A combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl is used when carrying out morphometrical corneal studies in vivo by means of ultrasound pachymetry. The aim of this was to determine the effect of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops on central corneal thickness values.

We carried out a prospective study involving 30 eyes of 30 healthy subjects. The mean age of the subjects was 26.13±2.62 years (age ranged from 20 to 30 years old). Central pachymetry was carried out prior to and three minutes after the instillation of two saline solution eye drops, and three minutes after the administration of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops. The mean of three consecutive measurements of the central corneal thickness obtained with the Orbscan Topography System II (Orbscan, Inc., Salt Lake City, UT. USA) was used as the corneal thickness value.

No significant differences were found (p=0.714) in the mean central corneal thickness values before and three minutes after saline solution eye drops had been instilled. Nevertheless, after anesthesia there was a significant increase in mean central corneal thickness (p<0.001). Increases ranged from 22 to 131 micrometers, with a mean of approximately 47 micrometers.

Following the instillation of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl eye drops corneal thickness increase. Researchers must be aware of this effect of topical anesthetic eye drops on corneal morphometry in order to analyze corneal thickness results correctly.

Key Words: Central corneal thickness – Topical anesthesia – Cornea – Ultrasound pachymetry

INTRODUCTION

Ultrasound pachymetry is the most widely used technique for in vivo corneal thickness measurement (Doughty and Zaman, 2000). It is a technique in which the ultrasound probe must be in contact with the ocular surface. Morphometric study of corneal thickness by means of ultrasound pachymetry involves the application of one or two anesthetic eye drops directly onto the corneal surface in order to avoid pain when the ultrasound probe touches the ocular surface (Price et al., 1999; Sanchis Gimeno et al., 2001; Lleó et al., 2003). Thus, theoretically corneal thickness values could be affected by the use of anesthetic eye drops.

Nevertheless, there are only a few references regarding the effect that anesthetic eye drops have on corneal thickness values when carrying out morphometric studies in vivo (Herse and Siu, 1992; Asensio et al., 2003).

In a study by Herse and Siu (1992), an average increase of 2.9% was observed in central corneal thickness (CCT) about two minutes after instillation of two drops of 0.5% proparacaine. More recently, it has been observed that 0.4% oxybuprocaine HCl.
eye drops can induce interindividual changes in corneal thickness values (Asensio et al., 2003).

Nevertheless, a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops can also be used to anesthetize the cornea before ultrasound pachymetry. Currently, the effect of the instillation of these anesthetic eye drops on corneal thickness measurements remains unclear.

In light of the above, we were prompted to study the CCT changes induced by the instillation of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops by analyzing CCT before and after topical anesthesia.

MATERIAL AND METHODS

The work was performed in accordance with the World Medical Association’s Declaration of Helsinki and written informed consent was obtained from all patients. Ethics approval from the Ethics Committee of the Faculty of Medicine of Valencia was obtained. We carried out a prospective study involving 30 eyes of 30 subjects. All subjects were healthy and none of them was taking any kind of topical or systemic medication. The manifest sphere ranged from -0.75 to -3.00 diopters (mean±SD, -2.27±0.39) and the mean cylinder ranged from 0 to -0.75 diopters (mean±SD, -0.38±0.26). The mean age of the subjects was 26.13±2.62 years (their ages ranged from 20 to 30 years old). Mean tonometry ranged from 12 to 19 mmHg (mean±SD, 16.10±1.78). Only the right eye of the subjects was analyzed. The choice of limiting the study to the right eye instead of the left eye was random.

Once the subjects had been chosen, all CCT measurements were determined on another day using the Orbscan II Corneal Topography System (Orbscan, Inc., Salt Lake City, UT, USA) following the procedures recommended by the manufacturer (Figure 1 and Figure 2).

Orbscan pachymetry was carried out prior to and three minutes after the instillation of two saline solution eye drops. Two drops of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops were instilled immediately after the post-saline solution measurement had been carried out. Three minutes after the administration of the anesthetic eye drops, Orbscan pachymetry was carried out again. One physician took all corneal thickness measurements. The mean of three consecutive measurements of CCT was used as the corneal thickness value.

The statistical tests used in the work were the Kolmogorov-Smirnov test and after this the differences between data sample means were determined by a t-Test. P values of below 0.05 were considered statistically significant.

RESULTS

The individual changes in CCT values before and after saline solution eye drops, before saline solution and after anesthesia, and after saline solution and after anesthesia can be seen in Figures 3, 4 and 5.

No significant differences were found (p=0.714) between the mean CCT values measured before (547±5 micrometers) and after the instillation of saline solution eye drops (548±6 micrometers).

