Age Related Change to Cardiovascular Sympathetic Function Assessed by Blood Pressure Response to Standing

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Cardiac sympathetic function can be affected in older age. Blood pressure response to sudden standing was studied in apparently healthy elderly person to observe the influence of age on cardiovascular sympathetic activity. This prospective study was conducted in the Department of Physiology, BSMMU, Dhaka during July 2005 to June 2006. For study group 30 elderly subjects, age ranged from 51 to 60 years were enrolled in one group whereas another 30 elderly subjects age between 61- to 70 years were enrolled in another group. For comparison sex and BMI matched thirty apparently healthy adults with age from 21 to 30 years were studied as control. Sympathetic nerve functions statuses of all subjects were assessed by blood pressure response to sudden standing. For statistical analysis, one way ANOVA (Post Hoc Test) and Pearson correlation co-efficient test were done. Mean (±SD), fall in systolic blood pressure after standing were 3.53 ± 3.28, 6.27 ± 6.59, 7.27 ± 7.21 mm of Hg in 21-30 years, 51-60 years and 61- 70 years age group, respectively. A significant ($p<0.5$) fall in systolic blood pressure was in 61 - 70 years age group than that of 21-30 years after standing. And 'r' value of fall of systolic blood pressure after standing was +0.211 and was statistically significant ($p<0.05$). From this study, it can be concluded that aging process substantially impaired cardiovascular sympathetic function.

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Key words: Blood pressure response to standing, Aging

Introduction

Autonomic nervous system plays important role in homeostasis.[1] Progressive decrement of all body functions are associated with aging process,[2] which also affects autonomic nerve function.[3,4] This leads to subsequent age related changes in heart rate, blood pressure regulations which ultimately may lead to the development of many cardiovascular diseases.[5] In old age, both sympathetic and parasympathetic system are affected.[6,7] There is a series of changes occur in sympathetic nervous system.[8] As age advances, the circulatory non-epinephrine level increased but its responsiveness to target organ is reduced[8-10] and also α, β adrenergic activity on heart and blood vessels is reduced.[11,12] Blood pressure response to standing up is one of the non-invasive cardiac sympathetic function tests. When a person stand up after 10 minutes rest, systolic B.P. normally fall less than 10 mmHg.[13]

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But after the age of 65 years, it falls more than 20 mmHg after sudden standing in 16 percent healthy person.[14] Old persons are more prone to syncope due to postural hypotension.[15] About 15 percent of the world population currently exceeds 60 years.[16] Some of them may have sympathetic nerve impairment which may be the underlying causes of many disease especially cardiovascular diseases. Unfortunately most of them remained unnoticed and usually treated without knowing the underlying etiology. With the above background, study of the influence of age on cardiovascular sympathetic activity is important. Though few investigations have been undertaken in different countries, no data in Bangladesh aged population has been published. Therefore the present study was conducted to observe the influence of age on blood pressure response to sudden standing in healthy elderly person in order to evaluate any impairment on cardiovascular sympathetic activity.

Methods

This prospective study was conducted in the department of physiology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka from July 2005 to June 2006 and the protocol of this study involving human subjects was approved by the ethical review committee of the department of Physiology of BSMMU. Sixty apparently healthy elderly subjects of both sexes were selected as study group and divided into Group B, consisting of 30 elderly subjects age 51-60 years and group C consisting of another 30 elderly subjects age 61-70 years. They were selected from a slum area of Malibag Wireless Gate and BSMMU staff quarter, Paribag, Dhaka. For comparison sex and BMI and socioeconomic status matched 30 healthy adults age 21- 30 years were studied as control (Group-A) from the same area. All of the subjects were belonged to lower socioeconomic status. Subjects having the history of chronic renal failure, diabetes mellitus, hypertension, heart disease, cardiac failure and neurological disorder were excluded. Before inclusion in the study, the objectives of the study were explained to all the subjects and their voluntary participation was encouraged. A written informed consent was taken from each subject. A detail medical, family, personal and socio-economic history were recorded in a prefixed data schedule. A through clinical examination was done. Height and weight of the subjects were recorded and BMI was calculated. The Random blood sugar and serum creatinine were estimated for to exclude diabetes mellitus and renal failure. Subjects were asked to attend the laboratory of department of Physiology as per schedule and their cardiovascular sympathetic function was assessed by blood pressure response to standing by established method.[15] The subjects were asked to lie on bed. After 10 minutes rest, their blood pressure was measured by the sphygmomanometer. Then they were asked to stand up as quickly as possible with pressure cuff around the arm. Again their blood pressure was measured. The differences in systolic blood pressure between lying and 1 minute after standing was calculated. Fall of systolic blood pressure 10 mm of Hg or below was taken as normal, 11-29 as border line and 30 or more as abnormal. Statistical analysis were done by one way analysis of various (ANOVA, Post Hoc Test) and Pearson correlation-coefficient (r) test.

