Prescribing prophylactic antibiotics to users of therapeutic contact lenses

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ARTICLE INFO

Article history:
Received 14 March 2012
Accepted 12 June 2012
Available online 9 May 2013

Keywords:
Contact lenses
Cornea
Drugs
Ocular disease
Visual acuity

ABSTRACT

Background: To describe the benefits and optimum use of prophylactic antibiotics in users of therapeutic contact lenses (TCL).

Methods: A microbiological study was carried out on samples from 33 patients who continuously wore TCL. The resistance to antibiotics of bacteria isolated in our health region was also reviewed. An assessment was also made on whether there were microorganisms of a higher pathogenic potential in TCL than conventional contact lenses, as reported in the literature.

Results: No bacteria were isolated from 17 (52%) of the 33 lenses studied. From the 16 (48%) remaining lenses, coagulase-negative Staphylococci were isolated from 10 (62%), Propionibacterium acnes from 4 (25%), and Corynebacterium from 2 (13%).

Conclusions: The high number of negative cultures and the presence of saprophytic bacteria indicate that prophylactic antibiotic treatment is not precise. The most frequent pathogenic bacteria found in contact lenses are strongly resistant to the current commercially available antibiotics.

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Pertinencia de prescribir antibióticos profilácticos en usuarios de lentes de contacto terapéuticas

RESUMEN

Objetivos: Conocer la pertinencia o no de prescribir antibióticos profilácticos en usuarios de lentes de contacto terapéuticas (LCT).

Métodos: Se procedió a realizar un estudio microbiológico sobre 33 LCT de 33 pacientes portadores de LCT. Se valoraron las resistencias de los gérmenes aislados a los antibióticos a partir de los estudios publicados en nuestra región sanitaria durante el año 2010. Valoramos lo mismo en el supuesto que las LCT se encontraran contaminadas por los gérmenes

Palabras clave:
Lentes de contacto
Córnea
Colirios
Enfermedad ocular
Agudeza visual


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con mayor potencial patógeno según la literatura médica en usuarios de lentes de contacto convencionales.

Resultados: De las 33 LCT estudiadas en 17 (52%) no se aisló ningún germen. En las 16 LCT restantes (48%) se aisló en 10 (62%) Staphylococcus coagulasa negativo, en 4 (25%) Propionibacterium acnes y en 2 (13%) Corynebacterium.

Conclusiones: El elevado número de cultivos negativos y la presencia de gérmenes saprofitos indican que no es preciso el tratamiento antibiótico profiláctico. Los gérmenes con mayor potencial patógeno en usuarios de lentes de contacto presentan severas resistencias a los antibióticos comercializados en forma de colirio.

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Introduction

The first contact lenses designed and manufactured in the late twentieth century were exclusively therapeutic. Since then, ocular diseases such as pseudophakic endothelial decomposition (PED), relapsing corneal erosions (RCE), positive seidels (PS) and others have been frequently overcome with supervised adaptation of therapeutic contact lenses (TCL). These lenses provide a barrier mechanism over the corneal epithelium, relieve ocular pain, facilitate cicatrization and act as a drug carrier, with the added interest that the user maintains the entire visual potential, in contrast with perfectly valid alternative therapies such as ocular occlusion, tarsorrephy or the administration of botulin toxin among others.

Despite the above benefits, TCL are not free of possible side effects. For instance, it is known that the contact lens biomaterials can become vectors for the adherence of microorganisms, which can subsequently migrate to the ocular surface. Fortunately, new designs and materials utilized nowadays for manufacturing TCL have reduced the complication rates which prevailed in the past as well as providing a satisfactory degree of ocular welfare. In this regard, the utilization of new silicone hydrogels have enabled a high rate of corneal oxygenation accompanied by a low accumulation of deposits at the level of the TCL. This minimizes one of the most feared complications, i.e., ocular infection (Table 1).

