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Sympathetic Vascular Reactivity Has Ambiguous Relation with Age During Pregnancy

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Abstract

Background: Pregnancy is a physiological condition associated with adaptive changes in the maternal hemodynamics and cardiovascular system. Autonomic nervous system plays a central role in this adaptation to the various needs of pregnancy. One of the well-known complication, that occurs commonly during pregnancy is pregnancy induced hypertension (PIH)/preeclampsia (PE). Impairment of autonomic functions has been suggested as one of the cause of pregnancy induced hypertension. Vascular reactivity is defined as the responsiveness of a blood vessel to a specific stimulus. Blood pressure (BP) reactivity to the cold pressor test (CPT) has been suggested as a one of the predictor of hypertension. *Materials and Methods:* A total of 225 pregnant females with gestation age of 7-8 weeks as per the ultra-sonographic reports were recruited in the study and were divided into 3 groups 18-23 years (n=132), 24-29 years (n= 78) and 30-35 years (n=15). Observations and *Results:* The baseline SBP were 102.90 ± 11.95 mm Hg, 103.23 ±12.58 mm Hg, and 113.23 ± 12.53 mm Hg respectively in different age groups. The baseline DBP was 63.90 ± 9.20 mm Hg, 65.78 ± 10.92 mm Hg and 71.33 ± 9.17 mm Hg. It was observed that resting SBP and DBP increased with maternal age. The change in SBP and DBP during CPT was 12.02 ± 11.56 mm Hg and 12.12 ± 10.57 mm Hg in 18-23 years of age, 13.76 ± 16.22 mm Hg and 13.15 ± 14.99 mm Hg in 24-29 years of age, 12 ± 14.62 mm Hg in 30-35 years of age. This shows that there is more change in SBP and DBP till the age of 25-29 years which further decreased in 30 -35 years of age group. *Conclusion:* Thus there is an ambiguous relation of sympathetic vascular reactivity with age in pregnancy

Keywords: Pregnancy Induced Hypertension; Autonomic Nervous System; Vascular Reactivity; Cold Pressor Test.

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Introduction

Pregnancy is a physiological condition associated with profound adaptive changes in the maternal hemodynamics and cardiovascular system. Autonomic nervous system plays a central role in this adaptation to the various needs of pregnancy [1].

One of the well-known complication, that occurs commonly during pregnancy is pregnancy induced hypertension (PIH)/ preeclampsia (PE) affecting 5% to 8% of all pregnancies. It is one of the most

common cause of maternal and neonatal morbidity & mortality [2, 3].

Early detection of high risk patients is essential for prophylactic interventions to reduce morbidity & mortality associated with this syndrome [4].

Impairment of autonomic functions has been suggested as one of the cause of pregnancy induced hypertension. There have been reports of greater resting sympathetic output in cases of pregnancy induced hypertension as compared to normal pregnancy [1].

Cardiovascular adaptations during pregnancy are triggered by decrease in systemic vascular résistance. It results into a feedback response of increase in cardiovascular sympathetic drive to meet the higher circulatory demands of pregnancy. Defect in this feedback response results into preeclampsia [5].

In some studies, increased sympathetic activity as well as decreased vagal tone has been found to be associated with pregnancy induced hypertension/ preeclampsia [6,7].

Since the sympathetic nervous system also has an important adaptive influence on the circulation, we decided to evaluate sympathetic nervous function by using standard noninvasive cardiovascular reflex test. i. e. cold pressor test [5].

Vascular reactivity is defined as the responsiveness of a blood vessel to a specific stimulus. Many physiological responses follow external stimuli in the vasculature; the most commonly noted responses are vasodilation and vasoconstriction. This is perhaps due to the fundamental role of the vasculature to distribute and regulate blood flow via functional and structural mechanisms. Vasoconstriction increases resistance, tone, and subsequently, decreases blood flow while vasodilation does the opposite [8]. It is the balance between vasoconstrictor and vasodilator factors which is ultimately of utmost importance when assessing vascular reactivity [9].

Tachycardia and cold provocation in elderly females produces greater vascular reactivity. Cold environmental temperatures increase sympathetic nerve activity andblood pressure, and increases the risk of acute cardiovascular events in aged individuals. Blood pressure (BP) hyper-reactivity to the cold pressor test (CPT) hasbeen suggested as a predictor of hypertension. An inverse association exist between arterial blood pressure and vascular sympatheticreactivity to isometric handgrip exercise [10].

Older individuals also had greater vagal withdrawal during stress compared to younger individuals [11]. Exaggerated sympathetic nervous system responses to stressors maybe one potential mechanism that predisposes overweight individuals to developing hypertension [12].

CPT induces sympathetic responses that are subnormal in hypertensive patients and those with a family history of hypertension, highlighting the importance of genetic factors in determining the sympathetic nervous reactivity to CPT [13].

Material and methods

The prospective study was conducted in the Department of Physiology, Uttar Pradesh University of Medical Sciences (UPUMS), Saifai, Etawah, India. The pregnant females of 18 to 35 years of age having the gestation of 7- 8 weeks as per the ultra-sonographic scanning, reporting to the Out Patient Department (OPD) of Obstetrics and Gynaecology referred to the Department of Physiology, were recruited for the assessment of sympathetic vascular reactivity by cold pressor test (CPT) as described by Hines (1940) [12]. The following materials were required to conduct the study: 1. Mercurial sphygmomanometer: To measure blood pressure, 2. Stethoscope: To measure blood pressure, 3. Cold water (4-5^{0}C): As cold stimulus for sympathetic vascular reactivity and 4. Thermometer: To measure temperature of the cold water to prevent temperature variations.

