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COMPARISON OF INTRAOCULAR PRESSURE OBTAINED BY ICARE REBOUND TONOMETER VERSUS NONCONTACT TONOMETER IN CHILDREN

Ophthalmology

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ABSTRACT

OBJECTIVE :To compare intraocular pressure(IOP) measurement in children using rebound tonometer (ICARE) & noncontact tonometer (NCT).. **METHODS:** A total of 160 eyes of 80 children from varied age group were included. IOP was measured both by ICARE & NCT without anaesthesia. A successful outcome was defined as the measurement of the IOP in both eyes. **RESULTS:** Bland – Altman plot analysis showed that there is no systematic difference between the measurements with both instruments .IOP was successfully measured in 64children(80%) by ICARE and 50children (62.5%) by NCT(McNemar test;P<0.001). **CONCLUSIONS:**Icare is easy-to-use portable tonometer. Below the age of 6 years, measurement of the IOP using Icare was better tolerated as compared with the NCT.

KEYWORDS

Intraocular pressure, noncontact tonometer, icare tonometer

I.INTRODUCTION

Juvenile glaucoma may occur as isolated disease or in association with other ocular or systemic disorders such as aniridia, anterior segment dysgenesis, sturge-weber syndrome.[1]It may also be acquired after infantile cataract surgery or trauma to anterior segment of eye.[2-5]A reliable assessment of intraocular pressure (IOP) is important to monitor children at increased risk for glaucoma.IOPmeasurment is also important to assess effectiveness of glaucoma treatment as it is difficult to evaluate visual fields and subtle changes in optic disc morphology in young children.Practically, general anaesthesia is often required in young children.

A variety of tonometers are used to measure IOP in children. Goldmannapplanation tonometry(GAT) has been the most widely accepted means of measuring IOP since its introduction in 1957.[6] Its has the disadvantage of requiring that the patient be positioned at a slit lamp biomicroscope and topical anaesthesia instillation is also required.Young children often do not tolerate GAT.

Noncontact tonometry follows the same principle as GAT, but it uses a puff of air to flatten the cornea.[7] Although it does not require topical anaesthesia, the puff of air can frighten a young child.The working principle is force of airjet increases rapidly and linearly with time. It also emits a collimated beam of light that is reflected from the central cornea and received by a photocell.When an area of the cornea 3.06mm in diameter is flattened, the light reflected to the photocell is maximum.The time required to produce peak reflection is directly proportional to force of the airjet and to counterbalancing IOP.

The rebound tonometer(Icare) is a hand held instrument consisting of a magnetised steel wire shaft covered by a plastic cap that propels a light ,disposable probe (26.5mg)at a speed of 0.25 to 0.30 m/sec at the cornea.[8]The probe is propelled from the tonometerby an electric-pulse generator that creates a magnetic field.After the probe strikes the cornea,it rebounds back into the instrument, causing voltage change that is detected by solenoid inside the tonometer & change in magnetic field, which is expressed as IOP.

II.MATERIALS AND METHODS

The study was a hospital based, cross sectional, comparative study. It was conducted in the department of ophthalmology ,VSSIMSAR,Burla. A total of 160 eyes of 80 children of varied age group were included IOP was measured both by ICARE & NCT without anaesthesia. A successful outcome was defined as the measurement of the IOP in both eyes. The participants were explained the details of the study, examination procedure and the time required for the same.

Exclusion criteria - patients having corneal pathology (e.g.corneal epithelial defects, corneal stromal scarring, and corneal edema).

IOP was recorded first using Icare. Patient is comfortably seated facing the examiner & asked to maintain a straight gaze. Icare tonometer is placed in front of the examining eye (right eye followed by left eye)&the tip of the probe is kept 3to 10mm from the cornea & a series of 6 readings are obtained.The device automatically eliminates the highest and lowest reading &averages the 4 remaining readings.This was followed by recording IOP, using Noncontact tonometer.NCT required three measurements on each eye and a reported value was calculated internally by the instrument using a proprietary algorithm.

Stastistical analysis was done using MedCalc version 18.11.3 software. Associations between differences and means were analyzed using Bland-Altman plots.Differences of 1.96 standard deviations from the mean were used. For clinical purposes, a difference not exceeding 3mmHg between the two measurements was defined as a priori & limits of agreement was compared to it.

III.RESULTS

The study included 160 eyes and the age of children ranged from 1-12 years, with mean age of 6years.Age& sex did not have a significant relationship with the iop measured with any device.The mean iop measured by both the tonometers in right eye and left eye are mentioned in table1below.