Even so, when adapting TCL to a patient exhibiting an ocular disease, the question about the most efficient measures to avoid the side effects TCL generates still arises.

This study aims at establishing the adequacy of prescribing prophylactic antibiotics for TCL uses and, if so, to determine which is best suited to the bacteriological spectrum of patients in our health region.

| Table 1 - Bacterial adhesion of Staphylococcus epidermidis to various contact lens types. |
|---------------------------------|-----------------|
| Material | Cells/cm² |
| Balafilocon A | 2.00E+0.6 |
| Lotrafilocon A | 1.00E+0.6 |
| Lotrafilocon B | 3.00E+0.6 |
| Etafilocon A | 5.00E+0.6 |

Etafilocon is the only conventional hydrogel lens, the remainder being silicone hydrogel.

Materials and methods

The study was carried out under the supervision of the Ethical Committee of the San Juan (Reus) University Hospital in accordance with the rules set forth in the Helsinki Declaration. All the patients signed an informed consent before taking part in the study.

A prospective study on 33 patients of our health region was carried out, 16 males and 17 females with a mean age of 61 years (46–81), adapting TCL to each.

The diseases they exhibited were: 20 PED, 11 RCE and two herpetic keratitis (HK).

The control group comprised 21 pathological eyes treated with alternative therapies: 3 PS and 4 RCE with ocular occlusion, 3 HK with tarsorrephy, 8 PED with botulin toxin and 3 PED with tarsorrephy.

A single type of silicone hydrogel TCL was used (67% lotrafilcon B and 33% water) having a mean diameter of 14.2 mm (Optix CIBA Vision®).

The TCL usage pattern was permanent, with fortnightly or quarterly replacements according to the severity or chronic nature of patients diseases.

After changing the TCL, the used ones were subjected to microbiological analysis. To this end, after administering anesthetic eye drops (Colircusi anestésico doble AlconCusi®) the TCL were withdrawn with sterile gloves by the same physician under strict sterility measures and deposited in a small container with physiological serum and immediately taken to the microbiology lab. The TCL were cut in smaller pieces and inoculated in a liquid rich medium (thiogycolate) incubated at 35 °C between 24 and 48 h. When growth was observed, subcultures were made in Makonkey agar, blood agar, chocolate polivitex agar and sabouraud agar, and incubated once more at 35 °C between 24 and 48 h for studying bacteria and 72 h at 25 °C for fungi.

The microbiological study of the control group was carried out with conjunctival smear.

None of the patients included in the studies were prescribed prophylactic antibiotics.

A review was made of the most frequent germs capable of generating severe corneal disease in contact lens users based on medical literature, with Pseudomonas aeruginosa, Staphylococcus aureus and Streptococcus pneumoniae acquiring significant relevance.

After obtaining the results of patient culture and considering the above-mentioned pathogen germs, we assessed the
The usefulness of prescribing prophylactic antibiotics in TCL users according to the expected response to treatment on the basis of the antibiogram values obtained during 2010 in our health region (Table 2). The statistical data were analyzed with SPSS 13.0 (SPSS Inc.; Chicago, IL, United States) utilizing the statistical description of each variable.

### Results

Out of the 33 TCL studied, no germs were isolated in 17 (52%), with 10 corresponding to PED patients and 7 to RCE patients.

In the remaining 16 TCL (48%), in 10 (62%) coagulase negative Staphylococcus was isolated, of which six corresponded to PED, three to RCE and one to HK, in four (25%) Propionibacterium acnes was isolated, of which 2 corresponded to PED, one to RCE and a further one to HK and in two (13%) Corynebacterium xerosis was isolated, both corresponding to PED.

Out of the 21 cultures taken of the control group, negative culture was obtained in 15 cases (71%), of which 3 patients had Ps, eight had PED and four RCE. In the remaining 6 eyes (29%), in 5 coagulase negative Staphylococcus was obtained, of which 2 patients had suffered HK and 3 had PED. In the remaining eye (17%), positive culture was obtained for P. acnes for patients with PED treated with tarsorraphy.

