Assessment of cognition & sensory-motor performance using audio-visual reaction time in young adults with parental history of hypertension: A cross sectional study

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Abstract

Background: Hypertension "A Silent killer" is a non-communicable chronic disease exhibiting a rising prevalence in today's globalized world. In long run it causes end organ damage like cardiovascular diseases, chronic kidney diseases, neuro-cognitive damage. Autonomic imbalance with added unhealthy lifestyle & professional stress hastens the pathophysiological process of the disease.

Aim of the study: Assessment of cognition & sensory motor response using audiovisual reaction time analyzer in young adults with & without parental history of hypertension.

Methodology: A total of 120 young adult participants were included in this cross sectional study after obtaining institutional ethical committee clearance & defining inclusion and exclusion criteria. Sixty young adults with parental history of hypertension were screened & 60 students with no parental history of hypertension were recruited using simple random sampling for control group.

Result: The study showed both ART & VRT were prolonged in study group & the delay in ART was statistically significant (p<0.05).

Conclusion: Cognition and sensory motor tasks are affected by sympathetic reactivity indicating genetic influence. Early screening of altered neurological functions helps to take steps to prevent further consequences.

Keywords: Audiovisual reaction time, parental history of hypertensive, bio-behavioural risk, neuro-cognitive impairment, sensory motor slowing down

Introduction

Hypertension "A silent killer" is a chronic non communicable disease & is projected to be the leading cause of death by 2020 worldwide. It is prevalent in both developed and developing nations, exhibiting a rising trend in developing nations in the recent times [1, 2, 3]. High blood pressure, if not controlled in initial stages can progress to develop complications like atherosclerotic changes in micro and macro vessels causing end organ damage. It is documented in many studies that 30-40% of subjects with primary hypertension have genetic

predisposition [4, 5, 6].

The offsprings with parental history of hypertension express autonomic hypervigilance in the form of early parasympathetic attenuation and sympathetic overactivity [7, 8, 9]. They being at the risk of developing hypertension in future due to genetic predisposition, added risks in them like unhealthy habits of inadequate sleep, sedentary lifestyle, unhealthy eating habits, alcohol consumption, smoking, professional stress or work place stress are found to be associated with early mental fatigue, neurocognitive impairment & sensory motor slowing down in the long run. These individual's needs to be evaluated at the earliest & look for any pathophysiological changes associated with sympathetic overactivity [10, 11, 12, 13].

Reaction time is the time interval between a given stimulus and initiation of an appropriate voluntary response. It is reliable non-invasive test that indicate rate of processing of sensory stimuli & execution of motor response. It assesses quickness, intelligence, alertness, arousal level & decision making ability of a person [14, 15, 16]. In 1968 Laming gave average time of simple reaction time as 220 milli seconds and recognition reaction time as 384 ms. The accepted mean simple reaction for young college age population since around 120 years is 190 ms (0.19 sec) for light stimuli and 160 ms for auditory stimuli. Many researchers till date have supported the finding that reaction time for sound is shorter than light stimuli, mean auditory reaction time ranged between 140 – 160 ms and visual reaction time is 180 -200 msec. Reaction time for touch is intermediate i.e., 155 msec. Mean reaction time in males was found to be 220ms and in females it was 260ms.

Individuals with high intelligence level were found to exhibit faster reaction time (RT) than individuals with normal intelligence. Personality type also affects RT, as extroverts have faster RT than introverts. Some studies found that anxious personalities had faster reaction time. Excessive anxiety levels e.g., before any competition / mental task, impair external performance by causing disorganization of behavior, which in turn decreases motor performance [17, 18]. Studies on panic disorder and high anxiety have found that these individuals with hypertensive parents exhibit sympathovagal imbalance in the form of sympathetic over activity [19].

There is meager literature available with AVRT as a modality to assess sensory motor response & cognition in young population. Present study is an attempt to fill this literature gap & also an attempt to make these young medical professionals aware of their health condition & adapt themselves to healthy lifestyle so as to reduce disability adjusted life years.

Objective of the study

To assess cognition & sensory motor performance using AVRT in young adults between 18 to 24 years & compare them between study & control group.

