International Research Journal of Biological Sciences _____ ISSN 2278-3202
Vol. **2(10),** 30-35, October **(2013)** *Int. Res. J. Biological Sci.*

Autonomic Response to Cold Pressor Test in Relation to ABO Blood Groups

David M. Anthony[1], Hashmi Syed Salman Hamid[2] and Rashmi T.M.[2]
[1]Dept of Physiology, Deccan College of Medical Sciences, DMRL X Roads, Kanchanbagh, Hyderabad 500 058, INDIA
[2]Deccan College of Medical Sciences, DMRL X Roads, Kanchanbagh, Hyderabad 500 058, INDIA

Available online at: www.isca.in, www.isca.me
Received 25th June 2013, revised 8th July 2013, accepted 9th August 2013

Abstract

Studies show that subjects with high cardiovascular sensitivity accompanied by delayed recovery time after the stimulus subsides, are at a comparatively greater risk of cardiovascular morbidity, in specific hypertension, in the later life. The cold press or response is an indicator of sympathetic activity after cold stress. The cold pressor test was done on subjects with various blood groups. The study was conducted on medical students in the age group 17-30 years. The data was analyzed for statistical significance. In the seated blood pressure more than half had a high normal blood pressure (63.31%) followed by normal (35.91%) and grade one hypertension. In the cold pressor reaction more than half (83.1%) were normo- reactors and the remaining hyper -reactors (16.9%). More than half (65%) and all (100%) the hyper- reactors had atleast one hypertensive parent in males and females respectively. After the test, blood pressure did not return to normal in more than half of both males (63.45%) and females (57.15%). The relation between the blood pressure and blood group was not statistically significant. We deduce that blood groups have no effect on the cold pressor test. In the seated blood pressure most subjects had a high normal blood pressure which were higher in males compared to females. The hyper- reactors were significantly high in males compared to females. And the history of hypertension even in one parent seems to be a significant factor in hyper -reactors in both males and females. Thus hyper- reactors can take preventive care so as to prevent the cardiac morbidity . The children of hypertensive patients can take preventive life style changes to decrease their risk for developing hypertension in future thus cardiac morbidity.

Keywords: Medical students, cold pressor test, autonomic nervous function, ABO blood groups.

Introduction

Blood groups as a potential risk factor for cardiovascular morbidity is still under evaluation .Studies have been done in the past between relation of blood group and risk of developing cardiovascular diseases in future[1]. Abnormal autonomic response also plays a role in cardiac morbidity. Studies show that subjects with high cardiovascular sensitivity accompanied by delayed recovery time after the stimulus subsides, are at a comparatively greater risk of cardiovascular morbidity, in specific hypertension, in the later life[2]. Sympathetic over activity plays an significant role in development of neurogenic hypertension[3].

In the following study an attempt was made to determine the sympathetic nervous system response to stimulus and its variation with blood groups. The cold pressor response is an indicator of sympathetic activity after cold stress. A healthy response to a cold pressor test(CPT) is sympathetic activation which in turn causes an increase of blood pressure. Clinically the test evaluates autonomic function. So the test was performed on selected subjects. The family history of hypertension was taken into account as it will have a influence on the reading of the test[4-6].

Many studies have reinforced cold pressor test as a tool to predict the chances of a person becoming hypertensive later on in life. Studies prove that black subjects have a greater risk of developing cardiovascular morbidity and show stronger reaction to cold press or test when compared to the white subjects[7]. The association between hypertension and sympathetic over activation has been established[8-10]. Hence if a particular blood group individuals have an abnormal cold pressor response this would reinforce that this blood group is a potential risk factor for cardio vascular morbidity.

