ANTIBIOTIC PROPHYLAXIS IN CATARACT SURGERY*

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THIS REPORT IS A CONTINUATION OF STUDIES DESIGNED TO EVALUATE PREVENTION of postoperative infection and to compare efficacy and modes of delivery of various antibiotics for this purpose.

It was realized a few years ago that the bandaged postoperative cataract eye provided an excellent human incubator for bacterial growth and that quantitative measurements of the bacterial flora before and after cataract surgery provided a reproducible and reliable area of testing effectiveness of antibiotics in diminishing this growth.[1]

Our first double-blind studies demonstrated that gentamicin 0.3 per cent and neomycin 0.5 per cent ointment were significantly superior to a placebo in prevention of ocular bacterial proliferation in an eye operated upon for cataract, and that gentamicin was more effective than neomycin.

In a second paper various modes of delivery of drugs were compared, as well as different types of drugs.[2] Again gentamicin given topically either in drop or ointment form in the preoperative and postoperative period, or subconjunctivally at the time of surgery, appeared more effective than other drugs tested. These included 30 per cent sulfacetamide drops, chloramphenicol 0.5 per cent ointment, and neomycin-polymixin B-gramicidin drops. However there was some beneficial effect from all drugs used except sulfacetamide.

The current study was undertaken for two purposes: first, to repeat a larger control series of cataract patients untreated with antibiotics in order to verify the reproducibility of this technique, since it has been suggested that there was important spontaneous variation in ocular

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bacterial flora,[3] and second, to compare with a double-blind technique the effectiveness of topical chloramphenicol 0.5 per cent solution and gentamicin 0.3 per cent solution in reducing bacterial count in two different treatment schedules in cataract surgery patients. These two were chosen because of their broad spectrum, previously demonstrated effectiveness,[2] and because gentamicin is bactericidal and chloramphenicol bacteriostatic.

MATERIALS AND METHODS

Patients studied were those undergoing routine cataract surgery on one of the services of the University of Oregon Medical School Department of Ophthalmology. Most of these patients were at the Veterans Administration Hospital, Portland, Oregon. Patients were selected for surgery and operated on by the resident staff at the University of Oregon Medical School. Those with complications of cataract surgery or preexisting inflammatory processes in the eyelids, lacrimal apparatus, etc. were excluded from this study. Hence only patients having a senile cataract operation were tested.

Ocular bacterial counts were obtained by rubbing a sterile cotton swab over the lower palpebral conjunctiva, the lower lid, and inner canthus, and avoiding the operative site. The swab was then immersed for a few minutes in .01 per cent solution of non-ionic surfactant (Triton x-100) in nutrient broth, followed by standardized shaking to break up clumps of bacteria through detergent action. An aliquot of the detergent-broth mixture was diluted in tenfold steps in nutrient broth tubes. Counting was done by conventional dilution pour plate technique. Sheep blood agar plates were used in order that bacterial genus and species could be identified. Plates containing at least 30 to 300 colonies were counted. The total number of bacteria per sample was obtained by multiplying the result on the counted plate by the dilution factor. This is a reasonably reliable technique for estimating total number of bacteria.[4] Antibiotic sensitivity testing by the disk method was done on "pathogens" isolated. Coagulase testing was used to differentiate Staphylococcus aureus from micrococcus.

In the control series of 92 patients, which was obtained with some difficulty since our residents preferred to utilize prophylactic antibiotics, a preoperative culture was done on Monday, cataract surgery on Tuesday or Wednesday, and a postoperative culture on Friday. Mydriatic and cycloplegic, but no antibiotic drops, were instilled as indicated on daily dressing changes.