Methodology

This is a cross sectional study conducted on 120 first year medical students. A total of 200 students were screened, out of which 60 students with parental history of hypertension were included in study group & 60 students without parental hypertension were selected using simple random sampling to form control group. Students with history of any chronic diseases like cardiovascular, neuronal & psychiatric illnesses on prolonged medication, any gross cognitive & auditory impairments, history of chronic smoking & alcohol intake were excluded from the study.

A self-administered questionnaire was given to obtain socio-demographic data like personal information, parental & family history. The reporting time to the lab for data collection was at 09:30 am with adequate amount of sleep a night before the test & consumption of light breakfast with no coffee/tea 2 hrs prior to the test was advised.

Anthropometric measurements like height and weight were measured using stadiometer (to the nearest of 0.5cms) & krup's weighing scale (with near accuracy of ± 0.5Kg) respectively. BMI was calculated using Quettlet's equation (Asian standard scale). Physiological parameters like pulse rate & Blood pressure following 10 minutes rest in sitting position was recorded. Sympathetic response was recorded using handgrip dynamometer in USA manufactured by INCO Ambala.

Audio visual reaction time was assessed using portable research reaction timer analyzer. It has two response choices (manufactured Anand agencies, Pune, March 2010 model) and can measure ART and VRT. This reaction timer needs a 230 volts AC current to work and it has 4 inbuilt digital chronoscope, a quartz clock & an auto displayer with accuracy of 0.001 sec display response time in milliseconds. The test was performed in quiet room with the subject in sitting posture. They were given sufficient practices to make them familiar with the apparatus. At least 3 readings were taken, where in the subjects were made to react to various stimuli thrown to them randomly by pressing a button. The stimuli were in the form of auditory in which a high/tone frequency sound & low/click frequency sound were used and visual stimuli in the form of green & red-light stimuli were used. The readings were recorded in milliseconds (ms) & the shortest response time was taken as the best performance by the subject to a given stimuli.

Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements were presented on mean ± SD & results on categorical measurements were presented in number. Significance was assessed at 5% level. Student's t-test was used to find the significance of study parameters between two groups. P value of ≤0.05 was considered as statistically significant.

Results

The present cross-sectional study assessed AVRT in young adult medical students between 18-24 years ago with parental history of hypertension. The study group comprised of 60 students with parental history of hypertension & control group comprised of students without parental history of hypertension. Total 120 study population was assessed, out of which 56 were males & 64 females. The results of study are presented in tabular & graph form.

Demographic and anthropometric profile of the students

Table 1: Comparison of demographic and anthropometric measurements between study and control group

Parameters	Study group (n=60)	Control group (n=60)	P-value
Age	18.95 ± 1.13	18.83±0.87	0.5261
Height (cm)	164.12 ± 8.38	166.38 ± 8.99	0.156
Weight(kg)	64.60 ± 13.10	63.13 ± 13.41	0.546
BMI	24.03 ± 4.17	22.75 ± 3.80	0.081

Table 1; show that the two groups do not differ much on demographic and anthropometric scale. The mean age of population was between 18-19 years, mean height was between 164-166 centimeters & there was not much difference between the two groups on mean BMI score that ranged from 22-24.

Table 2: Comparison of baseline physiological parameters between study & control group

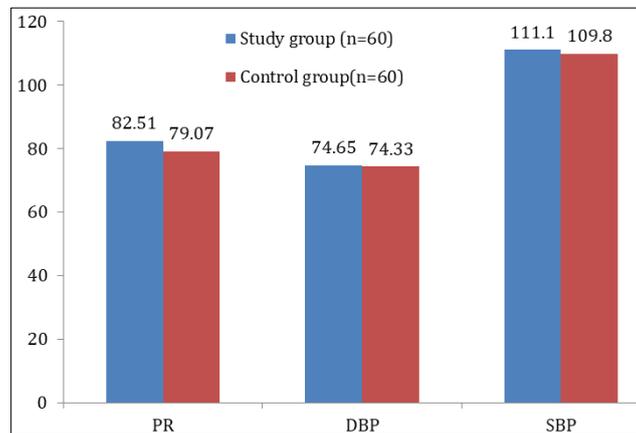| Baseline physiological parameters	Study group (n=60)	Control group (n=60)	P-value
PR	82.50±8.90	79.07±8.45	0.032
DBP	74.65±5.86	74.33±7.80	0.802
SBP	111.10±10.50	109.80±11.23	0.514

Graph 1: Comparison of baseline physiological parameters between study & control group

Table 2 & Graph 1 indicate the baseline PR, SBP & DBP are slightly increased among the study group compared to control group which was not statistically significant.

