Intraocular pressure measurement using near infrared spectroscopy

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Purpose Despite advanced modern technology measurement of intraocular pressure is still a challenge. All systems in use depend on a indirect principle of measurement, influenced by tissue parameters. A new non invasive system to measure the intraocular pressure based on near infrared spectroscopy might overcome these limitations by offering a real direct, non contact and non invasive intraocular pressure reading. It is based on the specific molecule absorption of near infrared radiation which is characteristically for individual molecule configurations. This principle is now being used in the human eye by measuring water molecule oscillation in the anterior chamber to assess the intraocular pressure transcorneally.

Methods 226 eyes from 113 patients were included in this study. Due to the impairment of existing pressure measuring devices, three different measuring techniques as reference methods for average calculation were used. Following standard Goldmann application tonometry, corneal thickness was evaluated and Goldmann readings were adjusted according to Shah. In addition, Dynamic contour tonometry (Pascal Tonometer; SMT Swiss Microtechnology AG, Zurich, Switzerland) was performed.

Results Intraocular pressure readings ranged between 8 and 52mmHg (mean ±SD 17.2±5.8mmHg).Mean discrepancy between near infrared spectroscopy’s pressure values and mean of standard techniques was 4.4±3.04mmHg (Coefficient of correlation r=−0.95, RASECV=2.2).

Conclusion Near infrared spectroscopy showed to be applicable in a real life environment for intraocular pressure measurement. Considering the lack of an objective intraocular pressure measuring device, results of this study suggest a high correlation between near infrared spectroscopy and standard devices.

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Effects of physical exercise on intraocular pressure after the instillation of latanoprost eye drops

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Purpose To study the behavior of intraocular pressure (IOP) after the instillation of latanoprost eye drops and the performance of a physical aerobic exercise.

Methods 20 healthy individuals were included. The initial IOP was measured at 21.00h of the previous night, followed by the instillation of one drop of latanoprost 0.005% in their right eye. 12 hours later (on the peak of the latanoprost effect), the IOP of both eyes was measured again. The individuals performed a physical aerobic exercise of moderate intensity on a bicycle ergometer for about 10 minutes (at 60-80 watts) and the IOP was measured again.

Results The mean IOP of the right eyes was 21.01±1.79mmHg after 12 hours (statistically significant difference, P<0.001). After the completion of the physical exercise the mean IOP of the right eyes was 21.05±1.90mmHg (P=0.001). As regards the left eyes, mean IOP of the right eye before the latanoprost instillation on the follow eye was 14.35±2.10mmHg and after 12 hours 14.25±1.66mmHg (not a statistically significant difference, P=0.733). A post exercise, mean IOP of the left eyes was 12.13±1.50mmHg (statistically significant difference, P<0.001). There was no statistically significant difference (P=0.942) between the two eyes, as regards the magnitude of the IOP reduction following the physical exercise.

Conclusion The instillation of latanoprost does not exclude the IOP reduction caused by physical exercise.

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Finite element model of the cornea for applanation tonometry

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Purpose Intraocular pressure (IOP) measurement is an important parameter in the diagnosis and monitoring of glaucoma. To estimate the IOP with Goldmann applanation tonometry (GAT), a pressure is applied on the cornea to form an flattened circular area of certain size. For normal human corneas the alternating and intraocular pressures are assumed to be equal. However, recently it has been shown that applying pressure is not always equal to true IOP and depends on corneal thickness, curvature and rigidity. Furthermore, different refractive surgeries modify the corneal dimensions and structures thus affecting the accuracy of routine IOP measurement by GAT.

Methods An axisymmetric finite element model of cornea was developed to investigate the dependence of the true IOP on the applanating pressure and corneal biomechanical properties. Cornea was considered as varying in the thickness composite shell, exhibiting orthotropic material behaviour. Parameter nonlinear numerical analysis was performed as internal and applanating pressures were combined to model the applanation tonometry.

Results The effects of variation in each corneal variable on IOP readings was studied. The model shows that GAT is significantly influenced by cornea biomechanical properties, thickness and curvature.

Conclusion The results show a good correlation with different published data, demonstrating that magnitude of error in Goldmann tonometry reading may be clinically significant in some patients.