

# Influence of age on conjunctival bacteria of patients undergoing cataract surgery

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## Abstract

**Aim** To ascertain the effect of elderly in the conjunctival bacteria frequency of patients undergoing cataract extraction.

**Methods** A retrospective case series study of 4432 consecutive patients who underwent cataract surgery, without excluding any of them for having pre-existing diseases. Their preoperative conjunctival culture were performed over a 3-year period (1994–1996). Bacteria were grouped in nine categories and patients were divided into seven groups, according to age; comparisons between groups were made by means of the  $\chi^2$  test, and the Mantel-Haenszel test to analyse age as a confounder, using SPSS program, version 12.

**Results** Patients aged over 74 years accounted for 41.4%; women predominated among this group (61.4%), but not in the patients younger than 75 (47.7%); In the whole sample women accounted for 53.4%. Patients aged 75–96 years had a greater frequency of: *Corynebacteria*, *Staphylococcus aureus*, *Streptococcus* sp. (except *Streptococcus pneumoniae*), Gram-negative cocci and Gram-negative rods (except *Haemophilus* sp.) and 'other bacteria' categories than those aged 3–74 years. Different bacteria frequency in both sexes produced a confounding effect in the comparison between age-groups. Men had more *Staphylococci* coagulase (–), *S. pneumoniae* and Gram-negative rods than women.

**Conclusions** Elderly patients awaiting cataract surgery had more conjunctival bacteria than those younger than 75 years, except *Staphylococcus* coagulase negative, *S. pneumoniae* and *Haemophilus* sp. At any age, men had more bacteria than women. These increments of frequencies could increase the risk of intraocular surgery contamination.

Eye (2006) 20, 447–454. doi:10.1038/sj.eye.6701899; published online 29 April 2005

**Keywords:** advanced age; cataract surgery; conjunctival bacteria; nonsurgical risk factors

## Introduction

Age was the strongest risk factor for having a poor visual outcome after cataract surgery, in a wide prospective National study.<sup>1</sup> Other risk factors studied were: sex, ocular comorbidity (age-related macular disease, glaucoma, diabetic retinopathy, amblyopia, and others), diabetes mellitus, history of stroke, kind of surgical procedure, grade of the surgeon, and capsule rupture/vitreous loss during the operation. The oldest age itself was associated with poor visual outcome after adjusting for presence of age related coexisting eye disorders.

Considering that in the year 2020 the number of patients blind from cataracts is expected to be 50 million worldwide (which is double that of the year 2000), mainly because of increasing life expectancy,<sup>2</sup> it is worth looking for conditions associated with age in order to improve the visual outcome after cataract surgery.

In our area we found that patients older than 64 years had more conjunctival flora and more bacteria density than those younger than 65 years, in a sample of 794 patients awaiting cataract extraction (panel communication to the National Congress of the Ophthalmology Spanish Society, Sevilla, 1992); this result disagrees with those found before 1975,<sup>3,4</sup> but agrees with two others obtained a few years later,<sup>5,6</sup> although patients in these studies did not undergo cataract surgery.

Also, the number of elderly patients undergoing cataract surgery began to increase

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Received: 15 October 2004  
Accepted: 28 February 2005  
Published online: 29 April 2005

after 1975; for instance, a significant increase in those patients older than 75 years was described from 1980 to 1987;<sup>7</sup> some years after this tendency still persists.<sup>8–15</sup>

For these reasons we study the preoperative conjunctival bacteria of patients undergoing cataract surgery at different stages of age. These bacteria are the main source of contamination of intraocular surgery,<sup>16,17</sup> and it is possible that sometimes bacteria produce inflammation that could be treated without developing infectious postsurgical endophthalmitis; but it could damage ocular tissues as well.

We analyse the preoperative conjunctival bacteria of a big sample of patients who underwent cataract extraction in our hospital,<sup>18</sup> stratifying the data from this study<sup>18</sup> according to the age we describe the frequency of these bacteria in age-groups, similar to the age-groups in the Desai *et al* study,<sup>1,12</sup> in order to ascertain the effect of age in the preoperative conjunctival flora.