Results

The mean (±SD) of age, height, weight and BMI of the different groups are shown in table I, except age all the groups were matched for height, weight and BMI.

Table I: Age, Height, Weight and body mass index in different study groups (n=90)

Groups	n	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m2)
A	30	26±2.67 (21-30)	161 ± 7.93 (150-172)	52±5.28 44-64	20.22±1.83 (17.36 -23.61)
B	30	56±2.68 (51-60)	159 ± 7.33 (148-171)	52±5.31 40-60	22.77±2.12 (16.49 -24.78)
C	30	66±2.97 (61-70)	158 ± 7.11 (148-170)	52±5.82 40-64	20.81±1.96 (16.53-24.89)

(Figures in parenthesis indicate ranges)

Statistical Analysis

Groups	P value			
	Age	Height	Weight	BMI
A vs B	0.000***	0.310^{ns}	0.944^{ns}	0.278^{ns}
A vs C	0.000***	0.090^{ns}	0.672^{ns}	0.258^{ns}
B vs C	0.000***	0.491^{ns}	0.622^{ns}	0.948^{ns}

(*** = Significant at P < 0.001, ns=Not Significant, n = Number of subjects)

Results are expressed as mean ± SD. One-way ANOVA (Post-Hoc) test was performed as the test of significance.

Group-A: 21-30 years of adults (Control)
Group-B: 51-60 years of elderly subjects (experimental)
Group-C: 61-70 years of elderly subjects (experimental)

Results of blood pressure response to standing of all groups and their statistical analysis are shown in table II. A significant (p<0.5) fall in systolic blood pressure after standing in group C than that of A. However, the fall in systolic blood pressure observed in B was though more than that of A and also in C than that of B but the difference between them was not statistically significant.

Table II: Assessment of sympathetic nerve functions by systolic blood pressure response to standing in different study groups (n-90)

Groups	n	Systolic blood pressure (mmHg) Lying	After standing	Fall after standing from lying
A	30	111±7.90 (100-120)	108 ± 8.04 (92 - 120)	3.53 ± 3.28 (0 – 10)
B	30	117±9.51 (100-130)	111 ± 13.36 (80 - 130)	6.27 ± 6.59 (0 - 20)
C	30	115±8.39 (100-130)	108 ± 11.22 (76 - 130)	7.27 ± 7.21 (0 - 26)

(Figures in parenthesis indicate ranges)

