

Tono-pen measurement of intraocular pressure under topical anaesthesia in full term normal newborns

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Abstract

• **AIM:** Tono-pen measurement of intraocular pressure (IOP) under topical anaesthesia in full term normal newborns.

• **METHODS:** The IOP measurements were taken using Tono-pen XL tonometer under topical anaesthesia in 150 newborns (300 eyes) within 24h after birth, over a period of three months, in a university hospital. Gender, gestation period, mode of delivery and birth weight of newborns were noted from medical records.

• **RESULTS:** There were 70 males and 80 females. All babies were Malays. The IOP measurements were taken between 12 and 24h after birth. The gestation period of babies ranged between 37 and 41 weeks; 118 babies were delivered by spontaneous vaginal delivery and 32 by caesarian section. The birth weight of babies ranged between 2.1 and 4.3kg. The mean IOP of 300 eyes was 15.99 ± 2.79 mmHg (range 8–22). There was no statistically significant difference of mean IOP and gender, laterality of eye, type of delivery, gestation age, or birth weight of newborns.

• **CONCLUSION:** The IOP in full term normal newborns was 16mmHg. Tono-Pen appears to be ideal instrument for taking IOP in newborns because of its small size and easy handling.

• **KEYWORDS:** intraocular pressure; newborn; Tono-pen

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INTRODUCTION

Measurement of intraocular pressure (IOP) with applanation tonometer in the newborns is quite difficult because of small eyeballs, their inability to keep the eyes open, and the relatively large size of the prism of the tonometer. Routinely, the IOP is measured under general anaesthesia in infants and young children using eye speculum.

In babies of one day age (24h after birth), the published data on values of IOP are limited; 25.8mmHg (range 12-30.4) by Giles^[1] and 21.7mmHg (range 15.9-29) by Kornblueth *et al*^[2]. An eyelid speculum is routinely used all over the world during examination of eye and for doing minor procedures in children/adults under general anaesthesia. Epley *et al*^[3] have reported that use of an eyelid speculum during the procedure of IOP measurement in children increases the pressure by an average of 4mmHg.

Pubmed literature search did not reveal any data on intraocular pressure in newborns from Asian countries. Therefore, we carried out the present study to measure the IOP with Tono-pen under topical anaesthesia in full term normal babies born in a university hospital in Malaysia.

SUBJECTS AND METHODS

This observational cross sectional study was conducted over a period of three months in the postnatal ward of Hospital University Sains Malaysia, Kubang Kerian, Malaysia. After explaining the purpose and procedure of measuring IOP, consent was taken from the mother of baby in all the cases.

The IOP was measured with Tono-Pen XL tonometer, within 24h after birth. All the instructions given in the booklet provided by the manufacturer of Tono-Pen (Medtronic Ophthalmic Incorporation, Jacksonville, Florida, USA) were strictly followed. The measurements were taken during office hours between 3 and 5pm, under topical anaesthesia without using eyelid speculum.

The baby was put on the examination couch in the ward with usual dress. One drop of proparacaine eye drops 0.5% was put in each eye for two times at one minute interval. The instrument was calibrated daily before use, and a new latex membrane was placed on the transducer tip for each patient. The eyelids of the baby were separated gently with the thumb and fore finger and the operator touched the center of cornea with the Tono-Pen tip several times until a reading was displayed. A pacifier was used for babies, whenever needed.

After the reading was taken, ciprofloxacin eye drops were put in both eyes. The gender of the baby, gestation period, mode of delivery and birth weight were noted from the medical records.

The reading shown at 5% bar of the liquid crystal display (standard deviation of the valid measurement is 5% or less of the number shown) on the instrument was taken as reliable reading. If the measurement showed at different numbers on the liquid crystal display, the procedure was repeated until it is shown at 5% bar.

All the measurements of IOP were taken by one person (Rosnita A). Babies having any ocular abnormalities or neonatal problems were excluded from the study. Similarly, babies of diabetic mothers were not included in the study. This research project was approved by ethics committee of the university hospital.

The data was analyzed using Statistical Package for Social Sciences (SPSS) programme. The two-tailed Student's *t*-test was used to test the significance of mean IOP between males and females, right eye and left eye, spontaneous vaginal delivery and caesarian section delivery. One way Analysis of Variance (ANOVA) test was used to test the significance of mean IOP among gestation period, and birth weight. The *P* value of < 0.05 was taken as significant.

RESULTS

The IOP measurement was performed in both eyes of 150 newborns (70 males and 80 females). All babies were Malays. The IOP measurements were taken between 12 and 24h after birth. The gestation period of babies ranged between 37 and 41 weeks; 118 babies were delivered by spontaneous vaginal delivery and 32 by caesarian section. The birth weight of babies ranged between 2.1 and 4.3kg.

The mean IOP of 300 eyes was 15.99 ±2.79mmHg (range 8-22). The IOP was less than 10mmHg in 5 eyes and more than 20mm in 8 eyes. There was no evidence of congenital glaucoma in these 8 eyes (corneal diameter, slit lamp examination of cornea and fundus examination were normal).

The IOP was same in both eyes in 65 newborns. The difference of IOP in between two eyes was 1mmHg in 23 newborns, 2mmHg in 34, 3mmHg in 16 and 4mmHg in 12 newborns.

The mean IOP in males and females, right and left eye, different gestation periods, different types of deliveries and in different birth weights of newborns is shown in Table 1. There was no statistically significant difference between mean IOP and gender, laterality of eye, type of delivery, gestational age, or birth weight of newborns.