## Materials and methods

### Study design

The preoperative conjunctival cultures of 4432 consecutive patients who underwent cataract surgery were analysed from January 1994 to December 1996, in the Ophthalmic Institute Laboratory of the Gregorio Marañón University General Hospital. None of the patients were excluded from the study for having pre-existing diseases. The age, sex, and the identified bacteria are recorded in the Laboratory database (one record per patient) using dBASE-III-PLUS program. Retrospectively, it has been confirmed by means of our hospital-computerised codes for diagnoses and surgical procedures,<sup>19</sup> that every patient from our laboratory database had been operated on for cataract.

The microbiological method used is described in the previous articles.<sup>18,20</sup> In order to allow statistical comparisons of the scarce species, the isolated bacteria are grouped in nine categories: two of nonpathogen flora (*Staphylococci* coagulase negative and *Corynebacterium* sp)

and seven of pathogen flora (*Staphylococcus aureus*, *Streptococcus pneumoniae*, other *Streptococcus* sp, *Haemophilus* sp, other Gram-negative rods, Gram-negative cocci, and other Gram-positive bacteria).

The patients age-groups are retrospectively selected by means of the dBASE-III-PLUS utilities, making a group for every five years except the first group who join the patients younger than 50 years, the second group aged 50–59 years (because there were not many people) and the last group who join patients older than 80 years (Table 1).

A literature review was carried out in order to investigate if age was a risk factor for postsurgical endophthalmitis (PE) in series of patients operated on for cataracts in the last 30 years.

### Statistical analysis

As the number of people who undergo cataract surgery after 75 years has increased in the last 20 years,<sup>7–15</sup> we compared the conjunctival bacteria of our patients aged 3–74 years with those aged 75–96 years, which is the main purpose of this study. A  $\chi^2$  test was calculated for each conjunctival bacteria category in both age-groups.

The differences in the preoperative conjunctival bacteria between men and women has been studied because it was found<sup>4</sup> that men had more Gram-negative rods and *Corynebacteria* than women, and, among our patients older than 75, there are more women than men, as happens in most series of patients awaiting cataract extraction nowadays.<sup>10–12,15</sup> Comparisons are made by means of the  $\chi^2$  test.

To find out if sex could introduce a confounding factor in the effect of age on the frequency of the preoperative conjunctival bacteria of patients undergoing cataract surgery, we compared these bacteria in the same age-groups 3–74 and 75–96 years, but for men and women separately. The comparisons were made by means of the  $\chi^2$  tests, and, the Mantel–Haenszel test was used to analyse age as a confounder, using SPSS program, version 12.

**Table 1** Age and sex distribution of 4432 patients undergoing cataract extraction in a 3-year period

Age groups	Men	(%) <sup>a</sup>	Women	(%) <sup>a</sup>	Total	(%) <sup>a</sup>
3–49	109	<b>2.46</b>	60	1.35	169	3.81
50–59	215	<b>4.85</b>	135	3.05	350	7.90
60–64	250	<b>5.64</b>	212	4.78	462	10.42
65–69	376	<b>8.48</b>	337	7.60	713	16.09
70–74	408	9.21	495	<b>11.17</b>	903	20.37
75–79	359	8.10	524	<b>11.82</b>	883	19.92
80–96	350	7.90	602	<b>13.58</b>	952	21.48

<sup>a</sup>Percentages of the total sample of patients (4432).

## Results

In Table 1 the age and sex distribution of the studied patients are summarised. The mean age of our sample was 71.2 years (SD = 11). Women accounted for 53.4% of the total sample. In all, 41.4 % of our patients were aged 75 years and over, and among this group women were predominant (61.4%); however, men predominated in patients younger than 75 years (52.3%). See bold-type numbers in Table 1.

In Table 2, the conjunctival bacteria frequency of each of the seven age-groups is described. The frequency of sterile cultures decreases as age increases (see bold-type row). The relative frequencies of the nonpathogen bacteria and the total pathogen bacteria are shown in Figure 1; in Figure 2 the relative frequencies of most pathogen bacteria groups are presented separately.

