Original Article

THE EFFECT OF EXERCISE ON PLATELET AGGREGABILITY AND OTHER CARDIOVASCULAR PARAMETERS

PagarAtishBhaskar*, RautSayaliEknath**, Hawaldar V. B.***

BACKGROUND & OBJECTIVE

The beneficial effect of regular exercise on physical fitness is well documented. However there is also evidence that acute and chronic exercise affect platelet activation in different ways. Few studies are available on effect ofexercise on platelets function. Therefore, present work has been undertaken to study the effect of acute heavy (severe) and regular moderate exercise on platelet aggregation,heart rate and blood pressure in normal healthy untrained subjects.

METHODS

Sample:60 healthy volunteers (30 males and 30 females) of age between 18 & 21 years. Exercise schedule was as follows,Acute heavy exercise(AHE):running on 400 meters track as fast as possible and as long as possible (minimum 4 rounds). Regular moderate exercise(RME):running on 400 meters track with moderate speed so as to complete one round in 3 minutes. Two rounds per day for 3 months.Blood samples were collected and heart rate (HR)& blood pressure(BP) were recorded at rest, immediately after completion of AHE & RME.Platelet aggregability was estimated by O'Brien J. R.method using ADP.

RESULTS

Very significant (P<0.0001)increase in platelet aggregability, HR and systolic BP were observed after AHE. After RME platelet aggregability was very significantly(P<0.0001) decreased while HR and SBP were significantly increased. HR and SBP showed significantly lesser increase after RMEcompared with AHE. Diastolic BP didn't show any significant change after either type of exercise. All results were same in both sexes.

INTERPRETATION & CONCLUSION

Regular moderate exercise decreases platelet aggregability and lowers the rise in HR and SBP after exercise, showing protective function in coronary artery disease. Whereas acute heavy exercise increases platelet aggregability and shows higher rise in HR and SBP after exercise.

Exercise should be cautiously advised in coronary artery diseases.

KEY WORDS: Acute heavy (severe)exercise, Diastolic blood pressure, Heart rate, Platelet aggregability, Regular moderate exercise, Systolic blood pressure,

INTRODUCTION

Mounting evidence suggests that haemostatic parameters are important cardiovascular risk factors. Although platelets are important in normal haemostasis, recent evidence emphasizes the pivotal role of abnormal platelet function in acute coronary artery disease (CAD), myocardial infarction, unstable angina, and stroke.[1]The beneficial effect of regular exercise on the physical fitness is well documented. It also decreases the risk factor for cardiovascular diseases. However a little known but equally important fact is that exercise in an untrained person can lead to precipitation of an acute cardiovascular event.

During exercise clotting activity as well as fibrinolytic activity both increase concomitantly, but not to the same extent.[2]Normally there is a balance between prostacyclin and thromboxane A_2. Prostacyclin decreases platelet aggregation whereas thromboxane A_2 increases it. Exercise is known to shift the balance towards prostacyclin. Exercise also increases endothelial function that secrets nitric oxide (NO) which is known to decrease platelet aggregation.[3]

There is also evidence that acute and chronic exercise affect platelet activation in different ways. Acute strenuous exercise stimulates all aspects of platelet function and thrombin phase of platelet

aggregation accelerates the clotting system, while regular moderate exercise results in decreased platelet aggregation.[3,4]

Therefore, the present work has been undertaken to study the effect of acute heavy (severe) and regular moderate exercise on platelet aggregation, heart rate and blood pressure in normal healthy untrained subjects.

MATERIAL & METHODS

Selection of subjects: The present study was conducted on 60normal, healthy, untrained, non-smoker volunteersof age between 18-25 years who had no evidence of any disease. Out of these 30 were males and 30 were females. Volunteers were randomly selected from 1st M.B.B.S students.

Subjects doing regular exercise were excluded as regular exercise is known to decrease platelet aggregability. Subjects suffering from bleeding disorders & subjects taking any drugs were excluded from the study.

Study protocol: The study was conducted at the Government Medical College,Miraj,Maharastra, India.

Written informed consent was taken from each subject.

Subjects were instructed on previous day. They were asked to have light breakfast one hour before exercise.

Heart Rate, Blood Pressure andPlatelet aggregability by ADP method were measured at rest as a baseline record before giving the exercise schedule to the volunteers. Then they were asked to undergo acute heavy (severe) exercise session in the form of running for 1600 meters as fast as possible. Same parameters were measured immediately after the acute heavy (severe) exercise. After this, they were given the regular moderate exercise schedule in the form of running on 400 meters track with moderate speed so as to complete one round in 3 minutes. Two such rounds were scheduled daily for 3 months and the parameters were measured.