CHART 1

Day of week	Monday	Tuesday	Wednesday	Thursday	Friday
Group A	Pre-treatment culture Antibiotic drops 4 ×	Surgery Antibiotic drop once postoperatively	Antibiotic drop once daily	Antibiotic drop once daily	Final culture done
Group B	Pre-treatment culture Antibiotic drops 4 ×	Antibiotic drops 4 ×	Surgery Antibiotic drop once postoperatively	Antibiotic drop once daily	Final culture done

Following this a double-blind study was undertaken to compare chloramphenicol with gentamicin on two different treatment schedules in 62 patients (Chart 1). Numbered individual medication bottles were assigned to each patient enrolled in the study. Some surgery was done on Tuesday and some on Wednesday, so that all patients had a culture performed on Monday morning, and were given one drop of the unknown antibiotic 4 times daily on Monday. Some were given antibiotic 4 times daily on Tuesday, had surgery on Wednesday followed by an antibiotic drop, and were treated once daily during dressing change on Wednesday and Thursday. Others had surgery on Tuesday, and after surgery were treated daily until recultured on Friday. None of the patients were on concomitant antibiotic therapy. Bacterial counts on preoperative and postoperative eyes were listed according to patient name and unknown drug number. The patients agreed to the conditions of the study, and signed informed consent forms. The Human Experimentation Committee of the University of Oregon Medical School approved the protocol.

After completion of the study the code was broken, and the treatment drug identified and matched with each patient's bacterial counts. Data was computer-analyzed by the analysis of variance technique.

RESULTS

For the control series of 92 cataract patients untreated with antibiotics the raw data is listed in Table 1. Eighteen of 19 patients with coagulase-positive staphylococci (S. aureus) had an increase in postoperative over preoperative count. Of 89 patients who had micrococci on the pre-

TABLE 1. BACTERIAL COUNTS IN CATARACT PATIENTS NOT TREATED WITH ANTIBIOTIC

Micrococcus		S. aureus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
10600	530000					600	4000
14200	700000						
40	56000			0	22000		
1200	1620			3200	820		
70000	90000						
		500	84000	60	0		
29600	240			1400	0		
1780	62000			2860	68000	Aerobacter	
3400	650000	800	13800	25800	0	0	2000
12600	200000	1200	270000	30000	0	Aerobacter	
						2200	10000
760	41000	0	200	0	600	Alpha strep	
						40	0
1440	0	120	4800	1300	15000	Alpha strep	
						100	0
0	300			0	140		
3860	39000			360	6200		
12800	13400			2000	2800		
8800	64000	0	6000	60000	6000		
340	4000			50000	5400		
1260	200			2360	4200		
170000	80000						
800	38000			3600	44000		
48000	326000	200	650000			Alpha strep	
						0	2000
440	132000					P. morgani	
						0	6000
19200	4200			10200	1000		
4780	40000			0	62000		
0	80						
10200	4000			15200	20000		
40	17600			60	0	P. morgani	
						0	1400
13800	18200			200	3000		
940	8000			700	0	P. mirabilis	
						0	26000
2000	20			114000	0		
2140	142000			1200	0		
100	48000	100	40000	800	22000		
28400	320000					P. morgani	
						0	32000
20	0			0	12000		
2120	14200						
6000	260			35600	0		
5800	2000						
2520	48000						
4600	20000			0	2200		
20	0						
52000	1100			38000	0		
60	8800			1040	860		
1920	11400			260	1200		
6200	35000			1000	0		
10000	9200			9200	0	Alpha strep	
						0	80000
18600	550000			1800	0		
1800	112000			7600	2000		
2000	9400			9000	1800		

Table 1 (continued)

Micrococcus		S. aereus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
14000	11000			40000	0		
182000	270000			300000	156000		
22000	19400			2600	8800		
3600	6400						
34000	11800			70000	8200		
24000	88000			8000	0	Alpha strep 4000	0
6400	54000			7200	0		
3000	25400			1200	0		
600	150000	2200	110000	5400	350000		
3100	44440						
1900	38200			18000	132000		
100	40						
8400	18400			0	7200		
320	5000			620	29600		
460	1000000			1660	0	Alpha strep 380	0
3500	1720	0	180	640	0		
140000	25000			84000	11400		
0	40						
20	450000						
60	202000						
1700	284000						
440	8600			11000	0		
14000	2620			400	0		
5400	26000			2000	16000	Alpha strep 33200	360000
21200	30000	1400	160000	600	0		
180	7200			1000	100	Alpha strep 1800 Bacillus sp 2200	0 0
1460	2560			85000	0	P. morgani 200	0
40000	2000	0	4400	104000	0	Alpha strep 38000	0
8000	13200			9200	0		
12800	1200000	0	118000				
40	0						
10000	15200						
0	620	0	60				
0	1740						
50800	45000	0	12400				
0	470000	0	10000				
0	0						
12200	26000			150000	480000	Alpha strep 3200	0
180	37800						
20	460			0	1080	Gamma strep 40 Alpha strep 380	260 0
1740	196000			960	0		
640	700	340	480	180	2600		
280	90000			2700	80000	Aerobacter 0	50000
6000	8000	220	3400	1400	30000		

