Original Article

Accuracy of IOP Measured By Non-Contact (Air – Puff) Tonometer Compared with Goldmann Applanation Tonometer

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Purpose: To determine the frequency of accuracy of intraocular pressure (IOP) measured by non-contact (air puff) tonometer compared with Goldmann applanation tonometer.

Material and Methods: This comparative study was done from April 2011 to September 2011, 286 patients between 10 to 72 years of age, both male and females coming to eye OPD for refraction and ocular examination included. Selected patients were explained and after informed consent; intraocular pressure was taken by consultant Ophthalmologist with Goldmann applanation tonometer (Haag – streit AT900) and Air puff tonometer (Keeler PT100) between 8 am to 1 pm.

Results: Air puff tonometer had an overall accuracy of 49.70% to measure intraocular pressure within ± 2 mm Hg difference compared with Goldmann applanation tonometer. Air puff tonometer is more accurate at low pressure range, 54.40% at 10 – 20 mm Hg and accuracy decreases at higher pressure range, 20% at 51 – 60 mm Hg. At all ranges of intraocular pressures Air puff tonometer measured higher (mean 2.87 mm Hg) values than Goldmann applanation tonometer.

Conclusion: Airpuff tonometer is quick, a non-contact method to measure intraocular pressure and is useful for screening purposes but the measurements should be confirmed with Goldmann applanation tonometer for accurate labelling of intraocular pressure.

Intraocular pressure (IOP) is one of the most important parameters in the diagnosis and treatment of glaucoma[1]. Glaucoma has been established as the second leading cause of blindness. The treatment of glaucoma focuses mainly on lowering intraocular pressure (IOP). The target IOP is often set to a level 20% to 30% of IOP reduction, and consequent large IOP reduction beyond 30% or even 40% in cases of advanced glaucoma[2]. The different methods of tonometery are: Goldman Applanation tonometery, Noncontact (air-puff) tonometery, Perkins tonometery, Tonopen tonometery, Transpalpebral tonometery[3].

Goldmann Applanation Tonometer is the method of choice in the optometric and ophthalmological clinical settings. Based on Imbert-Fick principle, the Goldmann tonometer assesses the intraocular pressure by measuring the force necessary to applanate a fixed area of cornea[3].

Air puff tonometry is based on the principle of Applanation, the central part of cornea is flattened by a jet of air to measure the level of IOP[5]. The main advantages of non-contact tonometers are that they are

non-invasive and thus comfortable for the patient with a minimal risk of infection. The performance of non-contact tonometery and the interpretation of results are easier than with Goldmann tonometery. Therefore, IOP screening with non-contact tonometer can be delegated by ophthalmic assistants[3].

The purpose of this study was to evaluate the difference, if any, between IOP measurements taken by a Goldman Applanation Tonometer and those taken by an Air Puff tonometer

MATERIAL AND METHODS

From April 2011 to September 2011 this comparative study was done, 286 patients between 10 to 72 years of age, both male and females coming to eye OPD for refraction and ocular examination included. A complete history was taken from the patients and a thorough ocular examination was done on all selected patients. Patients who have corneal opacity or disfigured cornea, corneal ulceration or inflammation, conjunctivitis or ocular infection, corneal dystrophy, corneal degeneration, keratoconus and pterygium were excluded. Selected patients were explained and after informed consent; two readings of intraocular pressure were taken by consultant Ophthalmologist with Goldmann applanation tonometer (Haag – streit AT900) and Air puff tonometer (Keeler PT100) each, between 8 am to 1 pm.

DATA ANALYSIS

All the data was computer based and SPSS version 10 was used for analysis. Mean and standard deviation were computed for quantitative variables like age and intraocular pressure readings. Frequencies and %age were computed for categorical variables like sex, accuracy of air puff tonometer to measure IOP in stratified ranges of IOP. Effect modifiers like age and genders were controlled by stratification to observe the effect on outcome of accuracy of air puff tonometer. All the data was presented in the form of tables 1, 2 and 3.