Material and Methods

The study was conducted on medical students during June 2013 in the department of physiology in a medical college in south India. Subjects with age group of 17-30 years were included. Exclusion of those subjects with any history of chronic illness or drug intake that may have a potential affect on the cardiovascular parameters was done. Age, sex, blood group, history of hypertension in parents was recorded. Height and weight of the subjects were measured to calculate their body mass index. Stadiometer was used to measure the height to nearest 1 cm with subject standing without shoes and weighing scale was used to record the weight to the nearest 1 kg. Mercury sphygmomanometer was used to record the blood pressure in the right arm in the seated position. Ten minutes rest was given before measuring the blood pressure to free the subject of anxiety. The systolic and the diastolic blood pressure were marked by 1st and the 4th korotkoff sounds.

In the cold pressor test (CPT) after an initial blood pressure recording subjects were asked to dip their left hand up to the level of their wrist in a water container having 4 degrees Celsius water for duration of 1 minute. During the cold pressor test a second recording of blood pressure was taken. Third recording of blood pressure was taken after 5 minutes from the test till then the hand was wrapped in a towel. An overview of the complete test was given to all subjects before starting the procedure. All the recording was done by the same investigator. Calibration of the instruments was done before the test was performed.

Based on the reactivity to cold pressor test the subjects were divided into two groups that is normo-reactors (NR) and hyper-reactors (HR)[11]. A well-accepted criterion based on the work of Edgar A Hines Jr was used to divide subjects into hyper-reactors and normo-reactors[11]. This criterion has been widely used by many authors[12,13]. Subjects with rise of systolic blood pressure of more than 22 mm of hg and /or rise of diastolic blood pressure by 18 mm of hg were grouped as hyper-reactors. Only subjects with systolic and diastolic blood pressures rise not more than 22 mm of hg and 18 mm of hg respectively came under the normo-reactors[6,14,15].

The blood group of each of the subjects was determined by agglutination test by using known commercial anti-sera by tile method.

Keeping cold pressor test as the stimulus, the response was recorded in the subjects with various blood groups. Then the results of the cold pressor test were evaluated and checked for any variation in relation to blood groups. A test of significance was performed. The data was analyzed by Epi-info 6.04 version and the p – value was determined.

Results and Discussion

The maximum number of subjects were aged 20-25 (81.69%) and minimum between the age 17 – 20 (1.40%). Males outnumbered the females in the study as shown in table-1. Subjects with blood group O (35.94%) were maximum followed by B (24.64%), A (23.23%), AB (16.19%) respectively. In males the subjects with blood group O (38.70%)were highest and in females the blood group B (32.65%) were highest. In both males and females the subjects with blood group AB (16.12% , 16.32%) were the least as shown in table- 2.

Table -1
Age and Sex Distribution

	SEX		
Age	**Male**	**Female**	**Total**
17-20	0(0%)	2(4.09%)	2(1.40%)
20-25	73(78.49%)	43(87.75%)	116(81.69%)
25-30	20(21.51%)	4(8.16%)	24(16.91%)
Total	93	49	142

Table- 2
Blood Group Distribution

Blood Group	Frequency (Males)	Frequency (Females)	Total
A	23(24.73%)	10 (20.40%)	33 (23.23%)
B	19(20.45%)	16 (32.65%)	35 (24.64%)
AB	15(16.12%)	8 (16.32%)	23 (16.19%)
O	36(38.70%)	15 (30.63%)	51 (35.94%)
Total	93	49	142

Maximum subjects had a normal body mass index (58.45%) followed by pre obese (33.82%), obesity grade one (4.92%) and remaining low body mass index(2.81%). In the males the number of subjects falling in pre obese (37.64%) and obesity grade one category (5.38%) were higher when compared to the pre obese (26.54%) and obesity grade one category in females (4.08%)[19] as shown in table- 3.

In the seated blood pressure more than half had a high normal blood pressure (63.31%) followed by normal (35.91%) and grade one hypertension (0.78%)[20] as shown in table- 4. Among the high normal subjects maximum were males (95.55%) followed by females (4.5%). Among the male in blood group AB all were hypertensive and in females blood group B (25%) were hypertensive as shown in table-5 and table-6.

