GENDER-SELECTIVE INTERACTION BETWEEN AGING AND CARDIOVASCULAR SYMPATHETIC ACTIVITY

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Abstract

Physiologically aging refers to the impaired ability to maintain homeostasis during external as well as internal stresses. The sympathetic nervous system becomes tonically, progressively and markedly activated with aging in humans. Study is done to measure the cardiovascular sympathetic dysfunctions in the males and females of the different age groups. Total 80, healthy subjects not having any major illness and any chronic addiction, were selected for the study. All the subjects were evaluated by using "CANWIN cardiac autonomic neuropathy analyzer" using the tests like Pulse rate by Palpatory method, Blood Pressure response to sudden standing and Sustained Handgrip test. In all the elderly subjects the sympathetic system was over activated and this over activation of the sympathetic system became more severe as the age advanced. Aging is accompanied by a greater increase in sympathetic activity in women than in men, independent of menopausal status. The study concludes that there is more marked influence of age on sympathetic nervous system activation and impaired sensitivity of baroreceptors in women than men.

Keywords: - *Sympathetic system; Baroreceptors; Cardiovascular; Aging*.

Introduction

Physiologically aging refers to the impaired ability to maintain homeostasis during external as well as internal stresses.[1] As the result of this impairment the individual becomes more vulnerable to these stresses and finally succumbs to one of the diseases, thereby bringing the cycle of life to an end.[1] Overall, the age related changes in autonomic functions of human body are less investigated.[1] The sympathetic nervous system and baroreflexes are the important "tools" by which central nervous system uses autonomic nervous system to maintain homeostasis.[2]

There is evidence for impaired baroreflex functions with aging but the experimental evidence is confusing and controversial.[2] It is generally accepted that sympathetic activity increases progressively with aging.[3] However, little is known of the effects of gender on age-related changes in sympathetic traffic and the existing evidence is conflicting.[4] The importance of understanding changes in sympathetic cardiovascular and baroreflex functions with aging lies in parts in the related clinical implications[2]. Thus autonomic nervous system plays an important mechanistic role in the etiology of age associated cardiovascular diseases leading to deteriorated quality of life. [2]

Although cardiovascular risk increases with age in both sexes, this increase is sharper in women as compared to the males of same age group.[5, 6] More women than men have congestive heart failure and overall, more women than men die from cardiovascular disease in the US.[5, 6] The mechanisms underlying this differential age effect are not well understood. Changes in serum total cholesterol level, body mass index and diabetes prevalence explain only 50% of the age-related increase in cardiovascular morbidity and mortality among women. [7]

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The present study was carried out to measure the cardiovascular sympathetic dysfunctions in the males and females of the different age groups and to assess the onset and grade of sympathetic functions or dysfunctions during aging process. We tested the hypothesis that aging has a greater impact on sympathetic activity in women than in men.

Material and Methods

The present study was carried out in Rural Medical College, Loni on 80 healthy volunteers (40 males and 40 females) not suffering from any major illness like Diabetes, Hypertension etc. and not having any chronic addiction and were grouped as follows:

Group : I - Age 31 – 40 yrs comprising of 10 males and 10 females.
Group: II - Age 41 – 60 yrs comprising of 15 males and 15 females.
Group: III - Age 61 yrs and onwards comprising of 15 males and 15 females.

The study protocol was explained to the subjects and written informed consent was obtained. The study was approved by the ethical committee of the institution. Subjects less than 30 years of age, suffering from any major illness and with chronic addiction were excluded from the study. Data comprising of clinical history regarding name, age, sex, occupation were obtained and recorded from all the subjects. Special emphasis was given in history for finding out any symptoms suggestive of autonomic neuropathy. All the tests included in this study were carried out using CANWIN.

CANWIN

Canwin is the state of the art PC (Fig 1); windows based cardiac autonomic neuropathy (CAN) analysis system manufactured by GENESIS MEDICAL SYSTEMS PVT. LTD., HYDERABAD, with interpretation. It has an extensive data base to keep tract of subjects' history and for archive test retrieval and comparisons being fully autonomic. The need of manual recordings, readings and calculation is eliminated. Inbuilt time domain waveform analysis and B.P. measurements

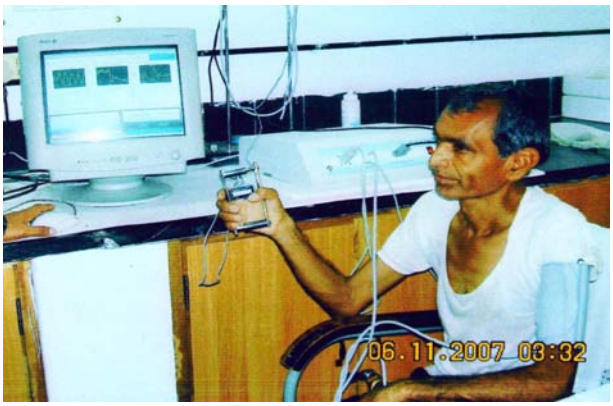

Fig: 1 Canwin 9 cardiac autonomic neuropathy analyzer

make the task of conducting the two sympathetic function tests very easy.

