Acta Medica et Biologica
Vol. 34, No. 1, 9-13, 1986

EXPERIMENTAL STUDIES ON THE PATHOGENESIS OF NONSPOREFORMING ANAEROBIC BACTERIA IN OCULAR INFECTIONS

MASAO OOISHI, FUJIO SAKAUE
AND
SHIGEO NAGAI

Department of Ophthalmology, Niigata University, School of Medicine, Niigata

(Received December 4, 1985)

ABSTRACT

The pathogenetic role of nonsporeforming anaerobic bacteria, Propionibacterium acnes ATCC 11828, in ocular infections was experimentally studied.

Adult guinea pigs were used for the experiment.

The results obtained were as follows:

1) It was obvious that P. acnes is capable of causing purulent endophthalmitis.

2) The effects of steroid drugs, dexamethasone sodium phosphate (Decadron) administered by subconjunctival injection and intramuscular injection for 5 days, were studied. Compared with eyes to which the steroid agent were not administered, the inflammatory reaction was shown to be suppressed in steroid treated eyes. However, the clinical course was prolonged.

In eyes administered the steroid agent, a long time seemed to be required for a decrease in the viable count of bacteria in the vitreous body.

INTRODUCTION

As anaerobic bacterial infections encountered in the field of ophthalmology, it is well known that panophthalmitis can be caused by such anaerobic sporeforming bacteria as Clostridium perfringens.

On the other hand, there have been few reports of ocular infections caused by

nonsporeforming anaerobic bacteria. There are quite a few aspects concerning the pathogenicity of those bacteria to the eye which are still unclear.

Propionibacterium acnes is often identified when a nonsporeforming anaerobic bacterium is isolated from patients with ocular infections. Moreover, this bacterium is often isolated as part of the normal flora of the normal conjunctival sac.

We carried out the present study with the objective of investigating the pathogenetic role of Propionibacterium acnes.

1. Experimental Method

1) Test animal: Adult guinea pigs (weighing 500～600 gram) were used.

2) Tested strain: Propionibacterium acnes (P. acnes) ATCC 11828 provided by Gifu University Anaerobes Experiment Laboratory was cultured with GAM bouillon at 37°C for 48 hours for inoculation.

3) Inoculation Method: 0.05ml (viable count 2.7×10^7) of P.acnes was transsclerally inoculated, using 27 gauge needle, directly into the vitreous body of the test animals anesthetized in the desicator. GAM bouillon was also inoculated as a control.

4) Clinical Observation : Clinical findings were evaluated on the basis of a score determined by conditions found at 3,6 and 12 hours on the lst, 2nd, 3rd, 5th and 7th day after the inoculation, as shown in Table 1.

5) Viable Count Measurement in Vitreous Body: The viable counts were measured by taking 0.1ml of vitreous body transsclerally with an 18 gauge needle, at 3, 6 and 12 hours on the lst, 2nd, 3rd, 5th and 7th day after the inoculation.

6) Experiments on Eyes with Previous Steroid Administration: After 5 days of

Table 1. Clinical Criteria

Clinical Picture				Score
Findings of the Slit Lamp Microscope	Exudate in the Anterior chamber & Visibility of the Iris	Exudate	Iris visibility	
		−	+	0
		+	+	1
		+	±	2
		+	−	3
	Bulbar Perforation	−		0
		+		1
Findings of the Ophthalmoscope	Red fundus reflex	+		0
		±		1
		−		2

consecutive administration of 0.2ml (0.8mg) dexamethasone sodium phosphate (Decadron) by subconjunctival injection and 1.6ml (6.4mg) of the same by IM injection, P. acnes was similarly inoculated into guinea pigs and clinical progress and viable count were measured.

RESULTS

1) Clinical progress: Fig.1 shows the clinical observation scored with the passage of time.

In the control group (eyes inoculated with GAM bouillon), the clinical score was 1 at 6 hours. Thereafter, the score did not increase, and the inflammation spontaneously disappeared by the 3rd day.

In the eyes which were inoculated with test organisms and not treated with the steroid, the score at the end of 6 hours after inoculation was also 1. However, in this group, the score increased to a peak value of 4.5 at 24 hours, Thereafter, the pathological score decreased gradually to 3.5 on the 3rd day, 1.0 on the 5th day and 0.8 on the 7th day.

In the steroid treated eyes, the pathological score was 1.1 after 6 hours, and it reached a peak of 3.8 at 24 hours. The score gradually decreased thereafter, falling to 2.6 on the 3rd days, 2.1 on the 5th day and 1.7 on the 7th day. Thus, it was clearly shown that the inoculation of P.acnes into the vitreous body caused the development of bacterial endophthalmits.

With regard to the effects of the steroid, it was found that , in comparison with the eyes which were not treated with the steroid, the steroid treated eyes showed less severe inflammatory symptoms, and the resultant infection was somewhat milder. However, the infection was also seen to last for a longer time.

2) Viable count change in vitreous body: Fig. 2 shows the plots of the viable conut of bacteria in the vitreous body with the passage of time after inoculation.

