Corneal Sensitivity in Normal Thai Population

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ABSTRACT

Objective: To measure corneal sensitivity in normal Thai people of different ages using the Cochet - Bonnet aesthesiometer.

Methods: This prospective, cross-sectional study was conducted with three hundred normal Thai subjects (600 eyes) who were divided into six groups according to their age. Corneal sensitivity was measured by using a Cochet - Bonnet aesthesiometer at the central cornea. The mean filament length of three measurements was considered to be the corneal sensitivity threshold.

Results: There were statistically significant differences in the mean corneal sensitivity of the central cornea among age groups (p < 0.0001). The mean corneal sensitivity decreased with advancing age, and was significantly reduced after the age of sixty.

Conclusion: The normal value of corneal sensitivity of the central cornea in the Thai population is the same as those of previous reports from other countries. Normal corneal sensitivity significantly decreased after the age of sixty.

Keywords: Corneal sensitivity; Normal population; Cochet - Bonnet aesthesiometer

Normal corneal sensitivity is important to the normal structure and function of the cornea. Significantly decreased sensitivity may be caused by certain ocular and systemic diseases such as corneal dystrophies, keratoconus, herpes keratitis, diabetes, leprosy and myasthenia gravis. Some medical and surgical ocular treatments including refractive surgery can also induce corneal hypesthesia as can a contact lens wear. A loss of normal sensitivity may compromise the protective blink reflex, delay epithelial wound healing, such as epithelial cell rate of mitosis and wound remodeling, or may be associated with decreased tear flow. Moreover, corneal sensitivity can be changed in physiologic conditions associated with advancing age, diurnal variation, endocrinologic changes and iris color. Thus, the normal value of corneal sensitivity should be known in different populations in order to detect an abnormal corneal sensitivity. There have been many studies demonstrating normal corneal sensitivity in various countries. However, to the best of our knowledge, there have been no publications evaluating the normal value of corneal sensitivity in Thai people.

This study measured corneal sensitivity at the central cornea in normal Thai people of different age groups using the Cochet - Bonnet aesthesiometer.

MATERIALS AND METHODS

Instruments

Corneal sensitivity was tested using the Cochet- Bonnet aesthesiometer (Luneau, Paris, France). The instrument consists of a 0.12 mm diameter nylon monofilament of variable length, 0 to 60 mm, that applies pressure on the cornea between 11 and 200 mg / 0.0113 mm². The measurement begins at the maximal length, approximately 60 mm, which is the lowest pressure. When the nylon filament touches the cornea perpendicularly, a bend in the filament (5 percent of its free length) gives an objective measurement of the contact. If the patient does not feel the filament at 60 mm, the filament length is decreased by 5 mm and retested until the patient can feel the nylon thread.

Study Design

This prospective, cross-sectional study was conducted at the Department of Ophthalmology, Faculty of Medicine Siriraj Hospital, Mahidol University from September 2003 to January 2005. An approval was obtained from the Ethics Committee of Siriraj Hospital, Mahidol University and all subjects signed their informed consents before participating in this study.

Study Population

A total of 300 normal Thai subjects (600 eyes) were recruited from volunteers over the age of twelve. All had no history of contact lens wear and were free of systemic and ocular diseases except for senile cataract. The subjects were divided into six groups according to their age as shown in Table 1. Each group consisted of fifty subjects and demographic details are given in Table 1.

Clinical Procedures

All subjects were screened for ocular health and excluded on the grounds of past or present systemic and ocular diseases, including contact lens wear. The Cochet-Bonnet aesthesiometer was shown, and the method of measurement was demonstrated to reassure the subjects that the test was harmless and painless. The subject sat on a chair looking straight ahead while the observer slowly moved the nylon thread of maximum length (60 mm) and perpendicularly toward the central cornea. A contact was detected by a slight bending in the filament (5 percent of its free length). The subjects were asked to indicate when the stimulus was felt. If the subject could not feel the filament at 60 mm, the filament length would be decreased by 5 mm and retested until the subject could feel...
the nylon thread. The subjects had to state exactly when they felt the touch. The reliability was controlled by occasional feint approaches. The mean filament length, from 3 stimulus applications that produced a positive response from the subjects, was considered to be the corneal sensitivity threshold. Measurements for right and left eyes of each subject were averaged for analysis. All measurements were performed by the same observer (AS).

Statistical Methods
Statistical analysis was carried out using SPSS 10 statistical software 2000 edition. All tests were analyzed at the level of 0.05 for significance. Differences in the mean corneal sensitivity among age groups were analyzed by using Kruskal-Wallis test. The Dunn’s multiple comparison method was used to adjust the data for multiple comparisons.