Precautions during measurements

i) Subject were not allowed to eat or drink, smoke, chew tobacco etc. at least half an hour prior to test as this would result in shift in results.
ii) Tests were carried out only when the subject was relaxed. Test may obtain erroneous result if the subject is mentally stressed, anxious, or impatient. Hence, the subject was allowed to relax for 5-10 minutes before starting the test.
iii) Subjects were instructed to restrict the movements while test was carried out.
iv) The tests were conducted in specified time without any discomfort to the subject.

Following Cardiovascular Autonomic Function Tests were carried out

i) Blood Pressure response to sudden standing. i.e. Postural or Orthostatic hypotension.
ii) Sustained Hand-grip test.

B.P. response to sudden standing

Procedure: The test was conducted with the subject in lying down supine position. Blood pressure was measured in supine position and then immediately after standing and one minute after standing. Blood Pressure was measured for the first time in supine position when the green light glows on the screen of canwin machine and then when red

light glows, the subject was asked to stand up quickly and the Blood Pressure is recorded immediately after standing for the second time. Then the Blood Pressure is recorded again after one minute after standing. The test ends automatically and the result was displayed immediately.

Hand - Grip Test

Procedure: The Blood Pressure was recorded in sitting position. Then the subject was asked to hold the spring dynamometer in the dominant hand and instructed to compress the dynamometer with full efforts for the period of 5 minutes. The blood pressure was recorded thrice during these 5 minutes automatically and the alteration in the blood pressure just before the release of hand grip test is taken as the index of response to hand - grip test.
Along with the above tests pulse rate was recorded on each subject by palpatory method for the period of one minute. All the data of the above tests were recorded and statistical analysis was carried out.

Results

A total of 80 volunteers i.e. 40 males and 40 females were included in the present study. The statistical analysis for sympathetic tests was carried out separately for males and females in all the three groups. After analyzing all the three groups the cardiovascular sympathetic functions was compared sex wise as well as age wise. It was observed that the sex wise comparison in Group I, Pulse rate, Orthostatic hypotension test and Hand grip test were statistically not significant i.e. $P > 0.05$ (Table 1). In Group II, Pulse rate and Hand grip tests were statistically significant i.e. $P < 0.05$ and Orthostatic hypotension test was statistically not significant i.e. $P > 0.05$ (Table 2). In Group III, Hand grip test was statistically significant i.e. $P < 0.05$ and Pulse rate and Orthostatic hypotension test were not statistically significant i.e. $P > 0.05$ (Table 3).
Age wise comparison between Group I and Group II and between Group I and Group III showed that Hand grip test statistically significant i.e. $P < 0.05$ and Pulse rate, orthostatic hypotension test statistically not significant i.e. $P > 0.05$ (Table 4 and Table 5). Age wise comparison between Group II and Group III showed that Pulse rate, orthostatic hypotension test and Hand grip test statistically not significant i.e. $P > 0.05$ (Table 6).

Table 1: Sex wise comparison of mean values of sympathetic tests in group I

Sympathetic tests	Male (n=10)	Female (n=10)	't' value	'p' value	Result
	Mean ± SD	Mean ± SD			
Pulse Rate per minute	73.8 ± 5.36	71.6 ± 5.76	0.88	p>0.05	Not significant
Orthostatic hypotension test	7.2 ± 6.43	5.50 ± 5.37	0.64	p>0.05	Not significant
Hand-grip test	9.8 ± 6.87	14.50 ± 12.80	1.02	p>0.05	Not significant

Table 2 : Sex wise comparison of mean values of sympathetic tests in group II

Sympathetic tests	**Male (n=15)**	**Female (n=15)**	**'t' value**	**'p' value**	**Result**
	Mean ± SD	**Mean ± SD**			
Pulse Rate per minute	72.53±7.42	77.5±5.71	2.03	p<0.05	Significant
Orthostatic hypotension test	7.4±4.73	7.64±6.54	0.11	p>0.05	Not significant
Hand-grip test	11.4±6.29	5.86±5.56	2.52	p<0.05	Significant

Table 3 : Sex wise comparison of mean values of sympathetic tests in group III

Sympathetic tests	**Male (n=15)**	**Female (n=15)**	**'t' value**	**'p' value**	**Result**
	Mean ± SD	**Mean ± SD**			
Pulse Rate per minute	73.4±7.81	78.18±8.34	1.65	p>0.05	Not significant
Orthostatic hypotension test	9.33±7.73	9.37±7.70	0.014	p>0.05	Not significant
Hand-grip test	11.66±11.1	4.56±3.33	2.37	p<0.05	Significant