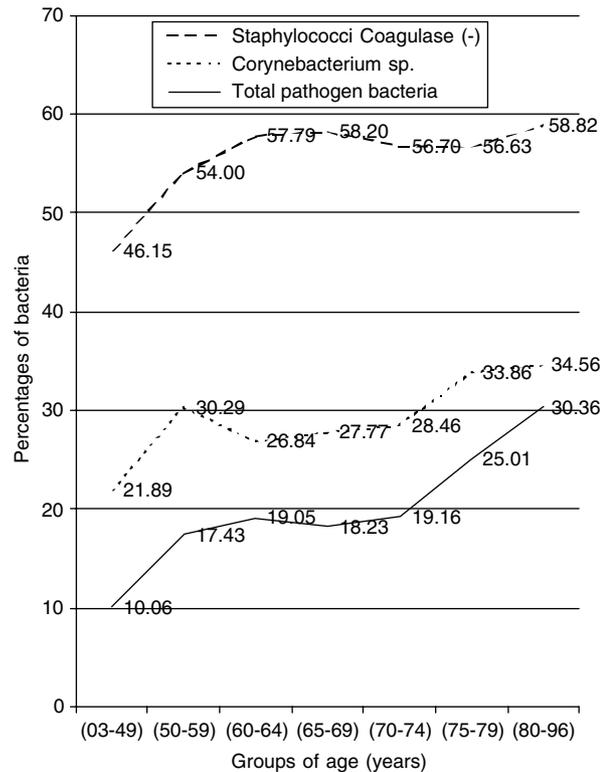
In Table 3, the preoperative conjunctival bacteria frequency of patients aged 75–96 years is compared with that of the patients aged 3–74 years. The differences were significantly higher in most of the nine categories of bacteria in the older group.

Table 4 describes the statistical significance of the conjunctival bacteria differences between men and women. Women turn out to have more *Streptococcus* sp (except *S. pneumoniae*) than men. Men have more *Staphylococcus* coagulase negative, *S. pneumoniae* and Gram-negative rods (except *Haemophilus* sp) than women.

In Table 5, there is a double comparison: the conjunctival bacteria frequencies of patients aged 3–74 and 75–96 years are compared in men and women. The preoperative conjunctival bacteria of our women increase significantly with age, especially towards the end of their lives, but most of these bacteria in our men increase many years earlier, as can be seen in Figure 3.

## Discussion

According to our results the frequency of conjunctival bacteria in patients awaiting cataract operation increases progressively with age (Figures 1 and 2). All bacteria groups, except *Staphylococci* coagulase (–), *S. pneumoniae*

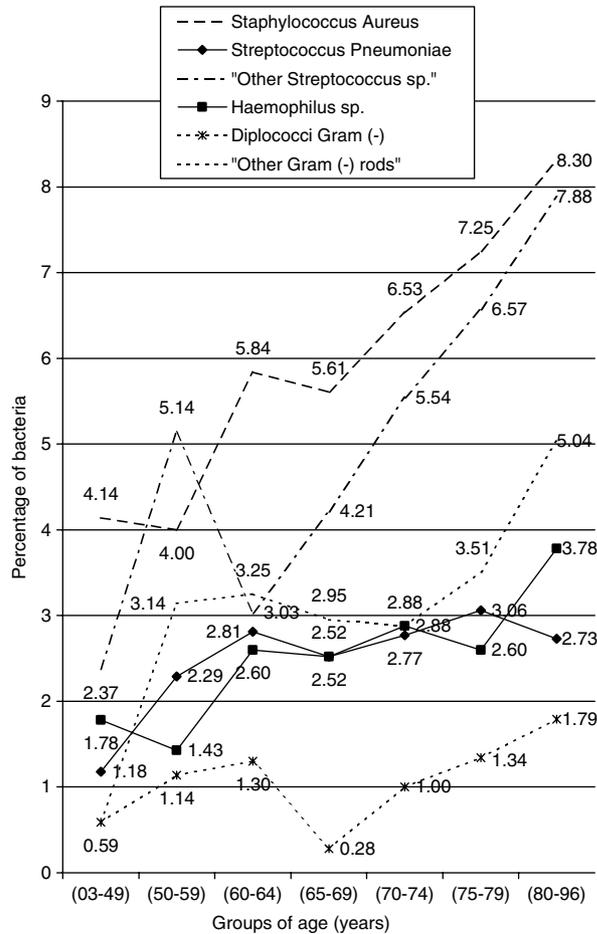


**Figure 1** Changes by age of the pathogen and nonpathogen conjunctival bacteria frequency of 4432 consecutive patients undergoing cataract surgery.