RESULTS

Three hundred normal Thai subjects (600 eyes) were evaluated. The mean age was 41.2 ± 17.2 years (ranging from 15 to 83 years). One hundred and seventeen subjects (39.0 %) were male, whereas 183 subjects (61.0 %) were female. Both eyes of all subjects were included in the study.

The mean corneal sensitivity of the central cornea in each age group and in all age groups are shown in Table 2. There were statistically significant differences in the mean corneal sensitivity among age groups (p < 0.0001). The Dunn’s multiple comparison showed that there were statistically significant differences in the mean corneal sensitivity between group 6 and each age group except for group 5. This demonstrated that the mean corneal sensitivity decreased with advancing age, and was significantly reduced after the age of sixty.

DISCUSSION
The innervation of the cornea derives predominantly from the long ciliary nerves of the ophthalmic division of the trigeminal nerve, which penetrate the cornea in the middle and anterior stromal layers and run forward in a radial fashion toward the center of the cornea, forming a network called the subepithelial plexus, beneath the Bowman’s layer. Fibers from this plexus pass into the epithelium through openings in the Bowman’s layer and emerge between the epithelial cells.15 Normal sensation of the cornea is extremely important to normal corneal structure and function. Sensory deprivation of the cornea is commonly affected by a variety of congenital and acquired disorders as well as medical and surgical ocular treatments.1-6 Contact lens wear is also a significant factor, which reduces corneal sensitivity and increases corneal thickness.2-4

Corneal hypoesthesia has been associated with decreased blinking reflex, decreased tear secretion, reduced rate of mitosis of corneal epithelium and delayed wound healing.5 Interestingly, the endothelium also depends on normal corneal innervation for its functions as reported by Thorgaard GL et al. that abnormalities in corneal innervation have been associated with corneal edema.25

Corneal sensitivity may be the most reliable test of a long-term corneal compromise.26 Tests for corneal sensitivity may be very simple or more sophisticated. The easiest and most widely used technique employs a cotton-tipped swab. However, a wisp from the cotton tip does not give any quantitative evaluation. The first quantitative measurement of corneal sensitivity was made by Von Frey in 1894, using hairs of different lengths attached with wax to the tip of a glass rod. These hairs were calibrated on a precision scale. Few other useful clinical devices were devised until Boberg-Ans introduced his

TABLE 1. Age group classification and demographic data of 300 subjects.

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>12-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>&gt;60</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>17.5 ± 0.8</td>
<td>26.1 ± 2.9</td>
<td>35.9 ± 3.0</td>
<td>45.1 ± 3.2</td>
<td>55.3 ± 3.0</td>
<td>67.1 ± 5.2</td>
<td>41.2 ± 17.2</td>
</tr>
<tr>
<td>Median</td>
<td>18</td>
<td>26.5</td>
<td>36</td>
<td>44</td>
<td>55</td>
<td>66.5</td>
<td>40.5</td>
</tr>
<tr>
<td>Sex (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6 (12.0)</td>
<td>25 (50.0)</td>
<td>19 (38.0)</td>
<td>20 (40.0)</td>
<td>30 (60.0)</td>
<td>17 (34.0)</td>
<td>117 (39.0)</td>
</tr>
<tr>
<td>Female</td>
<td>44 (88.0)</td>
<td>25 (50.0)</td>
<td>31 (62.0)</td>
<td>30 (60.0)</td>
<td>20 (40.0)</td>
<td>33 (66.0)</td>
<td>183 (61.0)</td>
</tr>
</tbody>
</table>

TABLE 2. Mean corneal sensitivity value of the central cornea (mm.) in each age group.

<table>
<thead>
<tr>
<th>Age group (yrs)</th>
<th>12-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51-60</th>
<th>&gt;60</th>
<th>Average</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corneal sensitivity (mm.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p &lt; 0.0001</td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>59.9 ± 0.6</td>
<td>59.8 ± 0.8</td>
<td>59.4 ± 2.5</td>
<td>59.5 ± 1.5</td>
<td>59.5 ± 1.0</td>
<td>58.6 ± 2.7</td>
<td>59.4 ± 1.8</td>
<td></td>
</tr>
<tr>
<td>Min, max</td>
<td>55.0, 60.0</td>
<td>55.0, 60.0</td>
<td>40.0, 60.0</td>
<td>51.7, 60.0</td>
<td>55.0, 60.0</td>
<td>46.7, 60.0</td>
<td>40.0, 60.0</td>
<td></td>
</tr>
</tbody>
</table>
aesthesiometer in 1955, using a single nylon monofilament of constant diameter. The monofilament can vary in length, thereby producing different forces when applied to the cornea.  