operative count there was an increase in bacteria in 67 and a decrease in 22. Of the patients carrying gram-negative species (Proteus, Aerobacter) there was an increased count in 7 and a decrease in 1. Other bactera did not seem to be useful indicators.

In the patients who were treated prophylactically with chloramphenicol for one day and then had surgery on Tuesday the mean preoperative count of micrococci was 4670 and the mean postoperative count was 9511 (Table 2). In those who were treated with chloramphenicol for two days and then had surgery on Wednesday the mean preoperative count was 31221 and the mean postoperative count was 36242 (Table 3).

The vagaries of random selection led to a smaller number of patients being treated with gentamicin. Those treated with gentamicin for one day and having surgery on Tuesday had a mean preoperative micrococcus count of 22599 and a mean postoperative count of 93 (Table 4). Those treated with gentamicin for two days and having surgery on Wednesday had a mean preoperative count of 29667 and a mean postoperative count of 365 (Table 5). As noted previously,[2] a striking number of gentamicin-treated eyes were completely sterile on the postoperative culture.

In this group of 62 patients there were too few with coagulase-positive S. aureus to provide a useful comparison. No unusual differences were found in antibiotic sensitivity if the counts before and after surgery were compared. As with the untreated group the Cornyebacteria and miscellaneous bacteria were not helpful indicators.

Analysis of variance of these data was done by computer. Micrococcus counts were used to compare the four groups because there was an insufficient number of S. aureus positive cultures for statistical analysis. Approximately 1 per cent of the variation in the postoperative count could be accounted for by the fact that a preoperative count showed that bacteria were present. The effect of the day of operation added another 1 per cent variation. However 28.89 per cent of the postoperative count variability was due to the use of the drug. This would indicate quite significantly ($P < 0.05$) that the variation from preoperative to postoperative count was due to the use of the drug, but not to (a) use of the drug for either 1 or 2 days before the operation, or (b) the presence of bacteria in the eye preoperatively; nor was there any indication that (c) the differences between the drugs was influenced by the day they were given.

Comparing the bacterial counts in the gentamicin-treated group with the counts in the chloramphenicol-treated group shows that there is a

TABLE 2. PATIENTS TREATED WITH CHLORAMPHENICOL DROPS AND OPERATED ON TUESDAY

Micrococcus		S. aureus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
11200	600	5200	4200	52000	0		
2020	76000			1100	0	Aerobacter	
						20	240
60	140			340	0		
4200	160	200	0	11800	780	Flavobacter	
						0	20
1540	0			3200	0		
1660	13800			420	0	Alpha strep	
						40	0
13400	7000			0	42400	E. coli	
						1600	2000
7200	120	1200	220	3800	0		
4000	1280	50000	0				
4200	12600			18200	0	Aerobacter	
						0	140
800	16600			19800	7200		
800	100			23800			
11800	160	400	0	8000	0		
14200	1660			16000	0		
1660	31000			3920	2200		
340	160			840	0		
320	320			1220	0		

TABLE 3. PATIENTS TREATED WITH CHLORAMPHENICOL DROPS AND OPERATED ON WEDNESDAY

Micrococcus		S. aureus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
4000	8000			8000	2000		
31000	20	10400	1600	13000	0		
100000	180						
4800	380			1400	0		
190000	820			180000	560	P. vulgaris	
						200	0
52000	280			244000	0		
13200	4000	0	62000	30000	0		
4000	1920			4400	0		
18600	1400			4400	3400		
52000	5000			44000	0		
2000	10000			1800	240000		
620	540000			11400	0		
9000	7600						
120	100			320	0		
3200	0	0	360000	3400	0	Serratia	
						4000	76000
16000	180			18000	2260		

