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Intraocular pressure estimation using human and Schiotz tonometry conversion tables in glaucomatous eyes of dogs: a comparative study with applanation tonometry

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In a prospective study, intra-ocular pressure (IOP) was measured in 13 glaucomatous eyes of dogs with an applanation tonometer, and the Schiotz indentation tonometer. The readings obtained with the Schiotz tonometer using 5.5 g and 7.5 g weights were converted to IOP estimates using the human and canine calibration tables, and compared with each other and to those obtained with the applanation tonometer. IOP estimates using 7.5 g weight and converted with canine and human calibration tables, and 5.5 g weight and converted with canine calibration table were significantly higher than those obtained with applanation tonometer. IOP estimates using Schiotz 5.5 g weight and converted using human calibration table did not vary significantly than those obtained with the applanation tonometer. Measurements obtained with the Schiotz tonometer, using either weight, and converted using the human calibration table were significantly lower than those obtained with either weight and the canine calibration table.

Key words: Applanation tonometer, Calibration table, Dog, Glaucoma, Schiotz tonometer.

Estimation of intraocular pressure (IOP) in canines, in India, is most frequently performed with the Schiotz indentation tonometer. The scale readings obtained with the Schiotz tonometer are then converted to estimates of IOP in mm of Hg using experimentally derived canine calibration table (Gelatt, 1991). Human calibration table developed by Friedenwald (Friedenwald, 1957) is also used. Comparison of these two tables reveals that the canine table gives a much higher estimate of IOP than the human table to the same Schiotz scale readings.

The purpose of this study was to compare Schiotz scale measurements obtained from glaucomatous eyes and converted to intraocular pressure estimates using the canine and human calibration tables, with those obtained with the most accurate Tonopen applanation tonometer (Tonopen-Vet, Reichert Inc., New York, USA).

Materials and Methods

Thirteen dogs diagnosed to be suffering from glaucoma in one eye each and not being given medications to alter IOP, formed the subject of this study. After the application of a topical anaesthetic-Proparacaine (P-Caine, Hi Care Pharma, Chennai) to the 13 glaucomatous eyes, Tonopen- Vet was applied first to each eye followed, 10 min later, by Schiotz tonometer, using the 5.5- and then the 7.5-g weights. The mean of three Schiotz scale readings obtained with each weight were then converted to an estimate of actual IOP by the use of Friedenwalds's human calibration table and the canine calibration table. The Tonopen-Vet was used first to measure the IOP, because applanation tonometer generally has a negligible tonographic effect (Schmidt, 1961) that could result in alterations in IOP measured by subsequent tonometers (Miller and Pickett, 1992). Both tonometers were used in accordance with manufacturer's recommendations, using as little restraint as possible in as calm a dog as possible. To avoid operator error, all IOP measurements were taken by the same person.

The means, mean differences and the absolute values of the differences were analysed using a paired Student "*t*" test.

Results and Discussion

Intraocular pressure measurements with Schiotz indentation tonometer using 5.5 g and 7.5 g weights converted with Canine calibration table ranged from 33.9 to 56.1 mmHg (Mean±SD= 42.62±7.09 mmHg) and 35.1 to 59.4 mmHg (Mean±SD= 43.95±7.35), respectively, but those converted with Human Calibration table ranged from 20.6 to 41.5 mmHg (Mean±SD= 28.58±6.62 mmHg) and 20.1 to 42.5 mmHg (Mean±SD= 27.76±6.49), respectively. Tonopen-Vet estimated

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IOP in the range of 22 to 44 mm Hg with a mean of 29.46±6.91 mm Hg. The estimates of IOP using either weights and converted with the canine calibration table were significantly higher (P<0.001) than those obtained with Tonopen-Vet (Table 1; Fig. 1), while the estimates of IOP using 7.5 g weight and converted human calibration table were significantly lower (P<0.01) than those obtained with Tonopen-Vet. The estimates of IOP using Schiotz 5.5 g weight and converted using human calibration table did not vary significantly (P>0.05) from those obtained with Tonopen-Vet (Table 1; Fig. 2). Estimates of IOP using either weight and human calibration table were closer to those obtained with Tonopen-Vet (Fig. 2).

Measurements obtained with the Schiotz tonometer, using either weight, and converted using the human calibration table were significantly (P<0.01) lower than those obtained with either weight and the canine calibration table (Table 1). The IOP measurements obtained with the 5.5 g and 7.5 g weights were significantly different when compared with each other using the canine calibration table (P<0.001), and when compared with each other using the human calibration table (P<0.001). When the canine calibration table was used, all the 13 glaucomatous eyes had an IOP=30 mm of Hg for the 5.5 and 7.5 g weights; only four of the 13 glaucomatous eyes had IOP=30 mm of Hg for both the weights, when human calibration table was used (Fig. 2).

Table 1: Clinical comparison of Tonopen- Vet and Schiotz tonometers in 13 glaucomatous eyes

	Mean±SD (mmHg)	Range (mmHg)
Tonopen-Vet	29.46±6.91	22 to 44
Schiotz-Canine		
5.5 g. wt.	42.62±7.09**	33.9 to 56.1
7.5 g. wt.	43.95±7.35**	35.1 to 59.4
Schiotz-Human		
5.5 g. wt.	28.58±6.62**	20.6 to 41.5
7.5 g. wt.	27.76±6.49**	20.1 to 42.5

**Significantly (P<0.001) higher than measurements obtained with the Tonopen-Vet.

The difference between measurements made with the 5.5 g and 7.5 g weights using the human calibration table was 0.82 mm of Hg, while it was 1.33 mm of Hg using canine calibration table. The mean of the differences of the IOP measurements using 5.5 g and 7.5 g weights converted using canine calibration table was significantly higher (P<0.0001) than that obtained using human conversion table (Table 2).