Table1: Mean± Standard deviation(SD) of IOP in mmHg of both

Tonometers	RE	LE
Icare tonometer	15.2±1.74	15.48±1.79
Noncontact tonometer	15.34±1.46	15.40±1.69

The Bland Altman plot analysis of IOP by I Care& NCT was carried out using MedCalc software and is depicted in figure 1&2. X Axis shows Mean of IOP with I care& NCT and Y Axis shows difference of IOP with I care& NCT. In RE,the mean difference was -0.1(95% CI, -0.42 to 0.14), lower limit was -2.1(95% CI ,-2.5 to -1.6), upper limit was 1.8 (95% CI, 1.3 to 2.3), coefficient of repeatability was 1.94 (95% CI, 1.6 to 2.4) and correlation coefficient ,r = 0.82(95%CI, 0.71 to 0.9), P< 0.0001. In LE, the mean difference was 0.1(95% CI, 0.2 to 0.36), lower limit was -1.9(95% CI, -2.3 to -1.37), upper limit was 2.0(95% CI, 1.53 to 2.5), coefficient of repeatability was 1.92(95% CI, 1.6 to 2.4) and correlation coefficient ,r = 0.84 (95% CI, 0.73 to 0.9), P< 0.0001. The 95% agreement range(limits of agreement) of iop with Icare and NCT was from -2.1 to 1.8 in RE & -1.9 to 2.0 in LE. A significant correlation was observed between NCT and Icare.

The zero line of equality falls within the confidence interval which indicates that there is no much systematic difference between the measurements taken with both tonometers. The diagram also shows that most of the measurements fall within the mean of measured

values. Thus it can be concluded that there is significant agreement between IOP measurements with rebound tonometry& noncontact tonometry. The iop was successfully measured in 64(80%) children using rebound tonometry & in 50(62.5%) children using noncontact air- puff tonometry (McNemar test;P< 0.001), shown in table2 and represented in pie chart.

Table2: Success rate in measuring IOP by ICARE & NCT

Tonometer	Number of children(N-80)	Success rate %
ICARE	64	80
NCT	50	62.5

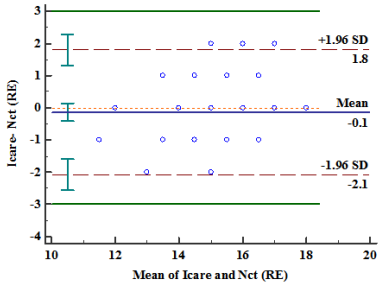

Fig1: Bland Altman plot analysis of IOP by I Care& NCT in RE

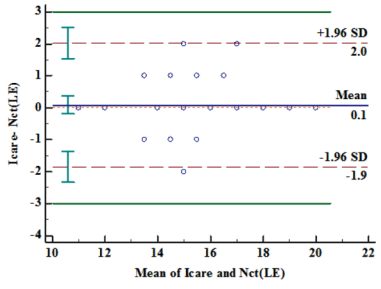

Fig2: Bland Altman plot analysis of IOP by I Care& NCT in LE

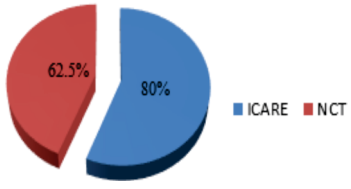

Fig3:Pie-chart representation of success rate%

IV. DISCUSSION

In the present study, there was no significant difference between IOP measured with icare rebound tonometer and noncontact tonometer. This study compared the iop measurement performance in both Icare& NCT. The success rate is higher in children measured with Icare rebound tonometer compared with NCT: 80% vs. 62.5% respectively(P<0.001).

Similar study conducted by Kageyama et al.9 compared iop in 180 normal healthy children using rebound tonometry &NCT.The mean age of the children was 6.4yrs(0.5-15 yrs).The iop was measured successfully in 160 children (88.9%) using Icare rebound tonometer &in 130 children (72.2%) using NCT.The mean iop was 0.90 mmHg lower in the right eye & 1.18 mmHg lower in left eye using rebound tonometry.The success rate markedly higher in children 3yrs of age & younger using icare compared with NCT:79% vs.30%, respectively.(P <0.001).The success rate was also higher in 4 to 6yrs of age using icare compared with NCT:86% vs. 71%, respectively (P=0.025).

In a study by Lundvall et al.10 IOP was measured successfully (2 or more reading) using rebound tonometry 41 of 47 infants(87%) seated on their parent's lap.

In another study, in Bland-Altman analysis revealed no biases between Icare and NCT with 95% limits of agreement of -4.46-4.80 in healthy eyes & have no statistical significant , concluding an inter-device agreement between the two instruments.

A study by Sahin et al.11conducted to establish the intraobserver and interobserver reliability of the rebound tonometer (RT) in healthy schoolchildren and to test patient tolerance in an unanesthetized eye, they concluded that measurement of IOP with the RT is a highly reproducible method in school children showing high intraobserver and interobserver correlation and it seems to be very comfortable when performing IOP measurements in school children without an anesthetic. The impact on the eye is so gentle that in a majority of the cases it does not evencause an eye blinking reflex. Thus, it should be a method for IOP measurement in schoolchildren that is rapid, reliable, operator independent, and has low variability

V. CONCLUSION

IOP values with Icare tonometer is in close agreement with the NCT in majority of children.Icare is easy-to-use portable tonometer .Its measurement are reproducible with fast learning curve.IOP measurement by rebound tonometry is better tolerated than NCT in children (especially <6 years).

VI. CONFLICT OF INTEREST: No conflict of interest was declared by the authors.

VII. FINANCIAL DISCLOSURE: The authors declared that this study received no financial support

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