RESULTS

In this study, 286 patients; 148 male and 138 female patients were included. The mean ± SD age was 42.965 ± 16.304 years with range of age was 10 years to maximum 72 years. The mean ± SD intraocular pressures were 19.692 ± 9.952 mm Hg with Goldmann

Table 1: Intraocular Pressure with Air - Puff Tonometer (keeler Pt100)

Total	Minimum	Maximum	Mean	Standard Deviation
286	10 mm Hg	58 mm Hg	22.562 mm Hg	± 10.355 mm Hg

Table 2: IOP with Goldmann Applanation Tonometer (Haag - Streit AT 900)

Total	Minimum	Maximum	Mean	Standard Deviation
286	10.00 mm Hg	54.00 mm Hg	19.692 mm Hg	± 9.9520 mm Hg

Table 3: Accuracy of Air Puff Tonometer (Keeler PT 100) in Different Ranges of IOP

Range of IOP (mmHg)	Count and Accuracy %		Total N (%)
	No N (%)	Yes N (%)	
10 - 20	89 (45.6)	106 (54.4)	195 (100)
21 - 30	21 (52.5)	19 (47.5)	40 (100)
31 - 40	18 (64.3)	10 (35.7)	28 (100)
41 - 50	12 (66.7)	6 (33.3)	18 (100)
51 - 60	4 (80.0)	1 (20.0)	5 (100)
Total	144 (50.3)	142 (49.7)	286 (100)

applanation tonometer as shown in table 2 and 22.562 ± 10.355 with air-puff tonometer as shown in table 1. The range of measurement was 10 to 54 mm Hg with Goldmann applanation tonometer and 11 to 58 mm Hg with air-puff tonometer.

The frequency of accuracy of air – puff tonometer within limit of ± 2 mm Hg from Goldmann applanation tonometer was stratified over different ranges of intraocular pressure as 10-20 mm Hg, 21 – 30 mm Hg, 31 – 40 mm Hg, 41 – 50 mm Hg and 51 – 60 mm Hg. The overall frequency of accuracy of air-puff tonometer was found to be 49.70%. This frequency of accuracy of air-puff tonometer was different in different ranges of intraocular pressure as shown in table 3. It was most accurate 54.40% in normal range of intraocular pressure i.e. 10 to 20 mm Hg and accuracy decreased with increasing range of intraocular pressure. The accuracy was only 20% at 51 to 60 mm Hg range of intraocular pressure. The frequency of accuracy of air-puff tonometer was checked over different stratified ranges of age and found no specific pattern of accuracy with age as shown in table 3.

DISCUSSION

More recently, the development of noncontact tonometers has simplified IOP screening. Goldmann applanation tonometer and Air Puff (i.e., noncontact) tonometers are the most common devices for measuring IOP in daily practice. Air Puff tonometers are easier to use and are more convenient, for both the patient and the examiner, than GAT. The GAT is currently the most widely used instrument for measuring IOP[4], and is considered the 'gold standard'[5].

Various studies have been done to assess the accuracy of air puff tonometers in the past. A study conducted by Salim S et al[6] to compare the measurements by the portable, noncontact tonometer with Goldmann applanation tonometry. A total of 98 eyes were examined for IOP. The results showed the mean ± SD intraocular pressure measurements were 15.98 ± 5.48 mm Hg and 15.65 ± 4.26 mm Hg for the PT100 and GAT, respectively. The range of measurements by GAT was from 4 to 29 mm Hg and by PT100 was 7 to 33 mm Hg. The frequency of measurements by the two tonometers that were in agreement by ≤ 3 mm Hg was 92.8%. The drawbacks of this study were limited number of subjects and the most of the measurements were made in normal range of IOP.

In this study the air puff tonometer consistently overestimated IOP than Goldmann applanation tonometer that was also shown in other studies[7]. In contrast some studies have shown that air puff tonomaters returned lower values relative to goldmann tonometer. Yet the other studies[8] conclude that the air puff tonometers overestimated at normal range of IOP and underestimated at high IOPs relative to Goldmann applanation tonometer.

In this study the accuracy of air puff tonometer was higher 54.40% in normal range of IOP 10-20 mm Hg but the accuracy progressively decreased at higher ranges of IOP.

CONCLUSION

Air puff tonometer is quick, a non-contact method to measure intraocular pressure and is useful for screening purposes but the measurements should be confirmed with Goldmann applanation tonometer for accurate labelling of intraocular pressure.

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