The Study of Intraocular Pressure in Systemic Hypertensive Patients of Chumphon Khet Udomsakdi Hospital

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Abstract

Background: Glaucoma is the second leading cause of blindness. The main treatment is to control the intraocular pressure (IOP). Patients with systemic hypertension can have increase IOP. This research aims to study the relationship between systemic hypertension and IOP by using non-contact air puff tonometer (NCT).

Methods: Three hundred and forty-nine systemic hypertension participants without glaucoma were enrolled in this study. Intraocular pressure was measured in all participants by using NCT. If IOP ≥ 21 mmHg, Goldman applanation tonometer (GAT) will use to confirm.

Results: Participants were male 31.52% and female 68.48% with mean ± standard deviation (S.D.) age was 65.18 ± 12.08 years. The means ± S.D. IOP with NCT right and left eyes were 17.02 ± 3.63 and 16.82 ± 3.71 mmHg, respectively. High IOP (≥ 21 mmHg) with NCT was 16.33% in right eye and 14.90% in the left eye. These high IOP were confirmed with GAT and were absolutely high 3.72% and 3.43% in right and left eyes, respectively. The result of IOP comparison between NCT and GAT in right eye were 22.77 ± 2.29 and 18.63 ± 2.64 ($P<0.001$) and in left eye were 23.21 ± 2.53 and 18.73 ± 3.21 ($P < 0.001$) significantly, respectively.

Conclusion: Intraocular pressure from NCT was higher than IOP from GAT. Finally, high IOP in systemic hypertension with NCT should confirmed by GAT.

Conflict of Interest: Author has no financial interest in this study

Keywords: Intraocular pressure, Goldman applanation tonometer, Air puff tonometer, Hypertension

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Introduction

Glaucoma is slow progressive optic neuropathy that leads to visual field loss and blindness. There are modified predisposing factors such as intraocular pressure (IOP), Diabetes Mellitus, systemic hypertension and steroid use and non-modified factors such as age, sex and genetics. Glaucoma is the second leading cause of blindness in the world (9.8%).[1] The current prevalence is approximately 61 million and this is expected to increase up to 81 million in 2020.[2] The goal of treatment is to decrease IOP and reduce optic nerve damage. Several studies showed the relationship between high systolic blood pressure (SBP) and high intraocular pressure.[3-5] Meta analysis of Bae H. et al., in 2015 found that systemic hypertension is the risk factor of primary open angle glaucoma (POAG) and increase risk of POAG 1.2 times in compared with non-system hypertension in Asia and

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Western country.[6] Gangwani RA, et al. reported that the systemic hypertension in elderly patients had linked to normotensive glaucoma up to 8%.[7] The relationship between POAG and systemic hypertension were related to ocular blood flow to optic nerve.[8] However, the prevalence of systemic hypertension patients in 2025 is predicted to increase to 1.5 billion around the world.[9,10] Therefore, this research aims to study the relationship between systemic hypertension and intraocular pressure by using non-contact air puff tonometer (NCT).

Methods

This study was conducted with the approval from the Human Ethics Committee of Thammasat University No. 1 (Faculty of Medicine) and was performed according to the tenets of the Declaration of Helsinki (project no. MTU-EC-OO-6-162/60). Patients with systemic hypertension, 385 patients were recruited from the outpatient of Chumphon Khet Udomsakdi Hospital with 140-179/80-109 mmHg between 40-80 years old. Patients with glaucoma, thyroid disease, corneal ulcer, ocular infection, history of eye injury, pregnancy and steroid use (in any route) less than 6 weeks were excluded. All patients of prospective cohort study were measured IOP by using NCT. If IOP ≥ 21 mmHg, GAT, anterior chamber depth and cup:disc will examine.