**Table 2** Preoperative conjunctival bacteria frequency of 4432 consecutive patients undergoing cataract surgery, in a 3-year period, by age

Age-groups (years)	3–49	50–59	60–64	65–69	70–74	75–79	80–96
Number of patients	169	350	462	713	903	883	952
<i>Staphylococcus</i> coagulase (–)	78	189	267	415	512	500	560
<i>Corynebacterium</i> sp	37	106	124	198	257	299	329
<i>S. aureus</i>	7	14	27	40	59	64	79
<i>S. pneumoniae</i>	2	8	13	18	25	27	26
Other <i>Streptococcus</i> sp	4	18	14	30	50	58	75
<i>Haemophilus</i> sp	3	5	12	18	26	23	36
Gram (–) diplococci	1	4	6	2	9	12	17
Other Gram (–) rods	1	11	15	21	26	31	48
Other Gram (+) bacteria	1	1	1	1	4	6	8
Total of isolated bacteria	134	356	479	743	968	1020	1178
Sterile cultures	65	89	109	168	194	172	146
<b>% of sterile culture</b>	<b>38.5</b>	<b>25.4</b>	<b>23.6</b>	<b>23.6</b>	<b>21.5</b>	<b>19.5</b>	<b>15.3</b>

and *Haemophilus* sp, increase significantly in patients older than 74 years (Table 3). Nevertheless, these results are quite different in men and women (Table 5); in



**Figure 2** Changes by age of the pathogen conjunctival bacteria frequency of 4432 consecutive patients undergoing cataract surgery.

women older than 74 years all bacteria groups increase significantly, except *Staphylococci* coagulase (-) and *S. pneumoniae*, whereas in men older than 74 years, only, the bacteria group 'other *Streptococcus* sp' increases.

In patients undergoing cataract surgery age was never found to change their conjunctival bacteria frequency. The influence of age on the conjunctival bacteria in our sample is difficult to compare with that in other authors' studies for the following reasons:

Firstly, the frequency of elderly patients in our sample and in most samples of patients operated on for cataracts nowadays<sup>7-15</sup> is higher than that of big samples studied before 1980. For instance, in the Khorazo and Thompson's sample<sup>3</sup> only 12.8% of the patients were older than 70 years, whereas in our sample there were 61.8%; in this study<sup>3</sup> age and sex do not modify the conjunctival bacteria significantly, however, the frequency of Difteroids increases with age and the sterile culture frequency decreases. These authors' studies<sup>3</sup> have been the most popular references, in Ophthalmology books<sup>3,21</sup> and articles for decades. Nowadays, the demographic change in the age of the patients awaiting cataract surgery needs to be taken into account, because the elderly people having coexisting diseases have increased,<sup>12</sup> which means that we are not isolating conjunctival bacteria from healthy people only. For instance, among our patients awaiting cataract surgery, we found that 4% of them had been carrying a pathogen conjunctival bacteria for a long period, and this condition was more frequent among elderly people.<sup>22</sup>

Secondly, in samples of patients<sup>3,23,24</sup> as big as ours, there are significant differences between their conjunctival bacteria frequencies;<sup>18</sup> most of these big samples were studied many years ago using poor isolating culture media (for instance, *Haemophilus* sp could not grow on it). In fact, the current culture media for isolating conjunctival bacteria described in Chapter 1

**Table 3** Statistical significance of the difference between conjunctival bacteria frequencies of the patients undergoing cataract surgery aged (3-74 years) and those aged (75-96 years)