Cochet and Bonnet constructed a slightly improved version of the Boberg-Ans instrument. This version has now become the most widely used as the standard clinical test for corneal sensitivity.  

Several other aesthesiometers have also been devised including those of Beuerman,  

Dupuy,  

Zaidman and Brennann and Maurice.  

These methods are complex, expensive and not commercially available; thus they have not gained popularity among clinicians.

The purpose of our study was to measure corneal sensitivity of normal people in our country because iris pigmentation was a possible variable in corneal sensitivity by the study of Millodot.  

He also observed no significant difference in corneal sensitivity between genders; thus this study was not concerned about gender of the subjects in each age group.

Our study reports the mean normal values of the central corneal sensitivity in each age group in Table 2 and the average of those values in all age groups was 59.4 ± 1.8 mm in filament length of nylon thread or 10.9 ± 3.3 mg/mm² when expressed as gravity according to the scale shown in the instruction manual of this instrument.

This result is similar to the normal sensitivity of the central cornea of 10-15 mg/mm² and 12 mg/mm² as reported by Boberg-Ans  

and Cochet & Bonnet, respectively; and it is also the same as that of 45-60 mm as shown by Norn.  

The central corneal sensitivity in our study decreases with advancing age. However, there is a statistically significant decline in corneal sensitivity after the age of sixty. The study of Millodot  

has shown that corneal sensitivity significantly reduces after the age of fifty; 25 ± 10.2 mg/mm² before the age of fifty and 26.7 ± 13.5 mg/mm² after that age. The age which the corneal sensitivity significantly decreases is earlier than that in our study. This discrepancy may be attributable to the different iris color or may be because nowadays people take much better care of their health than in the past. Nutrition, anti-aging medicine, detoxifying substances and exercise may slow the aging processes.

Although the Cochet-Bonnet aesthesiometer is the standard clinical test for corneal sensitivity, the positive response is more dependent on the subject’s attitude and apprehension. Therefore, several precautions must be taken to ensure that the measurements are reliable. The precautions necessary include monitoring of humidity, temperature and room illumination in order to retain analogous conditions for each measurement, as well as the mounting of the instrument to the slit-lamp biomicroscope so that the approach to the eye is carefully controlled. Sometimes the reliability may be tested by occasional feint approaches.

CONCLUSION

The normal value of corneal sensitivity of the central cornea in the Thai population is the same as those of previous reports from other countries. Normal corneal sensitivity decreased with advancing age and was significantly reduced after the age of sixty.

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ความไว้ของความรู้สึกของการกระทบในประชากรไทยปกติ

วิวัฒน์ ซิริณภริยา, นพ. ภูมิภัทร, คณิตศิลป์, นพ.อัชาสร, สุวรรณรัตน์, นพ.
ภาควิชานรศวิทยา, คณะแพทยศาสตร์ศิริราช\ มหาวิทยาลัยศิริราช ถนน 10700, ประภาศิน

วัตถุประสงค์: เพื่อวัดความไว้ของความรู้สึกของการกระทบในประชากรไทยปกติในช่วงอายุแตกต่างกันโดยใช้เครื่องตรวจ Cochet - Bonnet aesthesiometer

วิธีการศึกษา: การศึกษาopi จำนวน 300 คน (600 ตัว) ตัวอย่างเก็บตัวอย่าง 6 กลุ่มอายุ 10700 แบบสอบถามความไว้ของความรู้สึกของการกระทบต่อกลางโดยใช้เครื่องตรวจ Cochet - Bonnet aesthesiometer การทดสอบว่า 5 ครั้ง นำมาค่าเฉลี่ยเป็นค่าความไว้ของความรู้สึกของการกระทบ

ผลการศึกษา: พบความแตกต่างของค่าเฉลี่ยความไว้ของความรู้สึกของการกระทบต่างกันในแต่ละกลุ่มอายุอย่างมีนัยสำคัญทางสถิติ (p < 0.0001) ความไว้ของความรู้สึกของการกระทบต่างกันในแต่ละกลุ่มอายุมีนัยสำคัญทางสถิติอย่างมีนัยสำคัญทางสถิติมากกว่า 60 ปี

สรุป: ค่าประสบการณ์ของความรู้สึกของการกระทบต่างกันในประชากรไทยปกติต่างกันอย่างมีนัยสำคัญทางสถิติอย่างมีนัยสำคัญทางสถิติมากกว่า 60 ปี