International Journal of Research in Medical Sciences
Malarvannan KA et al. Int J Res Med Sci. 2023 Jun;11(6):2006-2009
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20231608

Original Research Article

Study of cardiovascular responses to isometric hand grip test in medical students with hypertensive parents

Malarvannan K. A.[1], Sivapriya A.[2]*

[1]Department of Surgery, Government Ramanathapuram Medical College, Ramanathapuram, Tamil Nadu, India
[2]Department of Physiology, Government Sivagangai Medical College, Sivagangai, Tamil Nadu, India

Received: 29 December 2022
Revised: 18 March 2023
Accepted: 19 May 2023

***Correspondence:**
Dr. Sivapriya A.,
E-mail: sivi1379@gmail.com

ABSTRACT

Background: Hypertension is one of the most powerful risk factors for cardiovascular disease. This biggest health challenge has to be detected early so that preventive measures can be taken for the susceptible population. Increased cardiovascular stress responsivity with sustained isometric muscle contraction is associated with cardiovascular disease. So this isometric handgrip exercise is a simple, non-invasive screening test to assess the risk of development of hypertension in future. Aim and objective of the study was to identify the chance of inheritance of hypertension in medical students of hypertensive parents.
Methods: After getting ethical committee approval, in this cross sectional study, 50 medical students of Government Sivagangai Medical college with normotensive and hypertensive parents were selected. Heart rate (bpm) and blood pressure (mmHg) before, immediately and 5 minutes after isometric hand grip exercise using hand grip dyanamometer in both the groups.
Results: Statistical analysis of the values among the participants was done by student t-test using statistical package for the social sciences (SPSS) version 11.0.and the results were compared between the study and control groups. A 'p' value of <0.05 is considered significant. Cardiovascular responses are found to be significantly higher in study group ($p<0.001$).
Conclusions: Early and regular screening of the students with hypertensive parents is necessary to prevent cardiovascular complications in future by emphasizing the life style modifications.

Keywords: Cardiovascular, Isometric exercise, Hypertension

INTRODUCTION

Hypertension is a biggest health challenge has to be detected early so that preventive measures can be taken for the susceptible population.[1] An early diagnosis of primary hypertension can prevent 3,00,000 of the 1.5 million deaths which result from cardiovascular diseases in India.

Hypertension is a transitory or chronic elevation of the blood pressure in the arteries.[2] According to International Society of Hypertension Global Hypertension Practice Guidelines, the criteria for diagnosing hypertension are having a systolic blood pressure greater than or equal to 140 mmHg, having a diastolic blood pressure greater than or equal to 90 mmHg and/or taking antihypertensive medication.[3]

Rapid urbanization, sedentary life style, junk food and stress are the powerful environmental factors which are responsible for the increasing prevalence of hypertension.[4] Hypertension is a global burden which makes lot of changes in our body including damage to vision, chest pain, muscular fatigue, vascular rupture and haemorrhagic stroke. This needs to be diagnosed at an earlier stage for proper management and preventing complications.[5]

The aim of this study is to compare the cardiovascular responses to an isometric exercise in medical students to identify the chance of inheritance of hypertension in medical students of hypertensive parents.

METHODS

This cross sectional study was done at Government Sivagangai Medical college for the period of 6 months from April 2019 to September 2019.

Study group

25 medical students with one or both parents having essential hypertension were a part of the study group.

Control group

25 medical students with normotensive parents served as the control.

Inclusion criteria

Normotensives, age 18-24 years, with normal body mass index (BMI) 18.5–25 were included in the study.

Exclusion criteria

Patients with hypertension, hepatic and renal diseases, muscular disorders, endocrine disorders, and drug intake were excluded.

Materials and methodology

After getting ethical committee approval, age and BMI matched 50 medical students from Government Sivagangai Medical college with normotensive parents (n=25) as control group and hypertensive parents (n=25) as study group were selected. After getting informed and written consent from the participants, medical history was taken. General examination, systemic examination was carried out. Anthropometric measurements like height (cm), weight (kg) and body mass index (kg/m^2) were recorded for the eligible students. Then cardiovascular responses like heart rate (bpm) and blood pressure (mmHg) at rest, immediately and 5 minutes after isometric hand grip exercise using hand grip dyanamometer were recorded in both the groups.