A contingency table was designed to study the relationship between the qualitative variables in the use of TCL and bacteria contamination.

In order to study the dependency relationships between the 2 qualitative variables, Pearson’s Chi Square statistical contrast was used, obtaining a result of $\chi^2$=2.108 with a $p$ value of $p=0.15$. A statistically not significant difference was found between bacterial contamination of the pathological eyes which had not been treated with TCL and those who had been treated with TCL (Table 3).

### Discussion

The entry and widespread expansion in the international market of silicone hydrogel TCL have enabled safer prescriptions for the permanent use of TCL adaptations due to the high degree of dissemination of oxygen and high DK/L said TCL exhibit. This releases the patient of the burden of daily removing and placing TCL, a significant factor due to the usually advanced age of users, as well as optimizing the use of maintenance liquids. A controversial issue is to determine how long TCL can remain in a supposedly pathological eye. Elia et al. have applied the guidelines of renewing frequent replacement TCL between 1 and 6 months and disposable TCL between 1 and 2 weeks.\textsuperscript{13} However, adequately programming checkups according to the subsidiary disease could be more important than establishing a specific date for changing the TCL because there is no statistically significant evidence between the time of use of TCL and the type of isolated germ.\textsuperscript{13}

Regardless of their positive effects, TCL are not free from potential side effects. It is known that the use of TCL could give rise in certain circumstances to epithelial disruption processes derived from accidental abrasion or toxicity of the solutions, or simply due to poorly adapted TCL. Concurrently, corneal hypoxia could generate metabolic changes in the cellular membrane which, together with the ensuing biological peeling delay caused by the barrier effect, could facilitate over-infection in already weakened cornea.

In healthy eyes, the bacterial flora that is isolated with greater frequency in the conjunctiva and the free palpebral edge is constituted by aerobic bacteria. Specifically, the most frequently found germs according to the literature are Staphylococcus epidermidis, S. aureus and Corynebacterium,\textsuperscript{14} although

### Table 2 – Germ resistance rates to antibiotics in our health region during 2010.

<table>
<thead>
<tr>
<th></th>
<th>Pseudomonas aeruginosa</th>
<th>Methicillin-sensitive Staphylococcus aureus</th>
<th>Methicillin-resistant Staphylococcus aureus</th>
<th>Staphylococcus epidermidis</th>
<th>Streptococcus pneumoniae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin</td>
<td>–</td>
<td>85.1%</td>
<td>100%</td>
<td>100%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>11.5%</td>
<td>0%</td>
<td>100%</td>
<td>83.3%</td>
<td>1.6%</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>36%</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1%</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>–</td>
<td>8.5%</td>
<td>94.3%</td>
<td>53.3%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Amikacin</td>
<td>6.6%</td>
<td>2.1%</td>
<td>52.6%</td>
<td>36.7%</td>
<td>–</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>28.6%</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>32.8%</td>
<td>0%</td>
<td>52.6%</td>
<td>56.7%</td>
<td>–</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>–</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Fosfomycin</td>
<td>86.9%</td>
<td>2.1%</td>
<td>15.8%</td>
<td>13.3%</td>
<td>–</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>–</td>
<td>17%</td>
<td>63.2%</td>
<td>66.7%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Linezolid</td>
<td>–</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>–</td>
</tr>
<tr>
<td>TMP/SMX</td>
<td>–</td>
<td>0%</td>
<td>10.5%</td>
<td>53.3%</td>
<td>–</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>–</td>
<td>17%</td>
<td>84.2%</td>
<td>70%</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

### Table 3 – Contingency table to study the relationship between the qualitative variables of contact lens use and bacterial contamination.