In the cold pressor reaction more than half (83.1%) were normo-reactors and the remaining hyper- reactors(16.9%) as shown in table-7. Among the hyper- reactors males (21.50%) out numbered the females (8.17%) as shown in table -7. In case of male hyper reactors maximum (5.5%) of the subjects had a pre-obese body mass index when compared to female hyper reactors (2%) as shown in table -8 and table-9. More than half (65%) and all (100%) the hyper -reactors had atleast one hypertensive parent in males and females respectively as shown in table- 10.

After the test blood pressure did not return to normal in more than half of both males (63.45%) and females (57.15%) as shown in table-11. In the blood group B highest number of subjects did not have a return of blood pressure to normal in both males (78.94%) and females (62.5%) when compared to other blood groups table-12, table-13. In the subjects with above normal body mass index more than half of the subjects did not have a return of blood pressure to normal in both males (57.5%) and females (61.54%) as shown in table-14 and table-15.

When the relation between blood group and blood pressure rise was evaluated the following p values were obtained. For the relation of systolic blood pressure and diastolic blood pressure rise and blood groups in males were 0.1415 and 0.0728 respectively as shown in table-16. In case of females the p values for relation between systolic blood pressure rise and diastolic blood pressure rise with blood group were 0.675 and 0.1706 respectively as shown in table-17. Both the relations were not significant from the p -values. Thus the blood pressure

rise and blood group was not found to be significant as shown in table -16 and table-17.

The relation between the blood pressure rise and blood groups was not found statistically significant. However, the systolic blood pressure rise was more than that of the diastolic pressure rise in both females and males as shown in table-16 and table-17. Systolic blood pressure is influenced by cardiac contractility which increases by sympathetic innervations. Its an indicator of work load on the heart and is characterized by a lot of fluctuations. Diastolic blood pressure on the other hand undergoes less degree of fluctuations and is of greater prognostic importance than the systolic blood pressure. Arterial blood pressure is an important factor in epidemiology of cardiovascular disease due to its association with anthropometric and demographic causes. According to Kasagi, Germano et al, Lambert and Schlaich blood pressure responses to cold pressor test are probably affected by different factors related to participants emotional state and coping style[16-18].

Table -3
Body Mass Index

Body Mass Index	Frequency (Males)	Frequency(Females)	Total
< 18.5	0(0%)	4(8.16%)	4(2.81%)
18.5 – 24.9	53(56.98%)	30(61.22%)	83(58.45%)
25-29(pre-obese)	35(37.64%)	13(26.54%)	48(33.82%)
30-34.9(obese grade 1)	5(5.38%)	2(4.08%)	7(4.92%)
35-39.9(obese grade 2)	0(0%)	0(0%)	0(0%)
Greater Than Or Equal To 40 (obese grade 3)	0(0%)	0(0%)	0(0%)
Total	93	49	142

Table- 4
Seated Blood Pressure

Seated Blood Pressure(mm of Hg)	Males	Females	Total
Normal-<130/80	6 (6.45%)	45 (91.83%)	51 (35.91%)
High Normal -130-139/85-90	86 (92.47%)	4 (8.17%)	90 (63.31%)
Stage 1 Hypertension -140-159/90-99	1 (1.09%)	0(0%)	1(0.78%)
Stage 2 -160-179/100-109	0 (0%)	0 (0%)	0
Stage3->180/110	0 (0%)	0 (0%)	0
Total	93	49	142

Table- 5
Seated Blood Pressure Versus Blood Groups In Males

Seated Blood Pressure	Blood Group				
	A	B	AB	O	Total
Hypertensive	22 (95.65%)	17 (89.47%)	15 (100%)	33 (91.66%)	87 (93.55%)
Non-Hypertensive	1 (4.35%)	2 (10.53%)	0 (0%)	3 (8.34%)	6 (6.45%)
Total	23	19	15	36	93