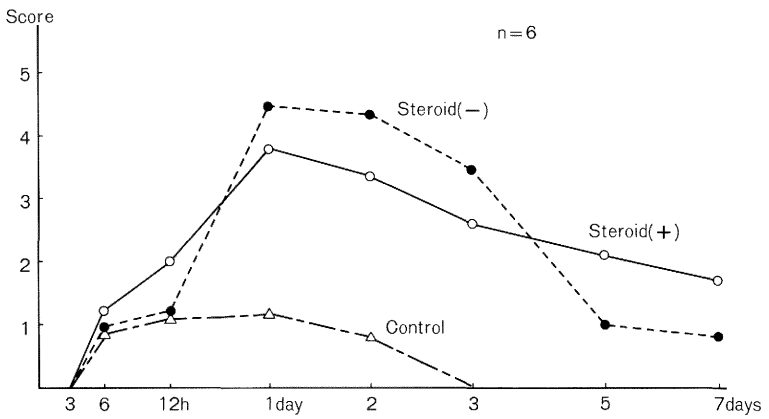

Fig. 1. Clinical Course

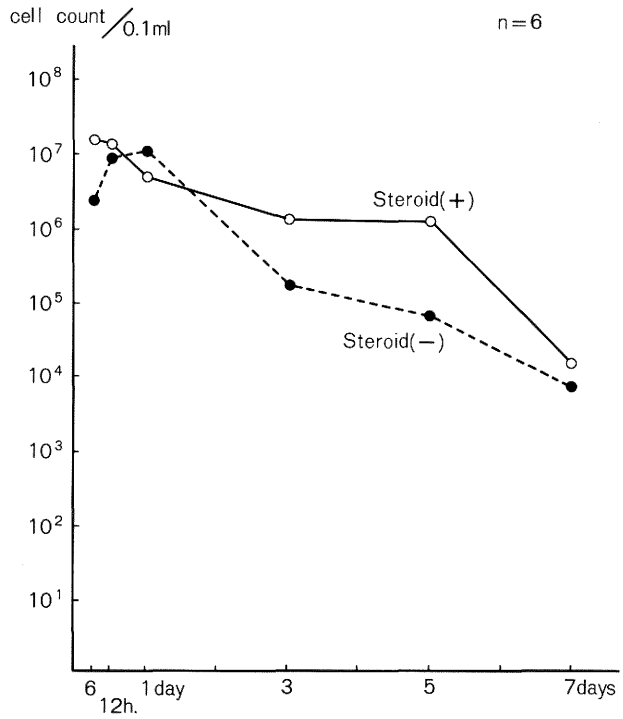

Fig. 2. Change in Viable Cell Count in the Vitreous Body

In the eyes untreated with steroid, the viable count began to increase 6 hours after the inoculation, reaching an average of 1.6×10^7/0.1ml at 12 hours. It decreased to 9.5×10^4 on the 5th day and 9.5×10^3/0.1ml on the 7th day.

In the steroid treated eyes, the viable count 6 hours after inoculation was 2.0×10^7/0.1ml. It gradually decreased to 1.4×10^6/0.1ml on the 5th day and 5.2×10^4/0.1ml on the 7th day. These score were higher than those in the untreated eyes on the 3rd, 5th and 7th day. Therefore, the decrease in the viable bacterial count was somewhat slower in the steroid treated eyes.

This finding concerning the viable bacterial count in the vitreous body supports the clinical progress above described. That is, the prolongation of the symptomes seen in the steroid treated eyes was accompanied by a slower clearing of the bacteria from the vitreous body.

Discussion

P. acnes is somewhat frequently detected is the normal conjunctival sac,[1] but many aspects of its pathogenesity are still unknown. However, endophthalmitis caused by P. acnes has been clinically reported.[2),3)] Many of these cases have developed in what is called a compromised host due to ocular injury and postoperative ocular infection.

As to whether P.acnes can be pathogenic in normal healthy eyes or not was studied by using animals. Judging from the clincal results, P.acnes obviously caused endophthalmitis, but its severity was much milder than the endophthalmitis caused by Pseudomonas aeruginosa, as we have previously reported.[4] In other words, the pathogenesis of P. acnes in normal healthy eyes was proved to be less toxic.

In order to study the development of symptoms under the presence of a compromised host, we experimented on eyes which had been previously administered steroids. The results indicated that both clinical progress and viable count change tend to be prolonged when compared with symptoms of normal healty eyes.

From the viewpoint of cellular immunity, it is supposed that these results are due to the suppression of the induction of cellular immunity in the steroid treated eyes.

From the above results, it is clear that P.acnes is pathogenic to the eyes. However, its symptoms are mild and it is presumed that the symptoms tends to be prolonged under the presence of a compromised host, and that ocular tissue damage is also aggravated.

References

1) Perkins, R. E. et al.: Bacteriology of normal and infected conjunctiva. *J. clin. Microbiol.*, 1: 147-149, 1975.
2) Jones, D. B.. et al.: Anaerobic ocular infections. *Trans. AM.Acad. Ophthalmol. Otolaryngol.*, 83:op 309-331, 1977.
3) Friedman, E., et al: Endopthalmitis caused by propionibacterium acnes. *Can. J. Ophthalmol.*, 13: 50-52, 1978.
4) Nagai, S.: Studies on the pathogenesis of nonsporeforming anaerobic bacteria in ocular infections. *Acta Soc. Ophthalmol. Jpn.* 88: 712-718, 1984.