Fig. 3.- Scattergraph showing the correlation between the pachymetric measurements obtained before and after saline solution eye drops (microns).

Fig. 4.- Scattergraph showing the correlation between the pachymetric measurements obtained before saline solution and after anesthesia (microns).

Fig. 5.- Scattergraph showing the correlation between the pachymetric measurements obtained after saline solution eye drops and after anesthesia (microns).
The mean CCT after anesthesia was 595±21 micrometers. Significant differences were found (p<0.001) between the mean CCT values measured before saline solution eye drops and after anesthesia, and between the mean CCT values obtained after saline solution and after anesthesia (p<0.001).

The mean change in CCT values before and after saline solution instillation was 0.533±3.33 micrometers (range, -6 to 4 micrometers). After anesthetizing the cornea there was an increase of 47.26±20.14 micrometers (range, 26 to 129 micrometers) in CCT values with respect to the values obtained before saline solution eye drops. After anesthetic eye drops the CCT values were 46.73±20.42 micrometers higher (range, 22 to 131 micrometers) than those obtained after saline solution eye drops.

**DISCUSSION**

The objective of this study was to determine the effect that a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl anesthetic eye drops have on CCT. Our results revealed that after the instillation of a combination of 0.1% tetracaine HCl and 0.4% oxybuprocaine HCl there was a significant increase in CCT values.
Thus, these results seem to confirm that anesthe-
sia by means of a combination of 0.1% tetra-
caine HCl and 0.4% oxybuprocaine HCl anesthetic
ey drops can affect CCT measurements.

We used Orbscan pachymetry because it is a
non-contact technique that can be used to obtain
CCT values without using corneal anesthetic eye
drops. Therefore, by analyzing CCT values befo-
re and after corneal anesthesia we were able to
detect changes in CCT values associated with the
instillation of anesthetic eye drops.

The literature does not explain the effect that
anesthetic eye drops have on human corneal
thickness, although Herse and Siu (1992) observed
a significant increase in CCT (2.9% of the
corneal thickness) about two minutes after instillation
of two drops of 0.5% proparacaine, which was
not found after instillation of 2 drops of artificial
tear solution. We found similar results, although
the increase in CCT values in our study was lower
than that reported by Herse and Siu (1992).

However, another study that analyzed the
effect of 0.4% oxybuprocaine HCl on corneal
thickness values did not find significant increases
in mean corneal thickness values, although an
individual response to anesthetic eye drops was
observed that was associated with increases or
decreases of corneal thickness (Asensio et al.,
2003). On the other hand, in this study we found
no decreases in corneal thickness values after
anesthesia. Thus, it seems that proparacaine,
oxibuprocaine, tetracaine or a combination of
these drugs can induce a different response in
corneal thickness values.

In our study only one physician carried out all
the Orbscan pachymetric measurements so that
the differences could not be the result of diffe-
rent observers analyzing the CCT but rather the
result of the effect of topical anesthesia.

It is known that when an anesthetic diffuses
depth into the corneal stroma it may inhibit the
cellular metabolism of the keratocytes and the
posterior layers of the cornea (Penna and Tab-
bbara, 1986). Moreover, it is known that the inhi-
bition of the endothelial cell metabolism may
lead to corneal edema (Penna and Tabbara,
1986) and this corneal edema can induce a chan-
ge in corneal thickness. In fact, corneal edema
was the reason attributed by Herse and Siu
(1992) for the increased values they observed
after topical corneal anesthesia.

Alterations in the degree of corneal hydration
after topical anesthetics were observed in a study
on the effects of cocaine, lidocaine, and benoxi-
nate on the corneal epithelium of rabbits (Wee-
ker, 1974). That study concluded that topical
anesthetics caused an alteration of the Na⁺/K⁺
endothelium pump, resulting in increased osmo-
tic pressure in the cornea and subsequent in-
creased hydration of the stroma, which could
explain an increase in CCT values.

Finally, an open question remains: should the
effect of anesthetic eye drops on corneal thick-
ness be ignored when carrying out corneal mor-
phometric studies in vivo? Our results have
shown that use of this kind of topical anesthesia
when carrying out morphometric corneal studies
in vivo by means of ultrasound can affect the
cornea, causing increases in CCT. In addition,
our results are similar to those of Herse and Siu
(1992) but differ from others (Asensio et al.,
2003), making it more complicated to ascertain
how anesthetic eye drops affect CCT. Therefore,
we believe there is evidence of a lack of know-
ledge regarding the effect and consequences that
anesthetic eye drops have on the human cornea,
and the present study should be complemented
with further research.

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