Original Article

Comparison Between the Measurements of Intraocular Pressure Readings taken by Pascal Dynamic Contour Tonometry and Goldmann Applanation Tonometry

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ABSTRACT

Objective: To compare the measurements of Intraocular Pressure readings taken by Pascal dynamic contour tonometry and Goldmannapplanation tonometry.
Study Design: Clinical Observational Study
Place and duration of Study: This study was carried out at the Outpatient Department of Ophthalmology, Dow University hospital (Ojha Campus) of Dow University of Health Sciences, Karachi from July 2010 to September 2010.
Materials and Methods: In a prospective single center study, 282 eyes from 141 subjects were examined by three experienced clinicians. The IOP measurements were obtained with PDCT and GAT and difference in intraocular pressure measured by PDCT and GAT was compared.
Results: IOP measurements by PDCT (mean ± SD, 18.66 ±4.68 mmHg) were significantly (P<0.001) higher than GAT measurements (mean ± SD, 17.84 ± 4.21 mmHg) correlating significantly with each other (r^2 = 0.842, P-value< 0.001)
Conclusion: PDCT allows the suitable and reliable IOP measurements. IOP measurements by PDCT are highly concordant with IOP readings from GAT. PDCT seems to be an appropriate method of tonometry for routine clinical use.
Key Words: Intraocular pressure, Pascal dynamic contour tonometry, GoldmannApplanation tonometry.

INTRODUCTION

 Elevated intraocular pressure(IOP) is an important risk factor in the development and progression of glaucoma.[1,2] Reduction of IOP is the only modifiable risk factor and the established treatment for Glaucoma.[3] Accurate and precise measurement of IOP has an important role in the diagnosis and follow up of patient with glaucoma and ocular hypertension. Goldmann Applanation tonometry(GAT) is considered the gold standard method of tonometry and is currently the most common method of measuring IOP.[4] GAT based on modified Imbert Fick Principle, in which Goldmann and Schmidt determined that surface tension and corneal rigidity would nullify one another and could therefore be ignored when using a tonometer head of 3.06mm, in diameter and a normal Central Corneal thickness (CCT) of 520µm.[5] GAT tends to underestimate IOP in eyes with thin CCT and overestimate IOP in eyes with thick CCT.[6-10]The Pascal dynamic contour is a non-applanation contact tonometer, supposed to measure IOP largely independent of structural properties of Cornea.[11] Pascal dynamic contour tonometry(PDCT) principle is based on contour matching,which assumes that if the eye were enclosed by a contoured,tight fitting shell,the forces generated by IOP would act on shell wall. Replacing part of the shell-wall with a pressure sensor would enable measurement of these forces and therefore the IOP.PDCT has a specially designed cylinder, contour matched pressure sensing tip with a concave contact surface of 10.5mm radius, which approximates to the shape of a normal cornea when pressure on both sides is equal.[12]The probe is placed adjacent to the central cornea and the integrated piezoresistive pressure sensor automatically begins to acquire data, measuring IOP 100 times per second. A complete measurement cycle requires about 8 seconds of contact time. During the measurement cycle, audio feedback is generated, which helps the clinician to maintain proper contact with the

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cornea.[13,14]The device also measures the variation in pressure that occurs with the cardiac cycle.

The purpose of this study was to compare the IOP readings obtained by the PDCT and GAT in the eyes of normalpatients. To the best of our knowledge, this study is first of its kind in Pakistan and has not been published so far in Pakistan.