TABLE 4. PATIENTS TREATED WITH GENTAMICIN DROPS AND OPERATED ON TUESDAY

Micrococcus		S. aureus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
232000	0						
58000	120			1600	0		
8800	0			600	0		
200	0			9200	0	Alpha strep	
						200	0
100	0	40	0	100000	0		
4560	20						
1960	0			100000	0		
1200	120			7000	180		
1100	20						
20	420			4620	0		
2600	800	11400	40000			Alpha strep	
						7200	0
40	0						
7800	0			14800	0		
2000	0			17200	0		
72000	20			20000	0		
5200	140						
6000	0			12600	0		
3200	20						

TABLE 5. PATIENTS TREATED WITH GENTAMICIN DROPS AND OPERATED ON WEDNESDAY

Micrococcus		S. aureus		Diphtheroids		Other species	
Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
112000	20						
5000	0						
60	140						
1080	0			1140	0		
9200	660						
9000	0	0	1200	6000	0		
8000	20	92000	320				
140000	0			8000	0		
26000	2740			2000	0		
16000	40			144000	0	Alpha strep	
						24000	0
0	400						

statistically significant ($P < 0.01$) advantage to using gentamicin over chloramphenicol. This confirms a preliminary evaluation of these data, done by another statistician, using Fisher's Exact Test, after the first 38 patients were counted.[5]

In neither the control, untreated group nor either of the antibiotic-treated groups were there any postoperative infections. This is not unusual, since incidence of postoperative infection is approximately 1 in 1000 cataract operations.[6] Since beginning our study of antibiotic prophylaxis in cataract patients in 1967, we have not had any intraocular infections following cataract surgery.

An interesting comment was made by the resident staff members who followed the patients. They much preferred the use of prophylactic antimicrobials because they felt that their patients' eyes were cleaner, whiter, had less muco-purulent discharge and eyelid crusting, and that hence the postoperative care was easier in the antibiotic-treated group. The residents could not identify any clinical difference between the two drugs tested in this study.

DISCUSSION

The value of a carefully planned double-blind study to analyze multiple variables is emphasized. We were able to compare widely varying bacterial counts, both before and after surgery, with an evaluation of the effect of one or two days of preoperative treatment and a comparison of a bacteriocidal and bacteriostatic drug. Such prospective studies with computer analysis of data are highly effective and economic.

It can still be claimed that micrococci are not important bacterial pathogens. Nevertheless clinical infections are seen in which this is the only organism found. A study comparing S. aureus counts would require a much larger group of patients in order to find a significant number of patients who were carrying S. aureus preoperatively. It appears interesting that a patient who has S. aureus in his ocular culture on Monday and then has cataract surgery will have more S. aureus when recultured on Friday (Table 1), unless treated by antibiotics.[3]

SUMMARY

Gentamicin is significantly more effective than a comparable commercially available aqueous solution of chloramphenicol in reducing the bacterial count in the postoperative cataract eye. Since the time when the eye is open at surgery is when the patient's own bacteria are most likely to contaminate the inside of the globe to cause postoperative infection, it is felt that the use of gentamicin drops several times for one day before surgery, and once a day during dressing change after surgery for at least two days is a highly effective technique of preventing infection from this source.

ACKNOWLEDGMENTS

We are greatly indebted to the resident staff of the Ophthalmology Department of the University of Oregon Medical School, who permitted us to use their patients for this study, obtained the signed forms, and directed use of the eyedrops. Quentin D. Clarkson, PH D, performed the statistical analyses.

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DISCUSSION

DR IRVING H. LEOPOLD. Every ophthalmologist is anxious to avoid infection after intraocular surgery. The range of sepsis from one institution to another can be influenced by many factors: a loophole in technique, the presence of an opportunistic organism capable of penetrating the loophole, and a patient with reduced local and systemic resistance.