Heart ratewas measured by the method (palpation) as described in 'Manual of Practical Physiology for MBBS' by A. K. Jain[5].

Blood pressure was measured by theindirect auscultatory method as described in 'Physical Diagnosis' by RustomJalVakil and Aspi F. Golwalla[6].

Heart rate and Blood pressure are particularly susceptible to the time of day, apprehension, temperature. Therefore they were measured in the morning with subjects in sitting position. Subjects were allowed to rest for 15 minutes before taking pulse count and blood pressure before exercise. The pulse was counted for full one minute to minimize the errors caused by sinus arrhythmia.

After acute heavy (severe) and regular moderate exercise heart rate and blood pressure were measured immediately also in sitting position, in the morning.

For determining theplatelet aggregability blood samples were collected in the morning. Time of blood collection was kept fixed to avoid the effect of diurnal variation in platelet aggregability. Nine ml blood was collected by plastic disposable syringe from antecubital vein under all aseptic precautions. It was mixed with 1 ml. of 3.8 % tri-sodium citrate in centrifuge tube and was centrifuged at a rate of 1300 rpm for 15 minutes. 2ml of platelet rich plasma (PRP) was used for platelet aggregability.

Platelet aggregability was determined byAdenosine-di-phosphate (ADP) induced platelet aggregationmethod given by O'Brien J. R.[7]

The experiment protocol was approved by the Research and Human Ethics Committee of Government Medical College,Miraj,Maharastra, India.

Statistical Analysis: Analysis was done by Statistical Package for Social Sciences (SPSS) software version 10, by using 't' test, 'Z' test. A 'P' value of < 0.05 was considered statistically significant.

Results & Discussion

It is observed that the platelet aggregability increases significantly after acute heavy (severe) exercise in healthy males as well as in females. Increased platelet adhesiveness after acute heavy (severe) exercise observed in present study is in agreement with the findings of Rizza, Egeberg,

Thomson and Poller.[8]

Clayton and Cross also reported similar findings which they explained on the basis of increased level of adrenaline. Poller L and Priest CM reported similar findings in their study and claimed them as effect of probable stress reaction.[8]

Effect of regular moderate exercise observed is however different. The platelet aggregability showed significant decrease after regular moderate exercise. This finding is consistent with findings of Pegrum et al (1965) who showed decreased platelet adhesiveness after prolonged exertion. Sex has no effect on variation in platelet aggregability in the present work.

Measurements of heart rate and systolic blood pressure show significant increase after acute heavy (severe) exercise when compared to before exercise values. However diastolic blood pressure does not show any significant change. These results are consistent with the very well proven effect of acute heavy (severe) exercise on heart rate and blood pressure those are documented in recommended text books. These effects can be attributed to the activation of sympathetic nervous system by exercise.

Similar changes in heart rate and blood pressure are observed after regular moderate exercise. They can also be explained similarly on the basis of activation of sympathetic nervous system.

When compared with the readings after acute heavy (severe) exercise, the measurements of heart rate and blood pressure after regular moderate exercise show lesser increase. This effect can be because of increased vagal tone after regular moderate exercise. Because of this vagal tone the resting heart rate and blood pressure decreases and even after sympathetic activation, exercise causes lesser increase in these parameters.

Therefore it is suggested that caution must be observed while prescribing the exercise regimen for the patients having heart disease.

Although we got these results, we recognize that we should estimate our results carefully because of some limitations. First, we estimated only platelet aggregability, heart rate and blood pressure. We could not assess the extent of sympathetic activation after particular type of exercise schedule. Second, the age group taken was small. In addition all subjects were healthy volunteers so whether different disease conditions show variable response to the effect of exercise on platelet aggregability could not be assessed. The type of exercise given was also of single type. So the effects of different types of exercise could not be assessed.

Considering these issues, a long term prospective study with a larger population, different types of exercises and parameters to assess sympathetic activity is expected to have elaborated justification for our findings.