Table 3: Comparison of auditory (tone stimuli) and visual (green stimuli) reaction time between study and control group

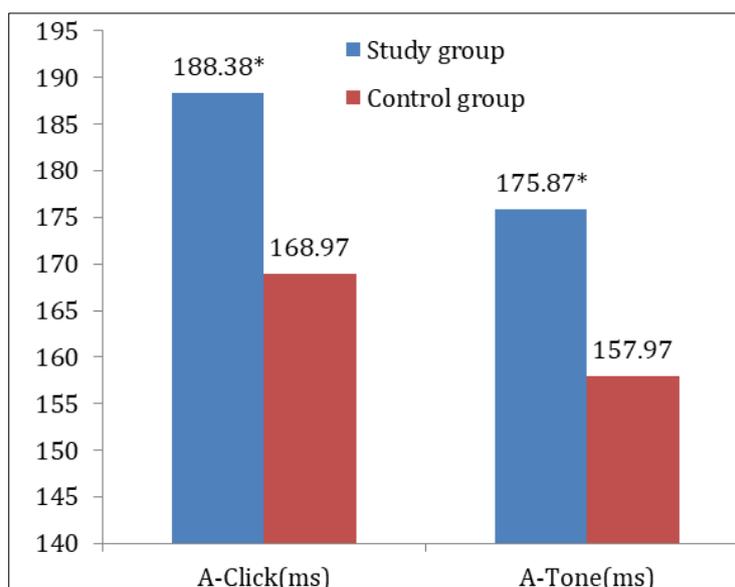| Reaction time (MS)	Study group(n=60)	Control group(n=60)	P
Auditory RT	175.87 ± 35.04	157.97 ± 24.63	0.002*
Visual RT	190.73 ± 3.58	187.18 ± 29.47	0.038

*$p<0.05$
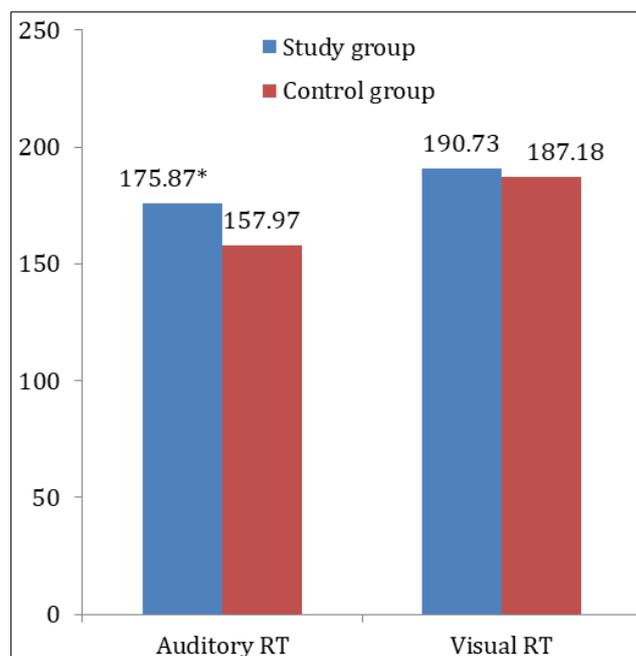
*$p<0.05$

Graph 2: Comparison of auditory and visual reaction time between study and control group

Table 3 & Graph 2 show, both ART & VRT are prolonged in study group while ART delay was statistically significant.

Table 4: Comparison of Auditory reaction time (ART) in study and control group for different frequency sound stimuli (click & tone)

| Auditory reaction time(ms)	Study group(n=60)	Control group(n=60)	P -value
Click (low frequency)	188.38 ± 38.16	168.97 ± 26.27	0.002*
Tone (High frequency)	175.87 ± 35.04	157.97 ± 24.63	0.002*

*$P<0.05$

*$P<0.05$

Graph 3: Comparison of Auditory reaction time (ART) in study and control group on click & tone sound stimuli

Table 4 & Graph 3, show that both low frequency & high frequency ART (click & tone) duration is prolonged in study group compared to control group which was statistically significant.