Even in pre-antiseptic days postoperative infection in the eye was relatively infrequent. It occurred in decidedly less than 3 per cent of cases in most series, compared to a much higher rate for general surgery during the same time period. This definite difference between general and ocular surgery in incidence of infection is just as apparent today when postoperative ocular infection may be expected to occur in less than 0.3 per cent of cases, as against 1.3 per cent to 10 per cent in various fields of general surgery.

A survey of reported intraocular infection following intraocular surgery over the past seven decades reveals some interesting phenomena presented in the following graph [not included]. These data, unfortunately, cannot be considered accurate, for it is not always possible to be certain of a diagnosis of endophthalmitis, particularly in those eyes that recover and in which the microbiologic studies have been negative.

A significant drop in incidence of infection, as seen on the graph, probably represents the beginning of the time when the members of the surgical team cleansed their hands and forearms with prolonged scrubs and wore caps and masks, sterile gowns, and gloves. The instruments and solutions were sterilized by heat and other methods. In some operating rooms attempts were made to reduce the bacterial contamination of the air by the use of ultraviolet radiation or chemical sprays. The skin of the patient in the operative field was cleansed with fat solvents and various antiseptic solutions, and the prepared area was isolated with sterile drapes, but cleansing the patient is probably the weakest step in the aseptic technique. It is evident that, while it is possible to remove surface organisms, it is impossible to destroy bacteria in the glands and crevices of the skin. Culture studies done before and at the close of surgery reveal the marked difficulty in sterilizing the area of ocular surgery.

There have been many demonstrations of the unclean nature of the ophthalmic operating field in spite of what are considered to be excellent aseptic techniques for preparation of the areas to be operated upon. Recently a study was undertaken at our institution to determine the microbial flora of the postoperative eye of 225 consecutive cataract procedures immediately before the eye patch was applied and the patient wheeled from the operating room. Organisms were found in 174 eyes or 78 per cent, and no growth could be cultured from 51 eyes or 22 per cent. None of these eyes developed ocular infection although many of them harbored pathogenic bacteria.

Other investigators have shown evidence of microbial contamination of the eyes associated with intraocular surgery, such as noted in the report by Crompton in 1958. About 50 years ago Ramsay reported that in many instances cultures taken in the cul-de-sac before operation were found to be sterile, whereas cultures taken at the time of the first dressing after the operation contained various pyogenic organisms. Various investigators since then have reported on the wisdom of obtaining pre- and postoperative bacterial cultures in ophthalmic surgery. These include Dunnington, Locatcher-Khorazo, Callahan, and Burns.

The role of the preoperative eye culture relative to postoperative infection is a subject of dispute. It is evident from personal experience and from data in the literature that the preoperative eye culture does not provide adequate indication of whether or not postoperative infection will occur. The operative cultures do provide the surgeon with the opportunity to attempt preoperative sterilization in the cul-de-sac. However it may require several days of specific topical therapy to obtain negative cultures. It has been suggested that the time period required will vary with the organism. Staphylococcus aureus may require from 1 to 5 days of such therapy, while Escherichia coli and proteus may take from 3 to 7 days. Unfortunately the organisms may reappear within 24 hours after cessation of therapy (Locatcher-Khorazo and Gutierriez, 1957). The organisms may wax and wane even without therapy, as borne out by Allansmith et al. in 1969.

Infections are observed after sterile preoperative cultures and have been absent when highly pathogenic species have appeared in the postoperative culture (Dunnington, Locatcher-Khorazo, 1956; Burns, 1959; Callahan, 1953; Leopold, 1960). However, there have been direct correlations of postoperative infections with preoperative cultures, as reviewed by Allen in 1969.