Table -6
Seated Blood Pressure versus Blood Groups in Females

Seated Blood Pressure	Blood Group				
	A	B	AB	O	Total
Hypertensive	0(0%)	4 (25%)	0 (0%)	0(0%)	4 (8.17%)
Non-Hypertensive	10 (100%)	12 (75%)	8 (100%)	15 (100%)	45 (91.83%)
Total	10	16	8	15	49

Table -7
Cold Pressor Test Interpretation

	Frequency(Males)	Frequency(Females)	Total
Hyper-reactors	20 (21.50%)	4(8.17%)	24 (16.9%)
Normo-reactors	73 (78.50%)	45(91.83%)	118 (83.1%)
Total	93	49	142

Table -8
Body Mass Index Versus Cold Pressor Test Reaction In Males

Body Mass Index	Normo-reactors	Hyper-reactors	Total
< 18.5	0(0%)	0(0%)	0(0%)
18.5 – 24.9	44 (60.28%)	9 (4.5%)	53 (56.98%)
25-29(Pre-Obese)	24 (32.88%)	11 (5.5%)	35 (37.72%)
30-34.9(Obese Grade 1)	5 (6.84%)	0(0%)	5 (5.3%)
35-39.9(Obese Grade 2)	0 (0%)	0 (0%)	0 (0%)
Greater Than Or Equal To 40 (Obese Grade 3)	0 (0%)	0 (0%)	0 (0%)
Total	73	20	93

Table -9
Body Mass Index Versus Cold Pressor Test Reaction In Females

Body Mass Index	Normo-reactors	Hyper-reactors	Total
< 18.5	4 (9.09%)	0(0%)	4 (8.18%)
18.5 – 24.9	28 (63.63%)	4 (8%)	32 (65.30%)
25-29(Pre-Obese)	10 (22.78%)	1 (2%)	11 (22.44%)
30-34.9(Obese Grade 1)	2 (4.5%)	0 (0%)	2 (4.08%)
35-39.9(Obese Grade 2)	0 (0%)	0 (0%)	0 (0%)
Greater Than Or Equal To 40 (Obese Grade 3)	0 (0%)	0 (0%)	0 (0%)
Total	44	5	49

Table -10
Family History of Hypertension versus Cold Pressor Reaction in Males

Type Of Case	Total Number of Cases	Hyper-reactors	Normo-reactors
Family History of Hypertension	55 (59.14%)	13(65%)	42(57.5%)
No Family History of Hypertension	38 (40.86%)	7(35%)	31(42.5%)
Total	93	20	73

Table -11
Family History of Hypertension Versus Cold Pressor Reaction in Females

Type Of Case	Total Number of Cases	Hyper-reactors	Normo-reactors
Family History of Hypertension	36 (73.46%)	4(100%)	26(57.77%)
No Family History of Hypertension	13 (26.54%)	0 (0%)	19(42.23%)
Total	49	4	45

Table -12
Time for Blood Pressure to Return to Normal after Cold Pressor Test Versus Blood Groups in Males

	A	B	AB	O	TOTAL
Blood Pressure Returned To Normal In 5 Minutes	6 (26.09%)	4 (21.06%)	5 (33.34%)	19 (52.77%)	34 (36.55%)
Blood Pressure Not Return To Normal In 5 Minutes	17 (73.91%)	15 (78.94%)	10 (66.66%)	17 (47.23%)	59 (63.45%)
Total	23	19	15	36	93

Table -13
Time for Blood Pressure to Return to Normal after Cold Pressor Test Versus Blood Groups in Females

	A	B	AB	O	TOTAL
Blood Pressure returns To normal In 5 minutes	4 (0.4%)	6 (37.5%)	4 (0.5%)	9 (0.6%)	23 (43.93%)
Blood Pressure not returned to Normal In 5 Minutes	6 (0.6%)	10 (62.5%)	4 (0.5%)	6 (0.4%)	26 (53.04%)
Total	10	16	8	15	49

Table -14
Time for Blood Pressure to Return to Normal after Cold Pressure Test Versus Body Mass Index in Males