Particular	Male	Female	Z Value	P Value
	Mean ± SD (n=30)	Mean ± SD (n=30)		
Age (Yrs)	18.9 ± 0.96	18.2 ± 0.41	3.68	<0.0001

Table 1: Comparison of age in both sexes

Change in Optical density	Before Exercise	After Acute heavy Exercise	t Value	P Value
	Mean ± SD (n=30)	Mean ± SD (n=30)		
Male	0.04 ± 0.01	0.06 ± 0.01	9.16	<0.0001
Female	0.03 ± 0.01	0.04 ± 0.01	8.75	<0.0001

Table 2: Comparison of change in optical density before exercise and after acute heavy (Severe) exercise in both sexes

Heart Rate	Before Exercise	After Acute heavy Exercise	t Value	P Value
	Mean ± SD (n=30)	Mean ± SD (n=30)		
Male	73.37 ± 2.75	141.63 ± 2.80	90.06	<0.0001
Female	73.33 ± 2.34	140.47 ± 3.14	90.43	<0.0001

Table 3: Comparison of Heart rate before exercise and after acute heavy (Severe) exercise in both sexes

SBP (mm Hg)	Before Exercise Mean ± SD (n=30)	After Acute heavy Exercise Mean ± SD (n=30)	t Value	P Value
Male	119.73 ± 2.33	166.2 ± 3.98	64.94	<0.0001
Female	118.8 ± 1.86	156.4 ± 6.27	32.41	<0.0001

Table 4: Comparison of Systolic Blood Pressure before exercise and after acute heavy (Severe) exercise in both sexes

DBP (mm Hg)	Before Exercise Mean ± SD (n=30)	After Acute heavy Exercise Mean ± SD (n=30)	t Value	P Value
Male	80.33 ± 2.04	80.2 ± 1.51	0.39	>0.05
Female	78.8 ± 1.86	78.67 ± 1.92	1	>0.05

Table 5: Comparison of diastolic Blood Pressure before exercise and after acute heavy (Severe) exercise in both sexes

Change in Optical density	Before Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	0.04 ± 0.01	0.02 ± 0.01	8.15	<0.0001
Female	0.03 ± 0.01	0.02 ± 0.01	3.88	<0.0001

Table 6: Comparison of change in optical density before exercise and after regular moderate exercise in both sexes

Heart Rate	Before Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	73.37 ± 2.75	103.3 ± 3.18	33.63	<0.0001
Female	73.33 ± 2.34	104.87 ± 3.09	39.11	<0.0001

Table 7: Comparison of Heart rate before exercise and after regular moderate exercise in both sexes

SBP (mm Hg)	Before Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	119.73 ± 2.33	143.33 ± 4.21	26.89	<0.0001
Female	118.8 ± 1.86	135.93 ± 3.04	30.79	<0.0001

Table 8: Comparison of Systolic Blood Pressure before exercise and after regular moderate exercise in both sexes

DBP (mm Hg)	Before Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	80.33 ± 2.04	80.2 ± 1.92	1	>0.05
Female	78.8 ± 1.86	78.8 ± 1.86	0	>0.05

Table 9: Comparison of diastolic Blood Pressure before exercise and after regular moderate exercise in both sexes

Change in Optical density	After Acute heavy Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	0.06 ± 0.01	0.02 ± 0.01	16.99	<0.0001
Female	0.04 ± 0.01	0.02 ± 0.01	8.45	<0.0001

Table 10: Comparison of change in optical density after acute heavy (Severe) exercise and after regular moderate exercise in both sexes

Heart Rate	After Acute heavy Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	141.63 ± 2.80	103.3 ± 3.18	53.09	<0.0001
Female	140.47 ± 3.14	104.87 ± 3.09	45.56	<0.0001

Table 11: Comparison of Heart rate after acute heavy (Severe) exercise and after regular moderate exercise in both sexes

SBP (mm Hg)	After Acute heavy Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	166.2 ± 3.98	143.33 ± 4.21	26.55	<0.0001
Female	156.4 ± 6.27	135.93 ± 3.04	18.67	<0.0001

Table 12: Comparison of Systolic Blood Pressure after acute heavy (Severe) exercise and after regular moderate exercise in both sexes

DBP (mm Hg)	After Acute heavy Exercise Mean ± SD (n=30)	After Regular Moderate Exercise Mean ± SD (n=30)	t Value	P Value
Male	80.2 ± 1.51	80.2 ± 1.92	0	>0.05
Female	78.67 ± 1.92	78.8 ± 1.86	1	>0.05

Table 13: Comparison of diastolic Blood Pressure after acute heavy (Severe) exercise and after regular moderate exercise in both sexes

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1. **Pagar Atish Bhaskar**
Block No. 7, Building No. 1,
Residential Quarters,
Govt. Medical College, Miraj,
Pandharpur Road,
Dist- Sangli, Maharashtra. Pin- 416410
2. **RautSayaliEknath**
Department of Physiology
3. **Hawaldar V. B.**
Department of Physiology