



Comparison of Intraocular Pressure between Air Puff Tonometer and Goldmann Applanation Tonometer at a Tertiary Eye Care Centre

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Abstract

Purpose: The purpose of this study was to evaluate the role of air puff (AP) tonometer by comparing the measurements of intraocular pressure (IOP) made using this device with those made using a Goldmann applanation tonometer (GAT) at Chittagong Eye Infirmary and Training Complex.

Method: An observational and comparative study was carried out at Chittagong Eye Infirmary and Training Complex from January 2016 to January 2017. Two techniques for IOP measurements using the standard GAT and the non-contact tonometer (NCT) were compared. A total of 400 eyes from 200 patients were included in the study.

Results: The mean IOP as measured by GAT in the right eye was 14.50 ± 5.59 mmHg and in the left eye was 14.87 ± 7.03 mmHg while that as measured by NCT in the right eye was 15.97 ± 6.12 mmHg and in the left eye was 15.94 ± 6.98 mmHg. The mean difference between the two methods of measurement in the right eye was 1.47 ± 0.53 mmHg and the left eye was 1.07 ± 0.05 mmHg. The readings obtained by NCT were higher than those obtained by GAT. There was no statistically significant difference found in IOP measurements between GAT and NCT according to patient's age, gender or laterality of eyes.

Conclusion: There was a significant difference in the measurement of IOP between GAT and NCT. Goldmann applanation tonometry remains the most suitable and reliable method for measuring IOP.

Keywords: Intraocular Pressure; Air-Puff Tonometer; Goldmann Applanation Tonometer

Abbreviations: AP: Air Puff; IOP: Intraocular Pressure; GAT: Goldmann Applanation Tonometer; NCT: Non-Contact Tonometer.

Introduction

Glaucoma is the second leading cause of irreversible blindness worldwide [1]. In the developed and developing countries, a significant proportion of glaucoma usually

presents to eye care facilities in the advanced stages when the optic nerve is already damaged [2,3].

Screening for glaucoma based solely on an IOP > 21 mmHg may miss up to half of the people with glaucoma in the screened population. However, IOP is still seen as a very important risk factor for the development of glaucomatous damage. Although other risk factors affect an individual's susceptibility to glaucomatous damage, IOP is the only

risk factor that can be altered at this time [4]. Applanation tonometry is based on the Imbert-Fick principle, which states that a perfect sphere has its internal pressure equally distributed and that the external force needed to flatten a known area of that sphere is directly proportional to the internal pressure of the sphere [5].

The Goldmann applanation tonometer (GAT) is currently the most popular tonometer available. It consists of a double prism mounted on a standard slit lamp. The GAT represents the gold standard for IOP measurement. With the GAT, the force required to flatten, or appanate, a constant area of the cornea is measured and related to the IOP using the Imbert-Fick principle. The GAT uses an applanation diameter of 3.06 mm and is performed with the patient seated at the slit lamp [6].

Air-puff tonometry is an applanation method using a standardized puff of air to flatten the cornea. This method has the advantage that no topical anesthetic or risk of corneal abrasion is involved [7]. The system consists of a central air plenum flanked either side by a light emitter and a light detector. As the pressure of the air pulse directed to the cornea increases to deform the cornea, the corneal surface behaves like a plane mirror, reflecting light to the detector. Corneal applanation is measured by collecting light reflected from the central cornea [8].

The purpose of this study was to compare the IOP with an air puff tonometer and a Goldmann applanation tonometer at Chittagong Eye Infirmary and Training Complex.

Methods

An observational and comparative study was conducted on patients who presented to the Glaucoma clinic of Chittagong Eye infirmary and Training Complex from January 2016 to January 2017. Exclusion criteria included patients having previous surgical intervention, one-eyed patients, traumatic cases, non-cooperative patients, those with severe visual loss and children less than 8 years of age. Demographic data were documented and statistical analysis was conducted using SPSS 16. The research follows the tenets of the Declaration of Helsinki, and each patient gave his or her informed consent to participate in this study. In case of children, informed consent from their guardian was obtained.

The medical devices used in the study were the NCT Nidek NT 510 and the GAT HS Haag-Streit Diagnostics. For the examination, topical anaesthetic eye drops were used. The medical equipment was calibrated prior to the examination. The IOP of both eyes of each patient were evaluated, first on

the right and then on the left and each eye was used as one isolated data. The NCT measurement was always performed before the GAT measurement to eliminate the effect of ocular massage, which has been described when using the GAT and is absent with the NCT [9]. Each assessment was conducted by a different optometrist who was completely unaware about the findings by the previous assessment.

Results

The study population comprised of 400 eyes from 200 patients. It included 128 males and 72 females with an age range of 8-85 years, and mean age was 49.75 ± 17.04 years. The data collected was classified into three groups according to the IOP measurements by GAT and NCT: Group 1, IOP < 12 mmHg; Group 2, IOP 12-24 mmHg; and Group 3, IOP > 25 mmHg. The differences in readings were calculated. The data were also classified according to the patient's age, gender and laterality.