Table 5: Comparison of visual reaction time (VRT) for different color visual stimuli (red-VR & green-VG) in study & control group

Visual reaction time (ms)	Study group(n=60)	Control group(n=60)	P-value
VR (Red)	204.20 ± 28.78	193.13 ± 28.86	0.038*
VG (Green)	190.73 ± 3.58	187.18 ± 29.47	0.519

*$P<0.05$
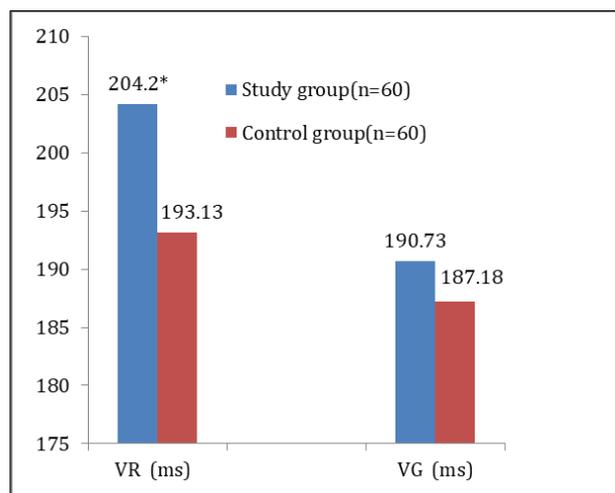
* $p<0.05$

Graph 4: Comparison of visual reaction time (VRT) for red (VR) & green (VG) visual stimuli in study & control group

Table 5 & Graph 4 reflect the duration of VRT for red & green color is more in study group in comparison to control group & statistically significant difference was observed for red color.

Discussion

In the present study AVRT was performed to assess cognition & sensory motor coordination. It is observed that students of hypertensive parents showed delayed response to both ART & VRT of which delayed ART was statistically significant. The high blood pressure reactivity is labeled as bio-behavioural risk factor that has harmful effect on cognitive functions like attention, verbal memory & confrontation naming [20]. Some studies have also reported that high sympathetic activity is associated with reduced cognitive performance [21].

Many studies have used audiovisual reaction time as a tool to measure sensory motor intactness, coordination & information processing speed in middle aged hypertensive cases. The previous study observed longer VRT and impaired cognition in known cases of hypertension. They also found positive correlation between RT & duration of hypertension, reflecting the harmful effect of elevated BP on nerve conduction velocity in long run [22]. The underlying pathology of nerve injury secondary to hypertension was explained as inflammatory changes in nerve cell basement membrane, axonal degeneration, atrophy & micro thrombi causing endoneural hypoxia in both slow & fast conducting fibers. The peripheral nerves were more vulnerable to early hypertensive changes causing neuropathy. The reduced blood supply & metabolism to the brain tissue was mainly found in the fronto-temporal & subcortical areas thus affecting cognitive functions in hypertensive patients. High BP causes damage to blood brain barrier & hastens the easy accessibility of toxins into the brain tissue. The duration of hypertension is found to be associated with atherosclerotic changes in blood vessels causing hypoxic-ischemia related complications. Many clinical trial studies have shown improvement in neuropathy & cognitive functions on proper antihypertensive medication in hypertensive patients. Many studies support the finding of ART to be faster than VRT, as auditory stimuli reach's motor cortex within 8-10ms & visual stimuli take longer time, around 20-40ms for the same [22, 23].

In the present study it was also observed that AVRT response was longer for visual red color stimuli & auditory click stimuli in children of hypertensive parents. Many studies on VRT conducted in normotensive individuals in the past have observed contrasting finding for visual red or green color and concluded that reaction time & chromaticity does not show any correlation. This needs to be further evaluated to study the harmful effect of high blood

pressure on chromaticity & color perception. Studies on micro vascular changes in children aged < 6years with parental history of hypertension have reported narrowing of retinal arterioles, mainly in female child with associated high prevalence of myopia in them. Though the cause for gender difference in retinal vascular changes is unclear but it was attributed to p-selectin mediated activation of C-reactive protein causing platelet adhesion & endothelial dysfunction [24, 25, 26].

Conclusion

Present study measured audiovisual reaction time in young adults with parental history of hypertension. Cognitive and sensory motor functions get affected adversely with sympathetic over-reactivity indicating genetic influence. To generalize the findings we need to undertake early assessment of these offsprings with hypertensive parent's on a large sample population with more advanced diagnostic modalities.

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Conflict of interest: The author's declare no conflict of interest

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