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Blood Pressure and Cardiac Responses to Isotonic Exercise and Its Modification by Beta Adrenoreceptor Blockade in Human Subjects

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ABSTRACT

Introduction: *The role of physical activity in cardio vascular health has received increasing attention in recent years. Exercise has dramatically occupied an unique projection as a recreational activity for the past two decades. Paffernbarger have shown that vigorous exercise is associated with lower incidence of hypertension. The terms aerobic, isotonic and dynamic are used interchangeably to refer to activity that is predominantly fueled by oxidative phospharylation (aerobic), is performed against a constant load that is isotonic and involves the rhythmic contraction of flexor and extensor muscle groups (dynamic). Use of isotonic exercise as non pharmacological therapeutic agent in rehabilitative medicine has become increasingly prevalent and progressively ever gaining prominence.*

The risk of sudden cardiac death is more common during the exercise than at rest, greater in sedentary subjects, in elderly and in the initial period of programme. In such case, Beta blocking drugs introduced into clinical practice during the past 2 decades. Drugs which block cardiac adrenergic transmission or cardiac beta adrenoreceptors are most effective in attenuating the pressor and tachycardiac response to dynamic exercise.

Materials and Methods: *Male volunteers of 20-30 years were only chosen for this study. They are moderate built with a mean weight of 58 kgs. Blood pressure, heart rate, and the resting respiratory rate also has been recorded. The subject who is sitting upright is instructed to pedal fast the bicycle. The blood pressure, Heart rate, Respiratory rate are continuously recorded at the end of the one minute interval during the exercise and at the end of 5 minutes on cessation of pedaling.*

After ensuring complete recovery from stress, in the first propranolol group 80mg of the drug was administered. After 2 hours of administration, all the 4 parameters are recorded and the subject is again subjected to dynamic exercise as above and the same recording done.

After ensuring complete recovery from stress, in the second Atenolol group 50mg of the drug was administered. After 2 hours of administration, all the 4 parameters are recorded and the subject is again subjected to dynamic exercise as above and the same recording done.

Results: *Before the administration of drugs to the individuals the resting parameters are recorded.*

In case of propronolol, the fall in systolic blood pressure at rest is 12.36%, Diaslostic blood pressure at rest is 14.031%. After administration of Atenolol, the fall in systolic pressure at rest is 10.69% and fall in diastolic pressure at rest is 11.60%. After 1mt isotonic exercise the % of all is 17.14%, in case of Propronolol 13.13 and

in case of Atenolol 11.60.
The percentage of fall in pulse rate after propronolol is 16.49 at rest and 16.59% after 1mt exercise. In case of Atenolol the pulse rate at rest is 15.08% and after 1mt exercise 12.73%. In relation to propronolol the values are maintained but the effect of Atenolol shows the percentage of all is less which is observed.
The percentage of fall in respiratory rate is less in case of propronolol than Atenolol. In case of propronolol the fall at rest is 9.77% and after 1mt exercise 6.67%. In case of Atenolol the fall at rest is 9.1 and after 1mt exercise it will be 13.81.
Key words: *isotonic exercise, propronolol, atenlol, blood pressure, heart rate, resting respiratory rate*

INTRODUCTION

Man is capable of prodigious exercise. The role of physical activity in cardio vascular health has received increasing attention in recent years. Exercise has dramatically occupied an unique projection as a recreational activity. Paffernbarger have shown that vigorous exercise is associated with lower incidence of hypertension. But Physiological activity is also a risk factor for coronary artery disease. Other factors altered are lipid profile, body mass index, and fibrinolytic process. Increasing physical activity or exercise protects the individual directly from coronary artery disease, indirectly protects by modifying the coronary risk factors like altered lipid profile, weight of the body. Exercise promotes fibrinolytic increased activity and inhibits platelet aggregation and reduced hypertension.

The terms aerobic, isotonic and dynamic are used interchangeably to refer to activity that is predominantly fueled by oxidative phospharyla-tion (aerobic), is performed against a constant load that is isotonic and involves the rhythmic contraction of flexor and extensor muscle groups (dynamic). Use of isotonic exercise as non pharmacological therapeutic agent in rehabilitative medicine has become increasingly prevalent and progressively ever gaining prominence.

The risk of sudden cardiac death is more common during the exercise than at rest, greater in sedentary subjects, in elderly and in the initial period of programme. In such case, Beta blocking drugs have probably been the most important group of drugs introduced into clinical practice during the past 2 decades. Drugs which block cardiac adrenergic transmission or cardiac beta adrenoreceptors are most effective in attenuating the presser and tachycardiac response to dynamic exercise.

The clinical indications for their usage including Hypertension, Arrhythmias, Ischemic heart disease, Thyrotoxicosis, Migraine headaches, Glaucoma and Anxiety states following the discovery of Adrenaline as the active principle in suprarenal (extracts) by Cliver and Schafer in 1985. Two types of adrenotropic receptors for adrenaline were proposed – excitatory and inhibitory drugs were found that selectively inhibited the excitatory responses. However, it was the pharmacological classification into alpha and beta adrenoreceptors by Ahlquist in 1948, the synthesis of beta adrenergic blocking agents and the further subdivision of beta receptors into beta – I and beta – 2 that led to the explosive development in the field of adrenoreceptors that has occupied in recent years and has resulted in

many new drugs selectively blocking or stimulating the sub types of adrenoreceptors.