Dr Burns and his associates have done considerable work designed to evaluate prevention of postoperative infection and to compare efficacy in modes of delivery of various antibiotics for this purpose. They have demonstrated that gentamicin is significantly more effective than a comparable commercially available aqueous solution of chloramphenicol in reducing the bacterial count in the postoperative cataract eye. They have suggested that the use of gentamicin drops several times for one day before surgery and once a day during dressing change after surgery for at least two days may be a highly effective technique for reducing bacterial flora. Whether or not this will reduce the incidence of infection has to be determined; it has not been evaluated in these studies. The fact that Dr Burns and his coworkers have not had any ocular infection in their intraocular surgery since 1967 following the use of prophylactic topical antibiotic is very suggestive of a favorable course, but the final data are not in.

There are a few factors that are somewhat bothersome in the study. Their major procedure of rubbing a swab over an area is a somewhat unreliable method and subject to considerable variation. Furthermore the swab is rubbed over the conjunctiva and inner canthus, and the lysosome antibacterial effect of tears, especially postoperatively, must be considered in the counts.

The micrococci and diphtheroids are most likely to be derived from the skin and its pores and are subject to considerable variation as is true of skin counts obtained in the same way.

The numerical increases in counts sometimes observed between pre- and postoperative cultures cannot be attributed readily to bacterial proliferation in 24 to 48 hours. If this were the case, should not the increase be geometrical at a 20-to-30-minute interval, and would the counts not be considerably higher, in the order of millions or billions? It is especially interesting that there were some actual drops in counts in some of the eyes.

It must be noted that, particularly without any prophylaxis, a good number of cases demonstrated lower postoperative counts of the micrococci and the diphtheroids, and in 26 of the 92 cases the counts dropped to zero. This is very difficult to explain.

On the other hand, in those eyes harboring the Staphylococcus aureus, a most likely pathogen, the vast majority of the postoperative analyses did show an increase in the untreated eyes. Again this is not striking as bacterial counts go and can hardly be attributed to untrammeled proliferation in the absence of antibiotic treatment. For this reason it is very difficult to evaluate the effect of the medication.

Although with the diphtheroid both chloramphenicol and gentamicin produced postoperative counts which dropped to zero, 26 out of 92 cases without any treatment performed in the same way. In the first place it is difficult to explain why so many of the eyes had zero counts postoperatively and not preoperatively. It is difficult to evaluate the effect of a drug in producing a specified effect if the same thing happens to one-third of the patients spontaneously.

The obvious way to evaluate the role of topical antibiotics is to observe the incidence of actual infection and the isolation of the causative organism. Fortunately, or unfortunately for the study purpose, the actual incidence of postoperative infection is so relatively rare that actual "proof of the pudding" may not be obtainable. Nevertheless Dr Burns and his associates have added another approach to antibiotic prophylaxis in intraocular surgery to the many which have already been suggested. These excellent studies have provided information which helps us answer the question concerning the extent to which antibiotics can be used justifiably to prevent possible infection in intraocular surgery.

DR SAMUEL D. MCPHERSON, JR. At the risk of being repetitive I would like to emphasize the value of preoperative subconjunctival antibiotics.

[Slide] We use these at the operating table before conjunctival flaps.

[Slide] With Ampicillin you see the very high concentration in aqueous humor obtained at one minute.

[Slide] In patients with a history of penicillin sensitivity we use Oiridine. You see the concentrations obtained.

[Slide] In animals comparable concentrations are found not only in aqueous humor but also in cornea, vitreous, and optic nerve.

[Slide] Again with Cephaloridine in animals a similar thing is shown. Corresponding results in a very small series of humans have been obtained.

Dr Thomas Moll in our hospital has recently reviewed our statistics; and, to update them, we now have 3,124 consecutive patients with intraocular surgery with no intraocular infection and no incidence of adverse postoperative reaction. We continue to recommend that, to avoid the pitfalls of postoperative infection, one consider the use of either subconjunctival Ampicillin or Cephaloridine given immediately prior to cataract extraction.

DR HENRY F. ALLEN. At the Massachusetts Eye and Ear Infirmary we have been interested in this subject for many years.

[Slide] In 1950 we undertook a prospective study which has now been expanded to 36,000 consecutive cataracts. This compares with a study at the Columbia Presbyterian Eye Institute in which Dr Khorazo, Dr Dunnington, and Dr Gutierriez have, I believe, 14,090 cases, and there is an additional series of 7,000 cases in which preoperative cultures were taken and the prophylaxis was tailored to the organisms recovered. In that series of 7,000 there were no infections. All of these statistics constitute a use test.