	Normal body mass index	Above Normal body mass index	TOTAL
Blood Pressure Return To Normal In 5 Minutes	17 (32.08%)	17 (42.5%)	34 (36.55%)
Blood Pressure Not Return To Normal In 5 Minutes	36 (67.92%)	23 (57.5%)	59 (63.45%)
Total	53	40	93

Table -15
Time For Blood Pressure To Return To Normal After Cold Pressor Test versus Body Mass Index in Females

	Normal body mass index	Above Normal body mass index	Total
Blood Pressure Return To Normal In 5 Minutes	16 (44.45%)	5 (38.46%)	21 (42.85%)
Blood Pressure Not Return To Normal In 5 Minutes	20 (55.55%)	8 (61.54%)	28 (57.15%)
Total	36	13	49

Table -16
Blood Group versus Cold Pressure Test Result and their P-Value in Males

Blood Group	Cold Pressor Test							
	Systolic Blood Pressure				Diastolic Blood Pressure			
	Mean	Standard Deviation	P Value	Significance	Mean	Standard Deviation	P-Value	Significance
A	16.60	3.92	0.1415	Not Significant	13.5	5.28	0.0728	Not Significant
B	15.05	5.55			13.57	6.02		
AB	17.73	4.7			16.9	5.0		
O	14.8	4.36			12.66	4.7		

Table- 17
Blood Group Versus Cold Pressor Test Result And Their P-Value In Females

Blood Group	Cold Pressor Test							
	Systolic Blood Pressure				Diastolic Blood Pressure			
	Mean	Standard Deviation	P Value	Significance	Mean	Standard Deviation	P-Value	Significance
A	11.20	7.00	0.675	Not Significant	10.10	5.42	0.1706	Not Significant
B	9.93	7.58			7.43	4.96		
AB	13.50	4.75			12.87	4.58		
O	11.93	4.36			9.800	6.68		

Conclusion

Our study leads us to conclude that blood group has no effect on the cold pressor test and so on autonomic function. Maximum subjects had a high normal seated blood pressure (Males more than females). The hyper reactors were significantly high in males compared to females. Parental history of hypertension seems to be a significant factor in hyper-reactors in both males and females.

The relation between the blood pressure rise and blood groups was not found statistically significant. Since there are very few similar studies[21], we cannot be sure whether there is a correlation - causal or otherwise. Further studies may implicate a particular type of blood group. If so those blood group individuals are more prone for cardiovascular morbidity.

Several studies have indicated that the cardiovascular response to the cold pressor test can be a predictor for development of hypertension later on in life[8,9,10]. Thus hyper reactors can take preventive care so as to prevent cardiac morbidity.

From our study we can interpret that family history of hypertension plays a significant role in the reaction of the cold pressor test . Thus children of hypertensive patients can take preventive life style changes to decrease their risk for developing hypertension and further cardiovascular morbidity in future.

Acknowledgement

We would like to appreciate the co-operation of the medical students for allowing us to conduct the test on them. We would

also like to thank the department of physiology of our institution for their help.

Limitations of the Study: i. Our study could not control various other factors like anxiety which influence the arterial blood pressure. ii. The sample size was relatively small. iii. Only young adults between 17 to 30 years were studied.

References

1. Meian He, Brian Wolpin, Kathy Rexrode, JoAnn E. Manson, Eric Rimm, Frank B. Hu and Lu Qi, ABO Blood Group and Risk of Coronary Heart Disease in Two Prospective Cohort Studies Author Affiliations Correspondence to Lu Qi, MD, PhD, Department of Nutrition, Harvard School of Public Health, Boston, MA 02115.PMID: 22895671 [PubMed - indexed for MEDLINE] PMCID: PMC3488453 [Available on 2013/9/1] **(2013)**

2. Pramanik T., Regmi P. and Shrestha P., Detection of individuals prone to develop hypertension in their future life, *Nepal Med Coll J*., **10**, 35–37 **(2008)**