The data were analyzed using SPSS 16. The mean IOP value as measured by GAT in the right eye was 14.50 ± 5.59 mmHg, with a range of 2-46 mmHg and the left eye was 14.87 ± 7.03 mmHg, with a range of 2-54 mmHg. The mean IOP value as measured by NCT in the right eye was 15.97 ± 6.12 mmHg, with a range of 3-48 mmHg and the left eye was 15.94 ± 6.98 mmHg, with a range of 4-55 mmHg. The mean difference of IOP values between GAT and NCT measurements in the right eye was 1.47 ± 0.53 mmHg and in the left eye was 1.07 ± 0.05 mmHg. The difference in IOP values between the two devices was statistically significant ($P = 0.0001$). This study showed that IOP values measured with NCT were higher than those measured with GAT (Figures 1 & 2).

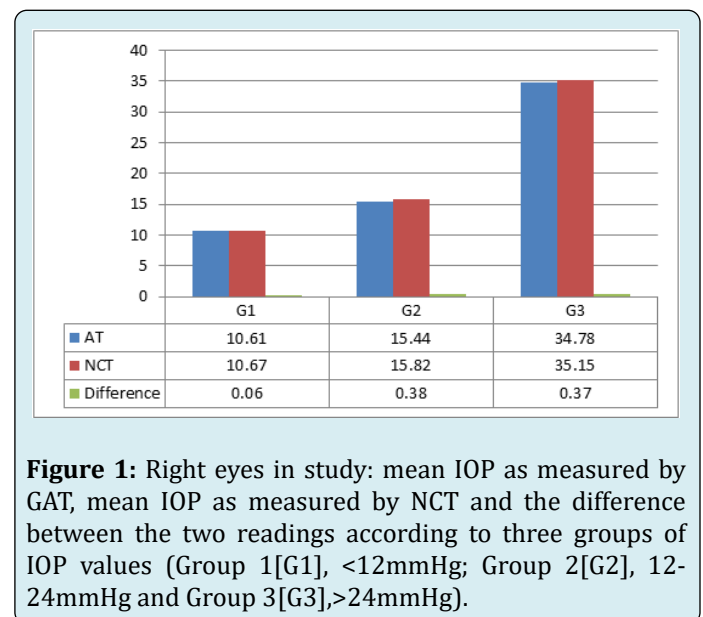


Figure 1: Right eyes in study: mean IOP as measured by GAT, mean IOP as measured by NCT and the difference between the two readings according to three groups of IOP values (Group 1[G1], <12mmHg; Group 2[G2], 12-24mmHg and Group 3[G3], >24mmHg).

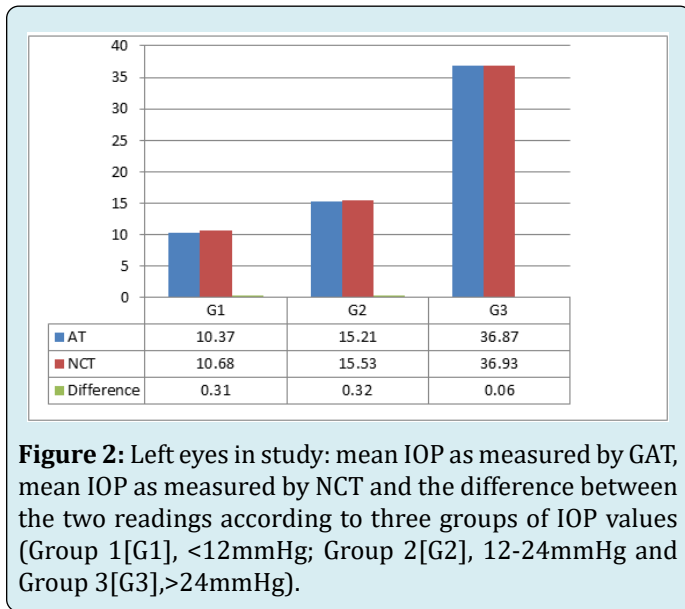


Figure 2: Left eyes in study: mean IOP as measured by GAT, mean IOP as measured by NCT and the difference between the two readings according to three groups of IOP values (Group 1[G1], <12mmHg; Group 2[G2], 12-24mmHg and Group 3[G3], >24mmHg).

Discussion

In the majority of ophthalmic institutes, GAT is the most commonly used and reliable instrument. In addition, it is still considered the gold standard for assessment of IOP [10]. This study showed there was a significant difference in measurements of IOP between GAT and NCT. The readings obtained by NCT were higher than those obtained by GAT in this study. Shah MA, et al. [11] study 2012 reported a significant difference between the mean IOP assessed by GAT and air puff tonometry.

Popovich and Shields evaluated 421 eyes and reported that the air puff was a reliable measurement compared to the GAT within the normal range of IOP. This fact is rarely supported in most of the published studies, where the majority of reports suggest that the GAT is the most consistent method of IOP assessment [12].

Several other studies have compared IOP measurements obtained with GAT and those obtained by non-contact tonometer's. Firat PG, et al. [13] study concluded that non-contact tonometer measurements were higher than those obtained by GATs and that this difference was statistically significant [13]. There was no statistically significant difference found in IOP measurements between GAT and NCT according to patient's age, gender or laterality of eyes.

Conclusion

The GAT remains the most reliable device and is the international gold standard for measuring IOP. Measurements of IOP by NCT are usually higher than those obtained by GAT regardless of the patient's age, gender and laterality of eyes.

Conflict of Interest

The author reports no conflict of interest.

Acknowledgement

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