MATERIALS AND METHODS

We reviewed IOP values of 282 of 141 patients (M: F= 183:99, in the age range 16- 80 years) measured using both instruments. The IOP measurement was first obtained by GAT followed by IOP measurement with PDCT. All patients underwent 5 tonometric measurements (2GAT readings, followed by 3 PDCT readings). After each GAT measurements, a rest period of 3 minutes was allowed to minimize the tonographic effects of GAT. The mean IOP reading for each measurement method was recorded. The right eye was always measured first. After application of topical anesthesia to the cornea, a paper stripe impregnated with fluorescein was used to stain the precorneal tear film before IOP measurement. GAT was performed using a slit lamp (Haag-Streit, Koeniz, Switzerland) with a tonometer calibrated according to the manufacturer's guideline. After the GAT readings, the IOP was measured with PDCT. The PDCT (pascal@ dynamic contour tonometer; Swiss Microtechnology AG, Port, Switzerland) is mounted on the slit lamp. A beeping sound is emitted by the device when the tip is in contact with the cornea and correctly positioned to take the IOP measurement and then the tip is lifted from the eye. The liquid crystal display (LCD) will generate the IOP and ocular pulse amplitude(OPA) value (in mmHg) and a quality Score 'Q'. The Q value is graded from 1 to 5 (Q1 is optimum; 2 and 3 are acceptable; 4 and 5 unacceptable). Q4 and Q5 were not included in our study. Three readings were taken and the mean value was obtained from each subject. The mean IOP per group was calculated for both GAT and PDCT, and the differences between these mean values were compared in each group.

Data was analyzed using SPSS software version 16. Continuous variables were compared using the t-test. Pearson Correlation coefficient was used to compare GAT and PDCT values. A Pvalue less than 0.05 was considered statistically significant.

RESULTS

The study included 282 healthy eyes, 183(64.9%) eyes were of male whereas 99(35.1%) eyes were of female. The mean ± SD of age was 44.58 ± 16.60 (range, 16-80 years) [Table I]. IOP values measured by GAT ranged from 9-24 mmHg (Mean=17.84 ± 4.21 mmHg) and PDCT ranged from 11.28-22mmHg(Mean=18.66 ± 4.68mmHg) with P value<0.001[Table 2].There was a strong correlation between GAT IOP and PDCT IOP

(r^2=0.842,P value<0.001) using Pearson correlation analysis.

Table No.I: Characteristic of Study Population (n=282)

Age, years	
Mean	44.58
SD	16.60
Range	16 – 80
Sex	
Male	183
Female	99

Table No.2: GAT IOP and DCT IOP Measurement in Study Population

	GAT (mmHg)	DCT (mmHg)	DCT – GAT
Mean	17.84	18.66	0.82
SD	4.21	4.68	0.47
Min	9	11.28	2.28
Max	24	22	2

DISCUSSION

Extensive studies are available on comparison between the IOP taken by PDCT and GAT. However, to our knowledge there is no study in Pakistan so far to compare the IOPs by PDCT and GAT. In our study on 282 healthy subjects, IOP readings obtained with the PDCT have shown high concordance with IOP readings obtained by GAT. IOP readings obtained by PDCT were around 0.82 mmHg higher than the readings obtained by GAT (18.66 ± 4.68 mmHg Vs 17.84 ± 4.21 mmHg). These findings are in concordance with those of several previous studies comparing measurements with the two tonometers in healthy eyes. The study conducted by Shneider and Grehn[15] on 100 healthy eyes reported that IOP measured by PDCT was higher than IOP measurement by GAT by an average of 2.34, and showing good correlation between PDCT IOP and GAT IOP(r^2 =0.693).The similar study conducted by Kaufmann etal[12] on 228 healthy eyes reported that IOP measured by GAT was lower than IOP measurement by PDCT by an average of 1.7 mmHg.Lee J etal[16] reported the significant correlation between IOP measurement by GAT and DCT(r^2=0.853,P<0.001).Pache etal[17] conducted study on 100 healthy eyes reported that PDCT IOP was higher than GAT IOP by an average of 1. Francis etal[18]also reported that IOP measured by GAT was lower than IOP measured by PDCT by an average of 1.7 mmHg and shown good concordance between the two tonometers. Several other studies[19-21] shown that PDCT IOP was higher than GAT IOP with significant correlation between the two tonometers.

The result of our study is quite similar to all above discussed studies demonstrating that there is significant correlation between IOPs measured by PDCT and GAT.

CONCLUSION

In healthy eyes, the PDCT allows suitable and reliable IOP readings and have an excellent concordance with measurements obtained by GAT. PDCT measurements are easy to perform and well tolerated by patient. PDCT seems to be an appropriate method of tonometry for routine clinical use.

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