3. Schneider G.M., Jacobs D.W., Gevirtz R.N., O'Connor D.T., Cardiovascular haemodynamic response to repeated mental stress in normotensive subjects at genetic risk of hypertension: evidence of enhanced reactivity, blunted adaptation and delayed recovery, *J Human Hypertens*, **17**, 829–840 (**2003)**

4. Wood D.L., Sheps S.G., Eleback L.R. and Schirger A., Cold pressor test as a predictor of hypertension, *Hypertension*, **6**, 301–306 (**1984)**

5. Briggs J.F. and Getting H., Vasomotor response of normal and hypertensive individuals to thermal stimulus (cold), *Minn Med*., **16**, 481–486 (**1981)**

6. Hines E.A., Jr. Significance of Vascular Hyper reaction as measured by Cold-Pressor test, *American Heart J*., **19**, 408–416 (**1940)**

7. Kelsey R.M., Patterson S.M., Barnard M. and Alpert B.S., Consistency of hemodynamic responses to cold stress in adolescents, *Hypertension*, **36**, 1013–1017 **(2000)**

8. Jacques de Champlain and Marie Reine Van Amerigen, Regulation of Blood Pressure by Sympathetic Nerve fibres and Adrenal Medulla in Normotensive and Hypertensive Rats, *Circulation Research*, **31**, 617–628 **(1972)**

9. Mancia G., Di Rienzo M., Giannattasio C., Parati G. and Grassi G., Early and late sympathetic activation in hypertension, *Scand Cardiovasc J Suppl*., **47**, 9–14 **(1998)**

10. DeQuattro V. and Feng M., The Sympathetic nervous system: the muse of primary hypertension, *J Hum Hypertens*, March **16 Suppl 1**, S64–S69 **(2002)**

11. Hines E.A., Jr. Reaction of the Blood Pressure of 400 school children to a standard stimulus, *JAMA*, **108**, 1249–1250 **(1937)**

12. Barnett P.H. and Hines E.A., Jr., Alaxander Schirger and Robert P. Gage: Blood pressure and vascular reactivity to the cold pressor test, *JAMA*, **183(10),** 845–848 (**1963)**

13. McIlhany M.L., Shaffer J.W., Hines E.A., Jr. The heritability of blood pressure : an investigation of 200 pairs of twins using the cold pressor test, *Johns Hopkins Med J*., **136(2),** 57–64 **(1975)**

14. Gupta A.K., Influence of family history of morbid cardiovascular events on blood pressure levels of school children, *Indian Pediatrics*, **28**, 131–139 **(1991)**

15. Thacker EA. A comparative study of normal and abnormal blood pressures among university students including the cold pressor test. *American Heart J*., **2**,89 **(1940)**

16. Verma V., Singh S.K. and Ghosh S., Identification of susceptibility to hypertension by the cold pressor test, *Indian J Physiol Pharmacol*, **49(1),** 119-20 **(2005)**

17. Kasagi F., Akahoshi M. and Shimaoka K., Relation between cold pressor test and development of hypertension based on 28 year follow up, *Hypertension*, **25**, 71-6 **(1995)**

18. Germano G., Lintas F., Truini A., Raggazzo M., Lannetti G.D. and Sperduti L et al., Blood pressure, *High Blood Pressure and Cardiovascular Prevention*, **2(10),** 87-90 **(2003)**

19. Global Database on *Body Mass Index - World Health Organization,* www.who.int/bmi/index, The International Classification of adult underweight, overweight and obesity according to BMI **(2013)**

20. K. PARK, Park's *Textbook of Preventive and Social Medicine* XX Edition, classification of hypertension ,page number 323 (**2009**)

21. Nishi K., Gupta N.K. and Sharma S.C. Study on the Incidence of Hypertension and Migraine in ABO Blood Groups, *ISCA J. Biological Sci.,* **1(2)**, 12-16 **(2012)**