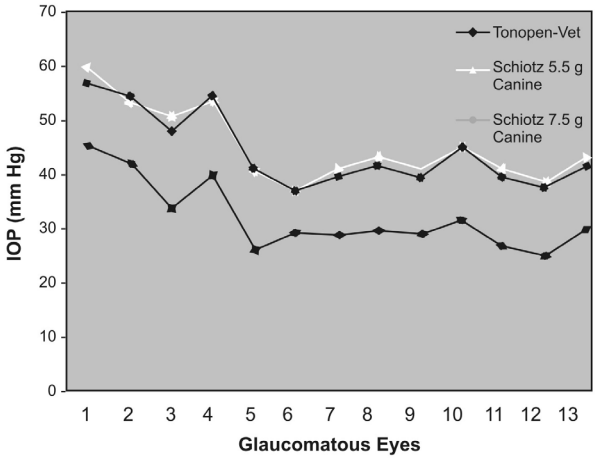

Fig. 1: Comparisons of measurements obtained from 13 glaucomatous eyes with the Tonopen-Vet applanation tonometer to those with Schiotz tonometer using 5.5 g and 7.5 g weight and converted with the canine calibration table. Notice that Schiotz measurements converted with the canine calibration table always overestimated those obtained with the Tonopen-Vet tonometer.

The canine calibration table appeared not to be clinically reliable for dogs with glaucomatous eyes since the estimates of IOP obtained with Schiotz tonometer using either weights and converted using the canine calibration table were significantly higher than those obtained with the more reliable and accurate Tonopen-Vet tonometer. But, the

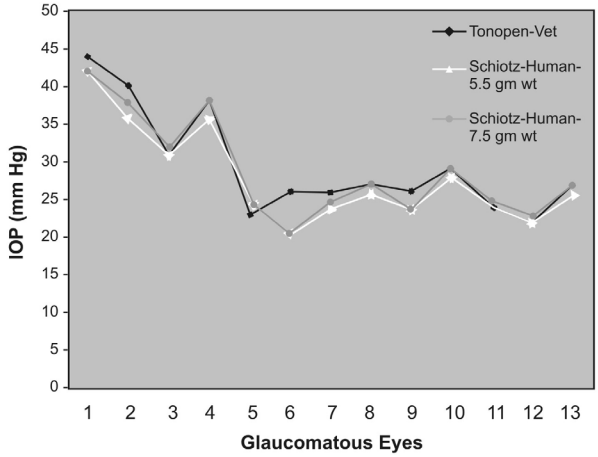

Fig. 2: Comparisons of measurements obtained from 13 glaucomatous eyes with the Tonopen-Vet applanation tonometer to those with Schiotz tonometer using 5.5 g and 7.5 g weight and converted with the human calibration table. Notice that Schiotz measurements using either weight and converted with the human calibration table were closer to those obtained with the Tonopen-Vet tonometer.

Table 2: Comparison of the differences and the absolute value of the differences in measurements obtained with Tonopen- Vet *vs* Schiotz tonometer, using the 5.5 g or 7.5 g weights and converted using human or canine calibration table.

		Comparison			
		Tonopen- Vet *vs* Schiotz 5.5 g. wt.		Tonopen-Vet *vs* Schiotz 7.5 g. wt.	
		Human calibration table	Canine calibration table	Human calibration table	Canine calibration table
Difference	**Mean±SD** (mm Hg)	0.88±1.78	– 13.16±1.95 **	– 1.70±1.78	– 14.49±2.18#
	Range	**– 1.4 to 5.4**	**– 15.3 to –7.9**	**– 0.8 to 5.9**	**– 18.6 to – 9.1**
Absolute difference	**Mean±SD** (mm Hg)	1.32±1.47	13.16±1.95	1.82±1.64	14.49±2.18
	Range	**0 to 5.4**	**7.9 to 15.3**	**0.1 to 5.9**	**9.1 to 18.6**

**Significantly different (P<0.0001) than the human calibration table. #Significantly different (P<0.0001) than the human calibration table.

human conversion table can be relied upon for dogs with glaucomatous eyes to convert the Schiotz scale readings using either weight, because its estimates were comparable to those obtained with the Tonopen-Vet tonometer. Similar published data on glaucomatous eyes are lacking, for comparison, but the present findings were in accordance with that reported earlier in clinically normal dogs (Miller and Pickett, 1992). The slight (1.7 mm Hg) underestimation of IOP with the human calibration table and the 7.5 g wt. relative to Tonopen- Vet tonometer may not be considered of much clinical importance as opined earlier (Miller and Pickett, 1992) considering the fact that Tonopen applanation tonometer estimates IOP in whole numbers only.

Schiotz measurements obtained using the 5.5 g weight and the human calibration table differed (either higher of lower) from the Tonopen-Vet tonometer a mean of 1.32 mm Hg with a range of zero to 5.4 mm Hg (Table 2). Such a mean variation in 114 normal canine eyes reported earlier (Miller and Pickett, 1992) using Schiotz and Tono- Pen was 3.2 mm Hg with a range of 0.1 to 17.0 mm Hg. The difference between measurements made with the 5.5 g and 7.5 g weights using the human calibration table was 0.82 mm Hg, while it was 1.33 mm Hg using the canine calibration table. This was similar to the findings in normal canine eyes reported earlier (Miller and Pickett, 1992), where the differences were 0.82 and -0.9 mm Hg, respectively, using the same calibration table.

It was thus concluded that the intraocular pressures estimated in glaucomatous eyes of dogs using canine calibration table were always an overestimation of the actual IOP. Hence, we recommend to use a human calibration table to convert the Schiotz tonometer scale readings obtained with 5.5 g weight, to estimates of IOP in mm of Hg.

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