Original Research Article

Effect of breath holding during abdominal exercise on blood pressure and heart rate in hypertensive individuals

Sweety Ashokkumar Shah[1], Kinjal Ravjibhai Patel[2*]

[1]Lecturer, [2]P.G. Student
S.B.B. College of Physiotherapy, AMC MET, V.S. Hospital Campus, Ahmedabad, Gujarat, India
[*]Corresponding author email: **kinjalv07@gmail.com**

International Archives of Integrated Medicine, Vol. 2, Issue 9, September, 2015.

Available online at http://iaimjournal.com/
ISSN: 2394-0026 (P) **ISSN: 2394-0034 (O)**
Received on: 18-08-2015 **Accepted on:** 25-08-2015
Source of support: Nil **Conflict of interest:** None declared.

Abstract

Background: Abdominal exercises have become an important part of fitness and rehabilitation. Sit ups are most common abdominal exercise performed by people without proper training. Hypertension is a progressive cardiovascular syndrome arising from complex and interrelated etiology in which the blood pressure in the arteries is elevated.

Material and methods: An experimental study including 30 hypertensive males and females aged 30-60 years was done. Exclusion criteria were back pain, spinal disorders, diabetes, renal disease, cardiovascular disease. They were divided into two groups: Group 1 performed straight and oblique sit ups with breath holding. Group 2 performed straight and oblique sit ups without breath holding. Instructions were given to perform 10 repetitions of straight and oblique sit ups with 10 min rest period between. Heart rate and blood pressure were measured before and after each set of repetition. Wilcoxon Signed Rank Test was used for within group analysis and Mann-Whitney 'U' Test was used for inter group analysis.

Results: For group A, W= -3.426, -3.458, -3.458 respectively for heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) and p=0.001 and for group B, W= -3.426, -3.475, -3.464 and p=0.001. The U value for inter group analysis is U=103.00, 73.00, 81.00 respectively for HR, SBP and DBP and p= 0.68, 0.099, 0.183 respectively for HR, SBP and DBP.

Conclusion: When performing the OPSU and SPSU exercises as used in this investigation, hypertensive individuals may experience peak heart rate and blood pressure increases. Voluntary breath holding significantly increased the blood pressure elevations for both the exercises, but particularly for the OPSU.

Key words

Abdominal exercise, Hypertension, Systolic blood pressure, Diastolic blood pressure, Heart rate.

Introduction

80% of adults will experience low back pain (LBP) at some time in their lives [1]. Of those seeking medical attention, many are prescribed abdominal strengthening exercises as part of a comprehensive treatment Program [2]. Although numerous abdominal exercises exist, researchers have reported that the straight partial sit-up (SPSU) and oblique partial sit-up (OPSU) produced high abdominal Muscle electromyography activity while maintaining low lumbar Compressive and shear forces [3-6]. consequently, these 2 Abdominal exercises are often included in therapeutic spine Stabilization and general fitness programs.

Abdominal exercise research has focused primarily on the electromyography and biomechanical aspects of exercise [7, 8]. The hemodynamic effects of abdominal resistance exercise as used in some rehabilitation and fitness programs are largely unknown. In fact, only 2 published studies [9, 10] have examined hemodynamic parameters before or after abdominal Exercise, and no study to date has examined these parameters. During abdominal exercise when the greatest hemodynamic Changes potentially occur. It is likely that heart rate and blood Pressure change during abdominal exercise because large muscle Co contractions are involved, that the exercises are expected to increase intra-abdominal pressure (IAP), and that some individuals may breathe hold during the exercises [9-14]. Prior research [12-14] has reported potentially injurious blood pressure elevations of up to 345/245 during traditional weight-resistance exercises such as the squat. Consequently, it is of clinical importance to determine the hemodynamic response to common abdominal exercises during the actual exercises.

The primary purpose of this study was to examine the Hemodynamic effects of common abdominal exercises in Hypertensive individuals with and without breath holding. The exercises were chosen based on their favorable biomechanical and electromyography profiles and their popularity for therapeutic and fitness purposes [3-6].

We hypothesized that breath holding during abdominal exercise would increase all measured hemodynamic parameters.

Material and methods

Population setting

30 hypertension males and females were recruited within our Institution. (SBB College of Physiotherapy, VS Hospital, Ahmedabad, India)

Inclusion criteria were hypertensive males and females aged (30-60 years) SBP ≥140, DBP ≥90 they were excluded if any history of back pain, spinal disorders, diabetes, renal disease, cardiovascular disease. Women who were pregnant at the time of the study were excluded the first 30 subjects meeting inclusion criteria were enrolled. There were 14 females and 16 males.