	Aged (3-74 years)		Aged (75-96 years)		$\chi^2$ test P-value
	2597	patients (%)	1835	patients (%)	
<i>Staphylococcus</i> coagulase (-)	1461	56.3	1060	57.8	0.318
<i>Corynebacterium</i> sp	722	27.8	628*	34.2	<0.001
<i>S. aureus</i>	147	5.7	143**	7.8	0.005
<i>S. pneumoniae</i>	66	2.5	53	2.9	0.482
Other <i>Streptococcus</i> sp	116	4.5	133*	7.3	<0.001
<i>Haemophilus</i> sp	64	2.5	59	3.2	0.134
Gram (-) diplococci	22	0.9	29***	1.6	0.024
Other Gram (-) rods	74	2.9	79**	4.3	0.009
Other Gram (+) bacteria	8	0.3	14***	0.8	0.034
Patients with sterile culture	625*	24.1	318	17.3	<0.001

Groups having significant higher frequencies: \*P < 0.001; \*\*P < 0.01; \*\*\*P < 0.05.

**Table 4** Statistical significance of the difference between conjunctival bacteria frequencies of women and men undergoing cataract surgery

	Women		Men		$\chi^2$ test
	2365	(%)	2067	(%)	P-value
<i>Staphylococci</i> coagulase (-)	1284	54.3	1237*	59.9	<0.001
<i>Corynebacterium</i> sp	694	29.3	656	31.7	0.084
<i>S. aureus</i>	160	6.8	130	6.3	0.523
<i>S. pneumoniae</i>	43	1.8	76*	3.7	<0.001
Other <i>Streptococcus</i> sp	152**	6.4	97	4.7	0.012
<i>Haemophilus</i> sp	55	2.3	68	3.3	0.051
Gram (-) diplococci	29	1.2	22	1.1	0.614
Other Gram (-) rods	67	2.8	86**	4.2	0.016
Patients with sterile culture	561*	23.7	382	18.5	<0.001

Groups having significant higher frequencies: \* $P < 0.001$ ; \*\* $P < 0.05$ .

**Table 5** Statistical significance of the difference between conjunctival bacteria frequencies of patients undergoing cataract surgery aged 3–74 and 75–96 years, divided in women and men

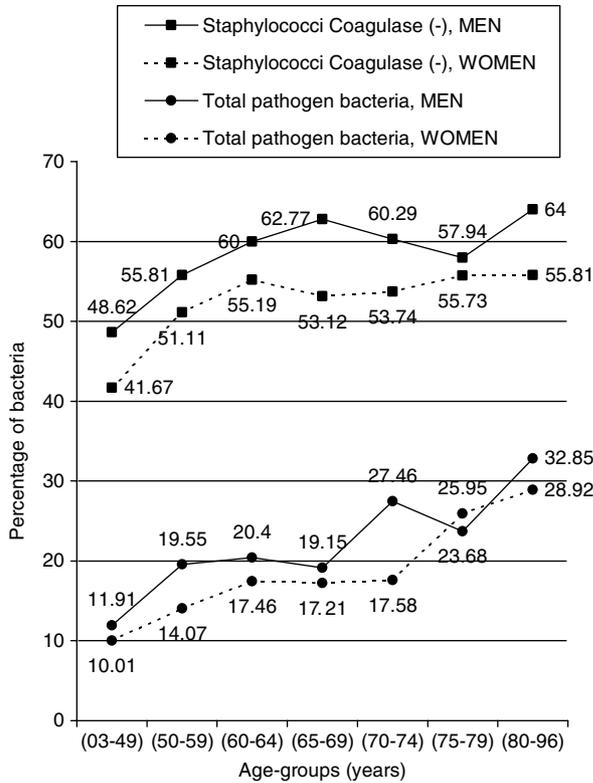
Age-groups (years)	Women				Men				Mantel–Haenszel test
	3–74		75–96		3–74		75–96		P-value
Number of patients	1239	(%)	1126	(%)	1358	(%)	709	(%)	
<i>Staphylococci</i> coagulase (-)	656	(53.0)	628	(55.8)	805	(59.3)	432	(60.9)	0.138
<i>Corynebacterium</i> sp	305	(24.6)	389*	(34.6)	417	(30.7)	239	(33.7)	<0.001
<i>S. aureus</i>	70	(5.7)	90***	(8.0)	77	(5.7)	53	(7.5)	0.007
<i>S. pneumoniae</i>	17	(1.4)	26	(2.1)	49	(3.6)	27	(3.8)	0.252
Other <i>Streptococcus</i> sp	62	(5.0)	90**	(8.0)	54	(4.0)	43***	(6.1)	0.001
<i>Haemophilus</i> sp	21	(1.7)	34***	(3.0)	43	(3.2)	25	(3.5)	0.091
Gram (-) diplococci	9	(0.7)	20**	(1.8)	13	(1.0)	9	(1.3)	0.040
Other Gram (-) rods	25	(2.0)	42***	(3.7)	49	(3.6)	37	(5.2)	0.004
Patients with sterile culture	351*	(28.3)	210	(18.7)	274**	(20.2)	108	(15.2)	NC