After explaining the procedure of cold pressor test to the subjects, the informed written consent to participate in study was taken from each subject. A detailed history (including family and personal history) was taken to rule out any exclusion criteria. After anthropometric assessment the subjects were requested to take rest for 10 minutes. After 10 minutes of rest, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded in sitting position.

The sympathetic vascular reactivity was assessed by cold pressor test by the method as described by Hines (1940) [10]. According to which, after 10 minutes of rest the subject was evaluated for the baseline SBP and DBP by auscultatory method using mercurial sphygmomanometer. Then the subject was asked to immerse one hand up to the wrist in ice cold water (4-5 degree Celsius) for one minute. The SBP and DBP were recorded after one minute with immersed hand. The change in the systolic blood pressure (ΔSBP) and diastolic blood

pressure (ΔDBP) was calculated by subtracting pre-test reading from the reading obtained during hand immersion state.

Observation and Results

A total of 225 pregnant females with gestation age of 7-8 weeks as per the ultra-sonographic reports were recruited in the study and were divided into 3 groups 18-23 years (n=132), 24-29 years (n= 78) and 30-35 years (n=15). The baseline SBP were 102.90 ± 11.95 mm Hg, 103.23 ± 12.58 mm Hg, and 113.23 ± 12.53 mm Hgrespectively in different age groups. The baseline DBP was 63.90 ± 9.20 mm Hg, 65.78 ± 10.92 mm Hg and 71.33 ± 9.17mm Hg. It was observed that resting SBP and DBP increased with maternal age.

The change in SBP and DBP during CPT was 12.02±11.56 mm Hgand 12.12 ± 10.57 mm Hgin 18-23 years of age, 13.76 ± 16.22 mm Hgand 13.15 ± 14.99 mm Hgin 24-29 years of age, 12 ± 14.62 mm Hgin 30-35 years of age. This shows that there is more change in SBP and DBP till the age of 25-29 years which further decreased in 30 -35 years of age group.

Table 1:

Age in years	Pre-test		During-test		Change in pre-test and post-test	
	SBP (mm Hg)	DBP (mm Hg)	SBP (mm Hg)	DBP (mm Hg)	SBP (mm Hg)	DBP (mm Hg)
18-23 (n=132)	102.90 ± 11.95	63.90 ± 9.20	114.93 ± 12.87	76.03 ± 12.49	12.02 ± 11.56	12.12 ± 10.57
24-29 (n=78)	103.23 ± 12.58	65.78 ± 10.92	117 ± 18.15	78.93 ± 16.01	13.76 ± 16.22	13.15 ± 14.99
30-35 (n=15)	113.2 ± 12.53	71.33 ± 9.17	125.2 ± 19.15	82 ± 11.43	12 ± 14.62	10.66 ± 7.78

Discussion

A total of 225 pregnant females with gestation age of 7-8 weeks as per the ultra-sonographic reports were recruited in the study and were divided into 3 groups 18-23 years (n= 132), 24-29 years (n= 78) and 30-35 years (n=15). Thebaseline SBP were 102.90 ± 11.95 mm Hg, 103.23 ± 12.58 mm Hg, and 113.23± 12.53 mm Hg respectively in different age groups. The baseline DBP was 63.90 ± 9.20mm Hg, 65.78 ± 10.92mm Hg and 71.33 ± 9.17mm Hg.

It was observed that resting SBP and DBP increased with maternal age which may be due to increase sympathetic activityas reported by Romy gaillard (2011)[13]. These findings are also consistent with the findings of Pfeifer MA (1983) [14] who hypothesised that there is sympathetic nervous system and parasympathetic nervous system compensation of cardiovascular function in response to an age-related decrease in baroreceptor sensitivity. Van Katwijk C Peeters LL (1998) [15] suggested that older age is associated with a gradual loss of vascular compliance, which subsequently leads to a higher afterload.

The change in SBP and DBP during CPT was 12.02 ± 11.56 mm Hg and 12.12 ± 10.57 mm Hg in 18-23 years of age, 13.76 ± 16.22 mm Hg and 13.15 ± 14.99 mm Hg in 24-29 years of age, 12 ± 14.62 mm Hg in 30-35 years of age. This shows that there is more change in SBP and DBP till the age of 25-29 years which further decreased in 30 -35 years of age group.This may be due to increased sympathetic activity already present in the higher age group as compared to lower age group. Thus the change in sympathetic reactivity as contributed by the cold stimulus given during CPT is less in higher age group as compared lower age group.These findings are in correlation with the findings of Shaikh WA (2014)[16] who reported that an inverse association exist between arterial blood pressure and vascular sympatheticreactivity to isometric handgrip exercise in Gujarati Indian adolescents.

Similar findings were also reported by Uchino BN (1999) [9], that the older individuals had greater vagal withdrawal during stress compared to younger individuals.Park J (2012) [10] concluded that exaggerated sympathetic nervous system responses to stressors maybe one potential mechanism that predisposes overweight individuals to developing hypertension.

According to Lambert EA (2004) [11] CPT induces sympathetic responses that are subnormal in hypertensive patients and those with a family history of hypertension, highlighting the importance of genetic factors in determining the sympathetic nervous reactivity to CPT.

Conclusions

The results of this study indicate that there is

an ambiguous relation of sympathetic vascular reactivity with age in pregnancy. As assessment of sympathetic vascular reactivity reflected as blood pressure reactivity has been used as one of the predictor for the development of hypertension and cardiovascular diseases. Thus, the subjects having increased sympathetic vascular reactivity may develop hypertensive disorders of pregnancy at later stages. Therefore, these subjects should be counseled for taking up parasympathetic stimulatory exercises like meditation.

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