The procedure of isometric hand grip test was explained to all the students participated in the study. Before the test, the subjects were allowed to rest for 10 minutes in a quiet room to reduce the anxiety. The blood pressures of all the subjects were measured by the auscultatory method with the help of a mercury sphygmomanometer. The appearance of Korotkoff's sound indicates the systolic blood pressure (SBP) and the disappearance of Korotkoff's sound indicates the diastolic blood pressure (DBP). Difference between systolic and diastolic pressure gives the value of pulse pressure. Mean blood pressure is calculated by the following formula

$$MBP = DBP + 1/3\,rd\ of\ the\ pulse\ pressure$$

The isometric hand grip exercise test was done in both the study and the control groups. After recording their basal blood pressures and pulse rate, the students were asked to perform the isometric hand grip exercise using the dynamometer. The dynamometer has a dual scale readout which displays isometric grip force from 0-90 kg (0-200 lb). The outer dial registers the result in kg and the inner dial registers the result in lb. It has a peak hold needle which automatically retains the highest reading until the device is reset. The handle easily adjusts to five grip positions from 35-87 mm (1½ - 3¼") in 13 mm (½") increments. Always use the wrist strap to prevent the dynamometer from falling on the floor if accidentally dropped. The purpose of using a hand dynamometer is to measure the maximum isometric strength of the hand and forearm muscles. The hand dynamometer can be adjusted for hand size and must be calibrated regularly for consistent results.

The students were asked to hold the hand grip spring dynamometer in the right (or dominant) hand to get a full of grip of it. The handles of the dynamometer were compressed by the students by putting in maximum effort for few seconds. The position of elbow being held at right angles as per the above procedure, the arm hanging by the side and the extended arm being swung from above the head to by the side during the squeezing motion. Depending on the position of the arm and hand, different results can be achieved. So, the students were requested not to change the position in between the procedures for better results. This whole procedure was repeated thrice with rests in between to prevent fatigue. The maximum of the three reading was referred to as the maximal isometric tension (T max).

The students were asked to perform the isometric handgrip exercise at 30% of T max for 2 minutes. During the test, the blood pressure and pulse rate were recorded from the non-exercising arm within at least 15 seconds of recovery. The blood pressure and pulse rate were again recorded 5 minutes after the completion of the exercise. By recording heart rate (bpm) and blood pressure (mmHg) before, immediately and 5 minutes after isometric hand grip exercise using hand grip dyanamometer in both the groups, comparison was done to show how the pressures vary in the different stages of the above procedures and how it differs in the two groups mentioned above.

Statistical analysis

Statistical analysis of the values among the participants was done by student t-test using statistical package for the social sciences (SPSS) version 11.0 and the results were compared between the study and control groups. A 'p' value of <0.05 is considered significant.

RESULTS

In this study, 12 male students and 13 female students in study group and 10 male students and 15 female students in control group were participated. Demographic data were shown in Table 1.

Statistical values of heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure at rest, immediately and 5 minutes after isometric hand grip test in the participants are shown in Table 2.

The results showed that at rest, heart rate, systolic (SBP), diastolic (DBP) and the mean (MBP) blood pressures were significantly higher ($p<0.0001$) in the offsprings of the hypertensive parents as compared to those in the control subjects of normotensive parents. Immediately after the isometric handgrip exercise test, the rise in the heart rate, systolic, diastolic and the mean blood pressures were significantly higher ($p<0.0001$) in the offsprings of the hypertensive parents. After 5 minutes of isometric handgrip exercise test, heart rate, systolic, diastolic and the mean blood pressures were found to be significantly higher ($p<0.0001$) in the study group as compared to those in the control group.

Table 1: Demographic data.

S. no.	Data	Study group (n=25)		Control group (n=25)	
		Mean	SD	Mean	SD
1	Age (years)	20.2	2.4	20.8	1.8
2	BMI	22.63	3.07	23.59	3.39

Table 2: Statistical values in study group and control group.