Procedure

An experimental study including 30 hypertensive males and females aged 30-60 years.
They were divided into two groups:

- **Group 1:** perform straight and oblique sit ups with breath holding
- **Group 2:** perform straight and oblique sit ups without breath holding

They were made familiar with both straight and oblique sit ups by demonstration and instruction were given to perform 10 repetitions of straight and oblique sit ups with 10 min rest period between. Heart rate and blood pressure were measured before and after each set of repetition. The outcome measures are heart rate and blood pressure. (**Figure – 1, 2, 3**)

Figure - 1: Straight partial sit ups.

Figure - 2: Oblique partial sit ups.

Figure - 3: Oblique partial sit ups.

Statistical analysis

Data were analyzed using statistical package for social sciences version 16 (SPSS 16) For within group analysis, for both the groups, Non parametric wilcoxon signed rank test was done with all the parameters were significant with p value 0.001 and For inter group analysis, Non parametric Mann-Whitney U test was done in which group A showed to be more significant than group B.

Results

Subjects were 30-60 years old.16 men and 14 women completed the study Mean age of the participants of group A was 44.73±8.01 and for group B was 47.73±6.35. No subject experienced pain or complications as result of study participation. Mean and standard deviation of pre and post exercise heart rate, systolic blood pressure and diastolic blood pressure was as per **Table – 1**. Mann-Whitney U test for inter group comparison was as per **Table - 2** and Wilcoxon signed rank test for within group analysis was as per **Table - 3**. For group A, W= -3.426, -3.458, -3.458 respectively for HR, SBP and DBP and p=0.001and for group B, W= -3.426, -3.475, -3.464 and p=0.001.The U value for inter group analysis is U=103.00, 73.00, 81.00 respectively for HR, SBP and DBP and p= 0.68,0.099,0.183 respectively for HR, SBP and DBP.

Discussion

This investigation represents the first quantification of the acute hemodynamic changes that occur during common abdominal exercises. Previous investigators have reported heart rate and blood pressure elevations after abdominal exercise in normal individuals [9, 10]. In these studies, the dependence on auscultation and sphygmomanometry precluded meaningful data collection during exercise. In comparison, our study we choose hypertensive individuals and found the large blood Pressure and heart rate elevations.

Heart rate increased an average of 10 bpm, systolic blood pressure increased 48mmhg and diastolic blood pressure increased 59 mmhg during all exercises, with the breath holding group OPSU and SPSU producing significantly larger elevations than the group 2.These results support our hypothesis that breath holding during abdominal Exercise would increase all measured hemodynamic parameters. The average blood

pressure elevations for both groups were146.40±4.67/ 152.13±4.98 and 144.40±4.3/ 148.6±4.7 respectively. (**Table - 1**)

Table - 1: Mean and Standards deviation of variables (S.D.).

Group		HR (BPM)		SBP (mmHg)		DBP (mmHg)	
		Pre	**Post**	**Pre**	**Post**	**Post**	**Pre**
A	MEAN±SD	73.73±3.5	82.53±5.09	98±6.67	146.40±4.7	152.13±4.8	93.33±2.69
B	MEAN±SD	76±3.77	82.13±5.56	98.33±2.58	144.40±4.3	148.6±4.7	91.60±2.02

Table - 2: Inter-Group Comparison: Mann-Whitney U Non parametric test.

	Post HR (BPM)	Post SBP (mmHg)	Post DBP (mmHg)
U	103.00	73.00	81.00
P	0.68	0.099	0.183

Table - 3: Within group analysis: Wilcoxon signed rank Non parametric test.

	Statistics	Post-Pre HR (BPM)	Post-Pre SBP (mmHg)	Post-Pre DBP (mmHg)
Group A	W	-3.426	-3.458	-3.457
	p	0.001	0.001	0.001

	Statistics	Post-Pre HR (BPM)	Post-Pre SBP (mmHg)	Post-Pre DBP (mmHg)
Group B	W	-3.426	-3.475	-3.464
	p	0.001	0.001	0.001

Many people hold their breath during abdominal exercise (particularly those new to the exercises); we examined the effect of breath holding on the hemodynamic parameters of interest. The heart rate increases would not be as great during exercises performed with breath holding compared with those performed without breath holding. Although these differences are not likely clinically meaningful, the slightly blunted heart rate increase with breath holding may is a result of a Valsalva -like effect induced by breathe holding [11, 13, 14]. Confirmation of a true Valsalva would require simultaneous monitoring of IAP, which was not performed during our study.

The effect of breath holding on blood pressure parameters, regardless of the etiology, is of potential clinical Significance [16]. Breath holding doubles the average blood pressure Increase, with some of our subjects exhibiting SBP and DBP elevations of over 60 mmHg. MacDougall, et al. [14] showed that a true Valsalva response, with its full spectrum of hemodynamic consequences, became obligatory at intensities of greater than 80% of a maximal voluntary contraction during resistance exercise. It is clear that our subjects were not exercising at such intensities during the study.