Results

The total of 385 systemic hypertension patients were selected by inclusion and exclusion criteria. Nineteen patients did not get their IOP measured via using the Goldman applanation tonometer (GAT). 10 patients had large pterygium cover more than 50% of the cornea leading to an inaccurate IOP reading. Seven patients had yellowish discharge. Therefore, 349 patients were enrolled in this study with male to female ratio of 1:3. The patients were between the age range of 61-70 years old with mean ± S.D. 65.18 ± 12.08 (Table 1). The systolic blood pressure (SBP) and diastolic bold pressure (DBP) were shown in Table 2. The number of 1 to 5 in Table 2 of systolic blood pressure refer to <120, 120-129, 130-139, 140-159, and 160-179 mmHg and diastolic blood pressure refer to <80, 80-84, 85-89, 90-99, and 100-109 mmHg, respectively. Intraocular pressure measured by NCT are in Table 3. The level of IOP 16 mmHg of both right and left eye had highest number of patients were 15.76% and 13.18%, respectively. Minimum and maximum IOP by measured with NCT ranged from 9 to 30 mmHg. The mean and S.D. of IOP by using NCT in right and left eyes were 17.02 ± 3.63 and 16.82 ± 3.71, respectively (Table 4). The patients with an IOP of ≥ 21 mmHg from NCT will be measured GAT, which was the gold standard. There were 62 patients (with loss follow up 5 patients) and 58 patients (with loss follow up 6 patients) in right and left eye had IOP ≥ 21 mmHg, respectively. The IOP was compared between NCT and GAT. The mean and S.D. of IOP in right eye were 22.77 ± 2.29 and 18.63 ± 2.64 while the left eye were 23.12 ± 2.53 and 18.73 ± 3.21, respectively (Table 5). However, the IOP ≥ 21 mmHg of the right eye from NCT were 16.33% (57 patients) whereas the IOP from GAT were 3.72% (13 patients). And the IOP of left eye from NCT were 14.90% (52 patients) whereas the IOP from GAT were 3.43% (12 patients). The IOP of both NCT and GAT were compared by using paired t-test in right and left eyes. The result showed a statistically significant difference with $P < 0.001$ in both eyes.

Discussion

There was a higher proportion of patients aged 61-70 years old with 32.66% and 28.08% respectively. The lowest number of patients were between 40-50 years old with 13.47%. These implied the high IOP level (lead to glaucoma) has more prevalence in old age with related to Tuck M. and Crick R. studied.[11-13] By these result, high prevalence of glaucoma can be found in aged society such as Thailand. The hypertension guideline was referenced from ESC/ESH (European Society of Cardiology/European Society of Hypertension). Most of the patients

had SBP of 140-159 mmHg and DBP of <80 mmHg and the second highest SBP of 130-139 mmHg and DBP of < 80 mmHg, respectively (Table 2). Increased systemic blood pressure level have been shown to be related to increasing IOP levels and lead to slow progressive optic neuropathy.[3-5] Cantor E., et al. reported that a higher DBP of more than 90 mmHg and ocular perfusion pressure less than 40 mmHg had increase risk factor to open angle glaucoma.[14] By comparison the IOP from NCT was higher than that from GAT and this was statistically significantly with P < 0.001 in both eyes. This result had related to several studies that NCT has higher IOP level than GAT.[15-17]

Conclusion

Intraocular pressure was measured by using NCT in systemic hypertension have various advantages such as non-contact, easy, faster and comfortable. However, if IOP ≥ 21 mmHg GAT was used to confirm the raised IOP. By using NCT, the pressure measured tends to be higher than expected. Therefore, if NCT was used for screening IOP in systemic hypertension patients and the pressure is more than normal, the GAT will used to confirm.

Table 1: Characteristic of patients

Characteristic	Number (N=349)	Percentage
Sex		
Male	110	31.52
Female	239	68.48
Age (X= 65.18, S.D. = 12.08, Range = 40-80)		
40-50 years	47	13.47
51-60 years	90	25.79
61-70 years	114	32.66
71-80 years	98	28.08

Table 2: Total number of systemic hypertension patients classified by systolic and diastolic blood pressure

Systolic	Diastolic					Total
	1	2	3	4	5	
1	25	2	5	1	0	33
2	32	9	6	5	0	52
3	42	24	14	11	0	91
4	53	24	35	25	7	144
5	6	4	4	11	4	29
Total	158	63	64	53	11	349

Table 3: Number of systemic hypertension patients classified by intraocular pressure

Intraocular pressure (mmHg)	Right eye		Left eye	
	Number	Percentage	Number	Percentage
9	2	0.57	2	0.57
10	2	0.57	4	1.15
11	6	1.72	6	1.72
12	25	7.16	15	4.30
13	23	6.59	32	9.17
14	30	8.60	42	12.03
15	27	7.74	41	11.75
16	55	15.76	46	13.18
17	39	11.17	35	10.03
18	44	12.61	31	8.88
19	21	6.02	22	6.30
20	13	3.72	15	4.30
21	25	7.16	21	6.02
22	12	3.44	14	4.01
23	8	2.29	2	0.57
24	6	1.72	7	2.01
25	2	0.57	3	0.86
26	1	0.29	3	0.86
27	2	0.57	2	0.57
28	4	1.15	4	1.15
29	2	0.57	1	0.29
30	-	-	1	0.29
Total	349	100	349	100

Table 4: Mean and Standard deviation of intraocular pressure measured by NCT

Eye	Total	Mean	Standard deviation
Right	349	17.02	3.63
Left	349	16 .82	3.71

Table 5: Intraocular pressure by NCT and GAT in right and left eye

Intraocular pressure	Total		Mean		Standard deviation	
	Right	Left	Right	Left	Right	Left
NCT	57	52	22.77	23.12	2.29	2.53
GAT	57	52	18.63	18.73	2.64	3.21

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