Condition	Heart rate (bpm), mean±SD	Systolic blood pressure (mmHg), mean±SD	Diastolic blood pressure (mmHg), mean±SD	Mean arterial pressure (mmHg), mean±SD
Study group (n=25)				
At rest	72.3±3.4	122.4±3.4	76.4±1.2	90.8±3.0
Immediately	84.2±6.5	136.2±6.2	86.2±4.4	104.2±4.2
After 5 minutes	79.4±4.2	130.4±2.8	84.4±2.6	98.6±1.8
Control group (n=25)				
At rest	70.1±2.2	118.4±1.2	70.4±1.8	80.4±2.2
Immediately	75.3±3.5	124.4±2.6	72.2±2.4	92.4±1.6
After 5 minutes	72.6±3.2	122.2±3.0	70.6±3.2	88.2±2.6

DISCUSSION

The blood pressure is regulated by the autonomic nervous system. An increased sympathetic tone could be considered as a risk factor for the development of hypertension in future.[6] This impairment of the autonomic activity is to be detected in the young offsprings of hypertensive parents by simple tests.[7]

A routine screening test must be performed to detect asymptomatic hypertension among adolescents with a family history of hypertension.[8] The relative consistency of the haemodynamic changes which occurs during the isometric hand grip test indicates that it is a simple and a reliable method for studying the cardiovascular response to stress.[9] Life style modifications can be advised to the people under risk of developing hypertension in future.

The rise in the blood pressure is explained on the basis of the activation of the sympathetic system, which is indicated by an increase in the plasma catecholamine level.[10] During exercise, increased concentrations of metabolites like lactic acid and adenosine are detected by the nerve fibers of skeletal muscle which increases the sympathetic activity. This causes vasoconstriction and rise in blood pressure.[11]

In this study, offsprings of hypertensive parents showed enhanced vascular reactivity to total peripheral resistance during the static exercise and this explains increased blood pressures in study group of students as compared to those of the control group.[12]

Limitations

Limitation of this study is the small study population. Other autonomic function tests could be combined to enhance the validity.

CONCLUSION

Early and regular screening of the students with hypertensive parents is necessary and life style modifications can be emphasized so that cardiovascular complications can be prevented in future. Parasympathetic response can be boosted with yoga practices.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Precilla Catherine for her guidance.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365(9455):217-23.
2. Lebbie A, Wadsworth R, Saidu J, Bangura C. Predictors of Hypertension in a Population of Undergraduate Students in Sierra Leone. Int J Hypertens. 2017;8196362.
3. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, et al. 2020 International Society of Hypertension Global Hypertension Practice Guidelines. Hypertension. 2020;75(6):1334-57.
4. Millar PJ, McGowan CL, Cornelissen VA, Araujo CG, Swaine IL. Evidence for the role of isometric exercise training in reducing blood pressure: potential mechanisms and future directions. Sports Med. 2014;44(3):345-56.
5. Oyeyemi AY, Usman MA, Oyeyemi AL, Jaiyeola OA. Casual blood pressure of adolescents attending public secondary schools in Maiduguri, Nigeria. Clin Hypertens. 2015;21:16.
6. Boone JB, Probst MM, Rogers MW, Berger R. Post exercise hypotension reduces cardiovascular responses to stress. J Hypertens. 1993;11:449-53.
7. Ferrara LA, Moscato TS, Pisanti N, Marotta T, Krough V, Capone D, et al. Is the sympathetic nervous system altered in children with familial history of arterial hypertension. Cardiology. 1988;75(3):200-5.
8. Koletsos N, Dipla K, Triantafyllou A, Gkaliagkousi E, Sachpekidis V, Zafeiridis A, Douma S. A brief submaximal isometric exercise test 'unmasks' systolic and diastolic masked hypertension. J Hypertens. 2019;37(4):710-9.
9. Garg R, Malhotra V, Dhar U, Tripathi Y. The isometric handgrip exercise as a test for unmasking hypertension in the offsprings of hypertensive parents. J Clin Diagnost Res. 2013;7(6):996-9.
10. Peacock J, Diaz KM, Viera AJ, Schwartz JE, Shimbo D. Unmasking masked hypertension: prevalence, clinical implications, diagnosis, correlates and future directions. J Hum Hypertens. 2014;28(9):521-8.
11. Mathias CJ, Bannister R. Autonomic failure: A text book of clinical disorders of the autonomic nervous system. Oxford: Oxford University Press. Investigation of autonomic disorders. In Bannister R, Mathias CJ eds. 1992;266.
12. Pal GK, Pal P, Nanda N, Lalitha V, Dutta TK, Adithan C. Sympathovagal imbalance in prehypertensive offspring of two parents versus one parent hypertensive. Int J Hypertens. 2011;263170.

Cite this article as: Malarvannan KA, Sivapriya A. Study of cardiovascular responses to isometric hand grip test in medical students with hypertensive parents. Int J Res Med Sci 2023;11:2006-9.