DISCUSSION

Mentor Tono-Pen XL instrument is a precision electronic tonometer which measures IOP. The body of the instrument is specially designed to fit comfortably into the user's hand,

Table 1 Showing relation between different clinical parameters and IOP in full term newborns (n=150)

Clinical parameters	<i>n</i>	Mean IOP±SD (mmHg)	<i>P</i>
Gender			
M	70	15.54±2.90	0.065
F	80	16.38±2.65	
Eye			
Right	150	16.18±2.93	0.258
Left	150	15.79±3.19	
Gestational age(weeks)			
37	15	15.70±1.92	0.647
38	35	15.44±1.50	
39	43	15.93±2.53	
40	25	16.60±2.86	
41	32	16.31±3.13	
Type of delivery			
Spontaneous vaginal	118	15.99±2.81	0.985
Caesarian section	32	15.98±2.75	
Birth weight (kg)			
2.01-2.50	17	16.00±1.87	0.933
2.51-3.00	60	15.97±3.05	
3.01-3.50	53	15.87±2.71	
3.51-4.00	18	16.47±3.09	
4.01-4.50	2	15.25±2.47	

facilitating fast and accurate measurements. This tonometer contains a solid state strain gauge with 1mm transducer tip. Utilizing a sophisticated "single chip" microprocessor and electronics housed in the body of the instrument, the waveform is produced by each touch on the anaesthetized corneal surface. The microprocessor immediately analyzes this waveform and emits an audible click when a reading is accepted. The operator repeats these small gentle pressure movements against the corneal surface until four valid readings are accepted and averaged. The instrument emits an audible bleep and provides the final reading along the percent variability between the highest (20%) and lowest (5%) readings. The reading shown at 5% bar of the on the instrument was taken as reliable reading. If the measurement is shown at different numbers on the liquid crystal display, the procedure was repeated until it is shown at 5% bar. The instrument is calibrated daily before use, and a new latex membrane (Ocu-Film) is placed on the transducer tip for each patient. Tono-Pen is an electronic applanation tonometer, easy to use, portable, light weight, battery operated. The measurements are taken quickly and are closely correlated with Goldmann applanation tonometer. IOP can be measured in any position of the patient in the hospital(clinic, ward, operation theater) or in nursing homes^[4].

We did not use eyelid speculum during IOP measurement in our study, based on the earlier report by Epley *et al*^[3] that use of eyelid speculum during the procedure increased

Table 2 Showing intraocular pressure (IOP) in the full term newborns reported in the literature

Author	Age of patients	Anaesthesia	Tonometer	Mean IOP (range) (mmHg)
Giles ^[1]	1h	Topical	Indentation	25.8 (12-30.4)
Kornblueth <i>et al</i> ^[2]	5-24h	Diethyl ether	Indentation	21.7 (15.9-29)
Radtke & Cohan ^[7]	19-173h	Topical	Applanation	11.4±2.4 (6-17)
Pensiero <i>et al</i> ^[8]	2-3d	Nil	Noncontact	9.59±2.3
Gotoh & Kitazawa ^[9]	25h-8d	Fluothane	Indentation	14.7 (9-22)
			Applanation	13.4 (7-22)
Horven ^[10]	4h-10d	Topical	Indentation	16.3 (10.2-24)
Uva <i>et al</i> ^[11]	1 week	Topical	Tono-Pen	17±2.6 (12-22)
Present study	12-24h	Topical	Tono-Pen	15.99±2.79 (8-22)

average 4mmHg of IOP in children. We used topical anaesthesia for taking IOP measurements and there was no problem during the procedure with any of the babies. The main advantage is that general anaesthesia is avoided which saves time and efforts for parents as well as doctors. The time taken for IOP measurement is also quicker than any routinely used applanation tonometer. Thus, use of Tono-Pen for taking IOP under topical anaesthesia is very helpful in children either in first visit or in follow up visits.

Gandhi *et al*^[5] reported that Tono-Pen XL mean IOP values in both eyes are slightly higher (1.4 ±2.3mmHg) than Goldmann applanation tonometer. However, Iester *et al*^[6] reported that when the values obtained by first the Goldmann tonometer and then the Tono-Pen XL were compared with those obtained by first the Tono-Pen XI and then the Goldmann tonometer, no significant difference was found between the two groups. They concluded that Tono-Pen XL (Mentor) provides similar results to Goldmann tonometer in 62% of the cases and the reading was slightly less accurate than Goldmann tonometer for extreme values. Nevertheless the precision is good enough for the purpose of adequate screening.

The intraocular pressure in Malaysian full term normal newborns (mean 15.99±2.79mmHg, range 8-22) is provided through our study, and it is the first report of IOP in newborns from Asia. The value of IOP observed in our study is higher than three studies and lower than four studies reported from different parts of the world^[1,2,7-11]. Moreover, the values of IOP less than 10mmHg and more than 20mm Hg in few eyes observed in our study, also have been reported by earlier investigators in the literature (Table 2).

In our study, there was no statistically significant relation between IOP and gender, laterality of the eye, gestational age type of delivery or birth weight of newborns (Table 1). A similar observation (no relation between IOP and gender,

gestational age or birth weight) has been reported by Pensiero *et al*^[12] in full term infants. Tono-Pen appears to be an ideal instrument for taking IOP in newborns because of its small size, easy handling in any scenario.

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Conflicts of Interest: Reddy SC, None; Rosnita A, None.

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