Higher frequencies among sexes ( $\chi^2$  test): \* $P < 0.001$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.05$ .  
NC = Not calculated.

(revised in the year 2004), volume 4 of Duane's Ophthalmology book<sup>21</sup> is different from that in the Khorazo *et al* studies<sup>3</sup> mentioned in Chapter 24 of the same volume, in the same book<sup>21</sup> (revised 10 years before). In more recent studies<sup>25–38</sup> most samples of patients undergoing cataract surgery have a small size and the frequency of the isolated bacteria varies a lot between them due to different factors<sup>18</sup> (the isolating culture media used, the exclusion criteria used to select the patients and the geographical area where they lived). Among these factors the climatic conditions in Madrid have been statistically associated with the conjunctival bacteria frequency of our patients undergoing cataract surgery.<sup>20</sup> It means that a small sample collected during a period shorter than a complete year could not have the whole possible bacteria. For example, in 313 patients awaiting cataract surgery, only 1.27% of alpha-haemolytic *Streptococci* were isolated from their conjunctival cultures processed from May to August<sup>27</sup> (the hottest months).

Considering the big number of pathogen bacteria species isolated in frequencies lower than 1% in big samples,<sup>18,24</sup> (mentioned above), one needs to recognise that a small sample size could more easily under or overestimate the frequency of the scarce conjunctival pathogen bacteria; probably, a sample containing less than a few thousand consecutive, nonselected, patients is not suitable for studying the influence of age in the conjunctival bacteria of patients undergoing cataracts surgery.

On the other hand, our men had a higher frequency of *Staphylococci* coagulase negative, *S. pneumoniae* and Gram-negative rods than women of any age (Figure 3 and Table 4). Fahmy *et al*<sup>4</sup> found that men had more Gram-negative rods and *Corynebacterium* than women, but in their sample there were not differences in the bacteria frequencies between age-groups; probably, this was due, in part, to their lower proportion of people over 74 compared to our sample (Table 1).



**Figure 3** Changes by age of *Staphylococci* coagulase negative and total pathogen conjunctival bacteria frequency of our men and women undergoing cataract surgery.

We do not find, in any previous study an explanation for the increment of conjunctival bacteria in men. In our study, suffice it to say that, as regards, the different style of life of men and women; men of this generation used to smoke tobacco, drink alcohol, and work outside the home more than women. On the other hand, women used to wash their hands more often than men because of the housework.

Taking into account that other samples of patients undergoing cataract extraction, nowadays, have similar distribution of sex and age to ours,<sup>10-12,15</sup> it can be suggested that old people and the male sex could have a increased risk of intraocular contamination during cataract extraction and PE, today, due to their higher frequency of conjunctival bacteria (Figures 1 and 3).