Table 4 : Comparison of mean value of sympathetic tests in group I and group II

Sympathetic tests	Group I (n=20) Mean ± SD	Group II (n=30) Mean ± SD	't' value	'p' value	Result
Pulse Rate per minute	72.7 ± 5.43	75.01±6.57	13.34	p>0.05	Not significant
Orthostatic hypotension test	6.35 ± 5.99	7.52±5.62	0.69	p>0.05	Not significant
Hand-grip test	13.65 ± 11.84	8.63±5.84	1.97	p<0.05	Significant

Table 5 : Comparison of mean value of sympathetic tests in group I and group III

Sympathetic tests	Group I (n=20) Mean ± SD	Group III (n=30) Mean ± SD	't' value	'p' value	Result
Pulse Rate per minute	72.7 ± 5.43	75.79±8.12	1.5	p>0.05	Not significant
Orthostatic hypotension test	6.35 ± 5.99	9.35±7.71	1.48	p>0.05	Not significant
Hand-grip test	13.65 ± 11.84	8.11±7.22	2.07	p<0.05	Significant

Table 6 : Comparison of mean value of sympathetic tests in group II and group III

Sympathetic tests	Group II (n=30) Mean ± SD	Group III (n=30) Mean ± SD	't' value	'p' value	Result
Pulse Rate per minute	75.01±6.57	75.79±8.12	0.41	p>0.05	Not significant
Orthostatic hypotension test	7.52±5.62	9.35±7.71	1.03	p>0.05	Not significant
Hand-grip test	8.63±5.84	8.11±7.22	0.31	p>0.05	Not significant

Discussion

To measure and compare the effects of aging on cardiovascular sympathetic functions, the analysis was done separately on males and females of different age groups. These results indicate that the Sympathetic dysfunctions begin to occur from the age of 30 years and go on increasing in severity as the age advances. Even though, the sympathetic dysfunctions associated with aging occur both in males and females, the females show early development and more severe autonomic dysfunctions as compared to the males of the same age group. The main finding in this study is that aging has a more striking effect on increasing sympathetic activity in women than in men. These changes can be explained on the basis of the Sympathetic – adrenergic and baroreflex functions with aging.

The sympathetic nervous system and the baroreflex are the important tools by which Central Nervous System uses the Autonomic Nervous System to maintain homeostasis.[2] Sympathetic nervous system activation, impaired cardiac and peripheral adrenergic functions and decreased baroreflex circulatory control are fundamental features of number of cardiovascular disorders including coronary artery disease, congestive heart failure, essential hypertension and type – II diabetes mellitus[2] .

Thus there was evidence of an age related increase of cardiovascular sympathetic nervous system activity.[8] These findings are consistent with the hypothesis that there is sympathetic nervous system and parasympathetic nervous system compensation of cardiovascular functions in response to an age related decrease in baroreceptor sensitivity.[8] The function of the arterial baroreflex could be theoretically disrupted by aging at a number of levels. Most obviously, this could occur in the afferent component of the reflex arc, with changes affecting the baroreceptors in the arterial wall, with medial thickening and rigidity, and with the formation of atheromatous plaques in the intima.[9]

In contrast to findings of previous study by Ng et al[10], Muscle sympathetic nervous activity (MSNA) in both younger and older subjects was significantly lower in women compared with men of the same age which might have been due to the small sample size and inclusion of older women using hormone replacement therapy.[10] However, our findings are consistent with findings of Matsukawa et al [11] who found that MSNA was lower in women than in men among subjects younger than 50 years and similar for both genders in subjects older than 50 years of age.[11] The age related menopause-independent increase in sympathetic activity in women may be relevant to the absence of any cardiovascular benefit from hormone replacement therapy in postmenopausal women.[12] Also the findings of our study are consistent with the epidemiological data indicating a higher prevalence of hypertension in women by age 60.[7, 13] The significant positive correlation between MSNA and blood pressure particularly in older females provides further support for a possible role of sympathetic activation in the close link between aging and hypertension, particularly in women. [14]

Conclusion

To conclude, there occurs increase in sympathetic activity as the age advances in humans due to reduced sensitivity of baroreceptors. Also aging is accompanied by a greater increase in sympathetic activity in women than in men of the same age group. This increase is independent of body mass index and menopausal status. Sympathetic neural mechanisms may thus contribute importantly to the more marked influence of age on blood pressure and cardiovascular disease in women. Since autonomic neuropathy is the cause or effect of many age related clinical disorders leading to deteriorated quality of life, therefore, the assessment of cardiovascular ANS functions is the important investigation in the geriatric medicine.

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