The series we reported in 1954 had a rate of slightly over 1 infection per 1,000 cataract operations. Since then we have a new series, B, with 9 infections in 16,000 operations. That series was closed on May 1, 1972. In the last

15,000 cases there were 3 infections, or 1 in 5,000. I think we all agree – Dr Burns, Dr Leopold, Dr Khorazo, Dr McPherson, and ourselves – that the patient's own flora is the principal remaining hazard in intraocular and retinal surgery; probably most of these infections are contracted through the open wound.

[Slide] We therefore all agree on the necessity for eliminating, reducing, or suppressing the indigenous ocular flora. In our second series there is a definite shift away from Staphylococcus aureus, which was so clearly incriminated by Dr Khorazo, toward the gram-negative rods and particularly Proteus. I noticed that in Dr Leopold's slide he showed that Proteus was in fact the last organism to be eliminated.

[Slide] We have used a number of regimens, all in combination. We do not rely on any one antibiotic to reduce the flora, but we have been able to isolate chloramphenicol as a variable from other antibiotics. This is the preoperative regimen of the last 15,000 cases with that low rate I mentioned, up to 1 May 1972.

[Slide] This shows the isolated effect of chloramphenicol as compared with one other antibiotic, and I might say parenthetically that we would be extremely leery or reluctant to use no preoperative antibiotic on the basis of our statistics. If I were to have a cataract operation I would most certainly elect to have preoperative antibiotics in my own eye.

In any event in the first series of 20,000 cases chloramphenicol in combination with other antibiotics showed a distinct advantage over no antibiotics and over combinations not containing chloramphenicol drops. In the second series the advantage was infinitely greater when chloramphenicol was substituted for neomycin, 0.1 per cent. Finally in the combined series there was a preponderant advantage of chloramphenicol.

We have not used gentamicin in any of these series. If we do we probably will use it in combination, and we are encouraged by Dr Burns's results that this may in fact have a very salutary effect.

Dr Philip M. Lewis. I would like to ask Dr Burns if he has had any experience at all with disagreeable allergic reactions from the use of gentamicin.

Dr Burns. I would like to thank the discussants for their kind remarks. Dr Leopold took us back into history. [Slide] I would like to take you back a little farther, to the introduction of asepsis by Lister. Lister originated the carbolic acid spray for prevention of infection in surgery. Sir Alexander Ogston followed Lister, and was able to take down this sign over the entrance to surgery, which the patient read while being wheeled into surgery: "Prepare to Meet Thy God." Surgery was such a hazard then, but has gotten safer since.

From a historical point of view I think a certain amount of comment should be made about the value of antibiotics. I was fortunate enough to be a student of Dr Khorazo, and I can well remember trying to get rid of some of the bacteria from the eye in the days when we were using only terramycin to sterilize the eye. We now have much more effective antibiotics. Data showing the time bacteria persist in the eye are not valid any more in considering use of modern antibiotics.

I have found gentamicin to be a highly effective antibiotic agent, and we have not recognized any disagreeable reactions in the postoperative cataract eye. I have seen such reactions when the drug is used in simple conjunctivitis. People can have a toxic reaction to gentamicin. This, after all, is an amino glycoside antibiotic, closely related to streptomycin and neomycin, and there is reason to suspect some patients also might have an allergic reaction. Of course, drug allergy is one of the hazards if one delivers a whole "bolus" of drugs in subconjunctival fashion, and you cannot get away from what you have done.

As far as the antibacterial effect of gentamicin is concerned, my laboratory technician gets very upset if in the control patient the resident puts in one drop, because she says the culture will be sterile thereafter; and indeed we have found a great number of eyes to be totally sterile after the use of this drug. So I believe it is the agent of choice for prophylaxis of infection. In this area of surgery, as in cardiac surgery and a few other areas, I believe antibiotic prophylaxis is indicated.