<table>
<thead>
<tr>
<th></th>
<th>Bacteria</th>
<th>No bacteria</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCL Count</td>
<td>16</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>Expected</td>
<td>13.4</td>
<td>19.6</td>
<td>33.0</td>
</tr>
<tr>
<td>No TCL Count</td>
<td>6</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Expected</td>
<td>8.3</td>
<td>12.8</td>
<td>21</td>
</tr>
<tr>
<td>Total Count</td>
<td>22</td>
<td>32</td>
<td>54</td>
</tr>
<tr>
<td>Expected</td>
<td>22.0</td>
<td>32.0</td>
<td>54.0</td>
</tr>
</tbody>
</table>

Expected frequency.
the proportion between them could vary according to geographical location and individual factors of each patient, even more so if associated to some disease, as is the case of our patients.

In this study, the germs confined in the TCL have been cultured according to the work by Das et al., in which they demonstrated that in keratitis cases caused by pathogen germs the microbiological study is presented as the most sensitive method for their identification than corneal smears. It should be taken into account that none of our cases exhibited active infection and therefore it could be possible that the germs in the conjunctiva did not appear in the TCL cultures due to the absence of associated conjunctivitis.

From the above table it can be inferred that *Pseudomonas aeruginosa*, one of the most aggressive and feared germs, exhibits intrinsic resistance to many antimicrobial agents, mainly chloramphenicol and tetracycline, although there is also a high percentage of resistance to other antibiotics such as ciprofloxacin, gentamicin and tobramycin.

*S. aureus* exhibits very little resistance in methyl-sensitive strains, which are the most frequently isolated strains. In contrast, methyl-resistant strains exhibit a high degree of resistance, most of all and alarmingly to fluoroquinolones. The majority of *S. epidermidis* strains are resistant to aminoglycosides, erythromycin and ciprofloxacin.

The introduction of a vaccine for *S. pneumoniae* has diminished the percentage of strains with a moderate level of resistance to β-lactams. Fortunately, the vast majority of strains is sensitive to fluoroquinolones.

It must be added that in the case of pneumococci, sensitivities have been developed from strains obtained from patients in hospitals or emergency wards. In the case of the other 2 species, they have only been collected from patients in hospital. Possibly, if all the strains found in the entire population were considered, the resistance results would have been lower.

The tables of the study did not include latest generation fluoroquinolones such as moxifloxacin, which has recently become of widespread use in ophthalmological practice. Even though it is a highly efficient antibiotic against microorganisms such as *S. pneumoniae* and *P. acnes*, it must also be considered that microorganisms such as *P. aeruginosa* could exhibit intrinsic resistances while others, such as methicillin-resistant *Staphylococcus* and *Neisseria gonorrhoeae* also exhibit acquired resistances.

In this context it could be inferred that the majority of antibiotics in the market are not very effective in protecting TCL users against possible exposure to the most frequent pathogens. However, in patients subsidiary to be colonized by pneumococci, as could be the case of patients with respiratory tract problems, the prophylactic use of antibiotic eye drops with fluoroquinolone could be justified to some extent.

In previous studies it was observed that between 15% and 45% of contact lenses of patients wearing hydrophilic lenses exhibited sterile cultures. In this study, we have found a low percentage of findings (52%), perhaps because these patients had been submitted at some point to antibiotic treatment.

Even though the large concentration of antibiotics accumulated at the level of the lachrymal film could alter the resistance and sensitivity results obtained in the tables, the fact remains that in numerous infectious diseases a favorable response is not found if an adequate selection of the drug is not carried out.

It is known that the indiscriminate prophylactic use of antibiotics is one of the reasons for germs to develop resistances. However, the utilization of contact lenses impregnated with antimicrobials substances such as silver or selenium derivatives among others has demonstrated to ostensibly reduce the number of initial colonies.

This study is concluded considering that antibiotic prophylaxis is not necessary in TCL users although it is necessary to personalize it according to chronicity, previous microbiological culture and the patient’s base disease (Table 4).

### Conflict of interests

No conflict of interests has been declared by the authors.

### REFERENCES