Statistical Analysis

Groups	P
A vs B	0.079 ^{ns}
A vs C	0.017 *
B vs C	0.517 ^{ns}

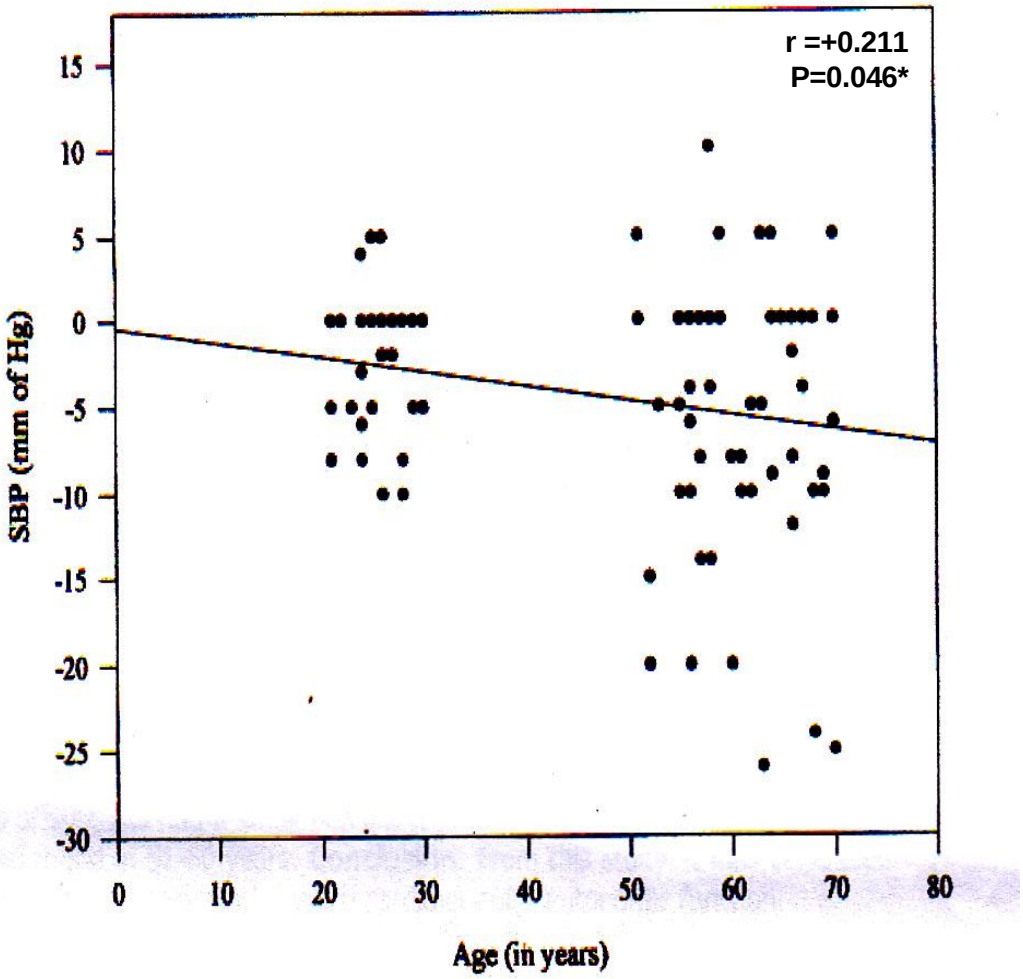
(* = Significant at P < 0.05, ns = Not Significant, n = Number of subjects)

Results are expressed as mean ± SD. One-way ANOVA (Post-Hoc) test was performed as the test of significance.

Group-A: 21-30 years of adults (Control)
Group-B: 51-60 years of elderly subjects (experimental)
Group-C: 61-70 years of elderly subjects (experimental)

Results of relationship of fall of systolic blood pressure after standing with age is shown in figure1. Here the fall of systolic BP was positively correlated with age and was statistically significant (r = +0.211, p<0.05).

Relationship between age and fall of systolic blood pressure after standing from lying



Pearson correlation-coefficient (r) test was performed as the test of significance.

SBP = Systolic blood pressure
* = Significant at $P<0.05$

Figure 1. Relationship of fall of systolic blood pressure after standing with age

Discussion

The mean value of fall of systolic BP after standing was significantly lower ($p<0.05$) in 51-60 and 61-70 years age group than that of 21-30 years. This finding is in consistent with other workers.[16-19] The fall of systolic BP after standing was greater in 61-70 years than that of 51-60 years age groups, but no statistically significant difference was observed between the groups. No data is available to compare this finding. There was positive correlation between fall of systolic BP after standing with age and it was statistically significant ($p<0.05$). This finding is in agreement with other workers.[19]

Above findings indicate that sympathetic nerve functions are impaired in old age. However, the exact mechanism involved for impairment of this nerve function, in the elderly subjects of present series cannot elucidate from this study. According to suggestions made by different investigations, the probable explanation for this more fall of systolic BP after standing may be due to reduced α and β adrenergic activity on heart and blood vessels in old age.[15,19,20] There might be increased non-epinephrine level with advancement of age but its responsiveness to target organ is reduced.[18,19]

Conclusion

From this study, it can be concluded that aging process substantially impaired cardiac sympathetic nerve functions.

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