To assess the weight of old age or being male as risk factors for endophthalmitis after cataract extraction is difficult due to the great amount of risk factors, which could coincide when a PE occurs.<sup>9,39-43</sup> In spite of this difficulty, a literature review was carried out to investigate the relationship between age, sex, and PE incidence in other series of patients operated on for cataract. In most series the ages of the PE-affected patients are given but not the ages or sexes of the patients

operated on for cataracts in the same period. The following information can be summarised:

- Fahmy *et al*<sup>44</sup> did not find any relation between the age of the 24 PE cases that occurred after cataract extraction and that of the 4498 consecutive patients operated on from January 1964 to April 1974. In this study, the proportion of people older than 70 years was much smaller than in our study. Neither did they find statistical significance for other examined factors (diabetes, chronic respiratory diseases, and surgical complications), which, some years later, have been found to be risk factors for PE.<sup>9,39-42</sup>
- Javitt *et al*<sup>45</sup> studied the risk of rehospitalization for PE in a big sample of patients operated on for cataract in 1984, but they only analysed those older than 65 years. No relation with age was found in this age-group.
- Norregaard *et al*<sup>8</sup> found that advanced age and being male increased the risk of rehospitalization for PE in 19426 patients older than 50 years who underwent cataract extraction in 1985-1987. These two results support our hypothesis that being men and being elderly increased the risk of contamination in intra-ocular surgery.
- Montan *et al*,<sup>41</sup> in a retrospective case-control study, described a trend towards a higher risk of PE in males and patients older than 81 years, among 22091 patients operated on for cataracts from February 1990 to December 1993, beside other risk factors.
- Allardice *et al*<sup>42</sup> studied a great number of risk factors for only 11 PE cases in a sample of 1223 patients operated on for cataracts from June 1998 to February 1999. This sample was some thousands smaller than the samples of the four previous studies. Female gender turns out to be a risk for PE (all PE cases were women), but the proportion of elderly women and men among the patients operated on is not given.
- Recently, the EPSWA Team<sup>43</sup> has describe a higher risk of PE in patients aged over 80 years, among 210 PE cases occurred after 117083 surgical cataract procedures, from 1980 to 2000; just this period being when the number of elderly people operated on had increased. They did not find significant differences in the PE incidence of men and women; however, cataract surgery was more commonly performed among female patients in their population.

Other data which support our hypothesis are described in the following studies:

- Heaven *et al*<sup>46</sup> separated the PE cases occurred from May 1982 to May 1991 into those with positive and negative cultures. The mean age of the 20 cases with positive culture was 77 years, but it was 68 years for

the 12 cases with negative culture. These results indicate that infectious PE could be more frequent in old people.

- In the same way, in 420 PE cases collected for the Vitrectomy Study Group,<sup>47</sup> the mean age of the PE cases where pathogen bacteria were isolated was 75.7 years, whereas in the PE cases with no growth or equivocal the mean age was 72.8 years.

In conclusion, an age over 80 years represents a higher risk of infectious PE in patients operated on for cataracts nowadays, probably due to their increased conjunctival bacteria. The effect of age on the frequency of these bacteria has become evident because the number of elderly patients operated on for cataract has increased in the past 20 years, and because we have analysed simultaneously the influence of sex. However, future studies are needed to assess the risk of PE due to the conjunctival bacteria in men and women at different stages of age, in order to select the appropriate surgical prophylaxis.

It would be interesting to study the climatic influence on the conjunctival bacteria frequency and its spectrum, in our patients aged under 75 years and those over 74 years, of each sex, but the low frequency of most pathogen bacteria groups did not allow to carry out statistical comparisons after stratifying month by month, as we did in the total patients sample.<sup>20</sup> In any case the transient nature of bacteria due to climatic factors could depend on the specific climatic conditions of a particular geographical area, which add complexity to the comparison between studies from different countries. However, the lack of age influence on the frequency of conjunctival *S. pneumoniae* and *Haemophilus* sp (Table 3, Figure 2) among our patients could indicate that the presence of these bacteria is mainly due to the climatic conditions in our geographic area.<sup>20</sup> The male sex being more affected by the presence of *S. pneumoniae*.

### Acknowledgements

We thank Carlos Cortés, PhD, MD, Head of the Department of Ophthalmology, for providing the organisation needed to obtain a large number of consecutive patients; the entire ophthalmic surgical staff of the department for accepting and following the protocol designed to obtain the conjunctival samples, especially, Teresa Cuesta, MD, who collect part of the data; José M<sup>o</sup> Bellón, Hospital Statistician, for helping with statistical calculations; Isabel García for helping with the code diseases system; Ana Almazán for microbiological help, and David Frost for his assistance with the English translation.

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