In such cases, the blood pressure and heart rate would be expected to be even higher than those recorded in our study. We suggest that clinicians monitor for breath holding and consider specifically instructing patients not to breathe hold during abdominal exercises and to avoid near-maximal efforts, particularly in patients with cardiac, cerebrovascular, or bleeding risk

factors. In addition, breath holding during the OPSU may be particularly risky, and this exercise may need to be avoided in these hypertensive patient populations. Future study should evaluate the acute hemodynamic responses of abdominal exercises at greater intensities, or in deconditioned or injured patients. Less sample size was the limitation of the study [15-17].

Conclusion

When performing the OPSU and SPSU exercises as used in this investigation, hypertensive individuals may experience peak heart rate and blood pressure increases. Voluntary breath holding significantly increased the blood pressure elevations for both the exercises, but particularly for the OPSU. Based on these findings, we conclude the following: the acute hemodynamic changes of abdominal exercise are Potentially clinically relevant, clinicians should consider avoiding the OPSU exercise as used in this study in patients With vascular risk factors, and patients should be instructed to avoid breath holding during abdominal exercise training to Avoid potentially detrimental increases in blood pressure and Cardiac stress.

Future recommendation

Similar study can be carried out in normal healthy individuals at different exercise intensity with more number of subjects and doing comparison of upper and lower abdominals on hemodynamic parameters in different population with using more specific outcome measures like rate pressure product and mean arterial blood pressure.

Acknowledgement

We would like to express our gratitude to all the elderly participants for providing us valuable information. We would give our humble thanks to our institution to provide us with all necessary resources and information that were needed throughout the course of study.

References

1. Biering-Sorensen F. A prospective study of low back pain in a general population: I. Occurrence, recurrence and aetiology. Scand J Rehabil Med., 1983; 15: 71-8.
2. Saal J, Saal JS. Non-operative treatment of herniated lumbar intervertebral disk with radiculopathy: An outcome study. Spine, 1989; 14: 430-7.
3. Axler C, McGill SM. Low back loads over a variety of abdominal exercises: Searching for the safest abdominal challenge. Med Sci Sports Exerc., 1997; 29: 804-11.
4. Andersson E, Nilsson J, Ma Z, Thorstensson A. Abdominal and hip flexor muscle activation during various training exercises. Eur J ApplPhysiol., 1997; 75: 115-23.
5. NegraoFilho R de F, Berzin F, Souza G da C. Electromyography study of the portions of the abdominal rectus muscle. Electromyogr ClinNeurophysiol., 1997; 37: 491-501.
6. Shields R, Heiss DG. An electromyographic comparison of abdominal muscles synergies during curl and double straight leg lowering exercises with control of the pelvic position. Spine, 1997; 22: 1873-9.
7. Warden S, Wajswelner H, Bennell KL. Comparison of Abshaper and conventionally performed abdominal exercises using surface electromyography. Med Sci Sports Exerc., 1999; 31: 1656-64.
8. Beim G, Giraldo JL, Pincivero DM, Borror MJ, Fu FH. Abdominal strengthening exercises: A comparative EMG study. J Sport Rehabil., 1997; 6: 11-20.
9. Rao S, Bellare B. Cardiovascular responses to abdominal exercises in females between 35 and 45 years of age. J Postgrad Med., 1993; 39: 79-81.
10. Boone T, Johns K. Cardiorespiratory and hemodynamic responses to inversion and

inversion with sit-ups. J Sports Med., 1989; 29: 346-57.
11. Hamilton W, Woodbury RA, Harper HT. Arterial, cerebrospinal and venous pressures in man during cough and strain. Am J Physiol., 1943; 141: 42-50.
12. Palatini P, Mos L, Munari L, et al. Blood pressure changes during heavy-resistance exercise. J Hypertens., 1989; 7(Suppl): S723.
13. Hill D, Butler SD. Haemodynamic responses to weightlifting exercise. Sports Med., 1991; 12: 1-7.
14. MacDougall J, McKelvie RS, Moroz DE, Sale DG, McCartney N, Buick F. Factors affecting blood pressure during heavy weight lifting and static contractions. J Appl Physiol., 1992; 73: 1590-7.
15. Imholz B, Wieling W, Langewouters GJ, van Montfrans GA. Continuous finger arterial pressure: utility in cardiovascular laboratory. Clin Auto Res., 1991; 1: 43-53.
16. Uber-Zak LD, Venkatesh YS. Neurologic complications of sit-ups associated with the Valsalva maneuver: 2 case reports. Arch Phys Med Rehabil., 2002; 83: 278-82.
17. Kitamura K, Jorgensen CR, GobelFl, Taylor HL, Wang Y. Hemodynamic correlates of myocardial oxygen consumption during upright exercise. J ApplPhysiol., 1972; 32: 516-22.