmitis vitrectomy study. *Arch Ophthalmol* 1997;115:357-61.
- 19) Olitsky SE, Vilardo M, Awner S, Reynolds JD. Needle sterility during strabismus surgery. *J AAPOS* 1998;2:151-2.
- 20) , , 가 . *Staphylococcus Aureus Ciprofloxacin*
2000;41:1807-14.
- 21) Lennethe EH, Balows A, Hausler WJ, Jr, Shadomy HJ. *Manual of clinical microbiology*, 4th ed. Washington DC: American society for microbiology, 1985;1093-107.
- 22) Lyons CJ, Fells P, Lee JP, McIntyre A. Chorioretinal scarring following the Faden operation. *Eye* 1989;3:401-3.
- 23) Knobloch R, Lorenz A. Ueber ernste Komplikationen nach Schieloperationen. *Klin Monatsbl Augenheilkd* 1962;141:341-8.
- 24) Weinstein GS, Mondino BJ, Weinberg RJ, Biglan AW. Endophthalmitis in a pediatric population. *Ann Ophthalmol* 1979;6:935-9.
- 25) Puliafito CA, Baker AS, Haaf J, Foster CS. Infectious endophthalmitis: review of 36 cases. *Ophthalmology* 1982;89:921-9.
- 26) Rowsey JJ, Newsom DL, Sexton DJ, Harms WK. Endophthalmitis: current approaches. *Ophthalmology* 1982;89:1055-66.
- 27) Olson JC, Flynn HW, Jr, Forster RK, Culbertson WW. Results in the treatment of postoperative endophthalmitis. *Ophthalmology* 1983;90:692-9.
- 28) Driebe WT, Jr, Mandelbaum S, Forster RK. Pseudophakic

- endophthalmitis: diagnosis and management. *Ophthalmology* 1986;93:442-8.
- 29) Dickey JR, Thompson KD, Jay WM. Anterior chamber aspirates after uncomplicated cataract surgery. *Am J Ophthalmol* 1991;112:278-82.
- 30) Parks MM. Routine antibiotic coverage in eye muscle surgery. *Binoc Vis Eye Muscle Surg Q* 1989;4:152-3.
- 31) Tucker DN, Forster RK. Experimental bacterial endophthalmitis. *Arch Ophthalmol* 1972;88:647-9.
- 32) Crompton DO, Anderson KF, Kennare MA. Experimental infection of the rabbit anterior chamber. *Trans Ophthalmol Soc Aust* 1962;22:81-97.

= ABSTRACT =

Experimental Scleral Perforation by Cultured Bacteria in the Needle Used during Strabismus Surgery

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Purpose : In order to investigate endophthalmitis and these causative organisms after accidental scleral perforation during strabismus surgery, the used needles after strabismus surgery were cultured and then the cultured bacteria were introduced into rabbit vitreous after perforating the sclera

Methods : We cultured the needles of sixty strabismus patients, and the identified bacteria were introduced into rabbit vitreous after perforation of the sclera, by dilution at different concentrations, using either sterile syringe or staining on the needles.

Results : Positive cultures were found in 10 patients. Of these 10, 7 were identified with *Staphylococcus epidermidis* and 3 with *Staphylococcus aureus*. After culturing these two strains and diluting them to different concentrations, they were injected into rabbit vitreous using sterile syringe. It was found that *S. aureus* at the concentration of 10^3 colonies/ml produced endophthalmitis while at 10^5 ~ 10^7 colonies/ml endophthalmitis was found to be present in all eyes. Although *S. epidermidis* at concentrations between 10^3 and 10^7 colonies/ml also produced endophthalmitis, the degree of inflammation was weaker than that induced by *S. aureus*, and some rabbits did not even develop endophthalmitis. After *S. aureus* was diluted to different concentrations, stained on needles and perforated into rabbits vitreous, endophthalmitis developed at the concentration of 10^7 colonies/ml.

Conclusion : The two strains isolated after strabismus surgery were the same as the normal bacterial flora found in the lid and conjunctiva. Three days after introduction of both strains, endophthalmitis developed at the relatively high concentration of colonies. In order to prevent endophthalmitis after scleral perforation, the surgeon should decrease the concentration of normal flora in the lid and conjunctiva before strabismus surgery. *J Korean Ophthalmol Soc* 42(9):1325-1330, 2001

Key Words : Endophthalmitis, Scleral perforation, *Staphylococcus aureus*, *Staphylococcus epidermidis*

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