Coronary heart disease or hypertension are associated with high autonomic tone and beta blockade in this situation may affect the patient for two reasons – removal of the sympathetic activity permits vagal dominance of the heart, resulting in appropriate cardiac slowing and a fall in cardiac output and blood pressure and shock. Beta adrenergic blocking drugs have probably been the most important groups introduced into clinical practice during the past 10 years.

Exercise training can increase cardiovascular capacity, decreasing myocardial oxygen demand for any given level of physical activity in normal persons as well as most cardiac patients. Regular physical activity is required to maintain the training effect. The potential risk of vigorous physical activity can be reduced by exposing the incumbents on the merits of exercise. Exercise may even help the effort to control cigarette smoking, hypertension, lipid abnormalities, diabetes, obesity and emotional stress. Evidence suggest that regular moderate or vigorous occupational or leisure time physical activity may protect against C H D and may improve the likelihood of survival from a heart attack.

Beta Blockers

Beta blockers have been used in the treatment of hypertension for well over 2 decades. They were accepted as first line treatment in the early 1970s.

Antihypertensive Mode of Action:

The blockade of adrenoceptors appears to be the mode of action. As dynamic exercise is associated with a sudden increase in arterial blood pressure, heart rate and respiratory rate, effects on cardiovascular responses to dynamic exercise and its modification by Beta adrenergic blockade is taken for study. Combination with calcium channel blockers or diuretics or angiotensin converting enzyme leads to profound fall in blood pressure bradycardia, respiratory arrest.

The most dominating worldwide used propronolol (non-selective cardiac blocker and atenolol (selective cardiac beta – blocker) are taken for study on healthy sedentary volunteers.

PROPRANOLOL

Propranolol was the first Beta adrenergic antagonist to come into wide clinical use and it remains the most important of these compounds since 1966. It is highly potent non selective Beta adrenergic blocking agent with no intrinsic sympathomimetic activity. However, because of its ability to block beta receptors in bronchial smooth muscle and skeletal muscle, propranolol interferes with bronchodilatation produced by epinephrine and other sympathomimetic amines and with glycogenolysis which ordinarily occurs during hypoglycemia. Thus the drug is usually not used in individuals with bronchial asthma and must be used cautiously in diabetics, who are receiving insulin and oral hypoglycemic agents.

ATENOLOL

Atenolol is selective beta 1 –adrenergic receptor blocking agent with insignificant partial agonist activity and week membrane stabilizing properties. The drug is incompletely absorbed when administered orally and is excreted largely

unchanged in the urine. Atenolol has a half life in plasma of approximately 6 – 8 hours but its anti hypertensive effect appears to last for a considerable longer period. It can thus be administered once a day for the treatment of hypertension.

Atenolol (Tenormin) is available in 50 and 100mg tablets for oral use. Initial dosage is generally 50mg once a day. If optimal response is not obtained in 1-2 weeks, the dose may be increased to 100mg per day.

Atenolol has a potent negative chronotropic effect. The lack of peripheral beta 2 blockade similar to proctolol has been clearly shown and gives a more favourable immediate pressure – lowering effects particularly during exercise compared to unselective beta blockers as propronolol. This property would be of value in the treatment of both angina and Hypertension.

MATERIALS AND METHODS

Male volunteers of 20-30 years with a mean age of 25 years, were chosen for this study. They are moderate built with a mean weight of 58 kgs. The criteria for selection of controls based on the fact that they have not been trained or exposed to any sort of athletic activity for at least one month prior to the present study. In this context even the individuals who are subjected to any type of regular recreational sports activity were deliberately excluded from this study.

Each subject was medically examined and their past medical history has been carefully evaluated solely aimed at including those with cardiac or pulmonary disease or diabetes etc routine hematological examination E C G recording pulmonary function tests specially vital capacity recording by spirometer was done in each subject. The subjects used to attend the laboratory in the morning after having a light breakfast at the early hours of the day.

They are divided into two groups. Propranolol group and Atenolol group.

Before the actual procedure is begin, the precardial chest leads were fixed and connected to the ECG apparatus, the blood pressure and the resting respiratory rate has been recorded.

After recording the above parameters at rest, the subject is instructed to pedal fast the bicycle at a uniform rate of 60 revolutions per minute.

The blood pressure, heart rate, respiratory rate are continuously recorded at the end of the one minute interval during the exercise and at the end of 5 minutes on cessation of pedaling.

After ensuring complete recovery from stress, in the first propranolol group 80mg of the drug was administered. After 2 hours of administration, all the 4 parameters are recorded and the subject is again subjected to dynamic exercise as above and the same recording done.

After ensuring complete recovery from stress, in the second Atenolol group 50mg of the drug was administered. After 2 hours of administration, all the 4 parameters are recorded and the subject is again subjected to dynamic exercise as above and the same recording done.

Table No. I Comparative study of Pulse rate / min.

	Before Drug	After Propranolol	After Atenolol
At rest	77.38	64.62	65.16
1 Min after exercise	10.4.22	86.92	85.0
5 Min after exercise	129.56	105.28	105.0
2Min after exercise	110.28	89.6	90.426
4 Min after exercise	93.08	80.92	78.6
6 Min after exercise	84.44	71.68	68.16
8 Min after exercise	77.4	65	65

$P < 0.05$

Table No. II Respiratory Rate / Min

	Before Drug	After Propranolol	After Atenolol
At rest	22	20	20
1 Min after exercise	27	25	24
5 Min after exercise	33	30	30
2 Min after exercise	28	26	25
4 Min after exercise	25	24	23
6 Min after exercise	23	21	21
8 Min after exercise	22	20	20

$P < 0.05$

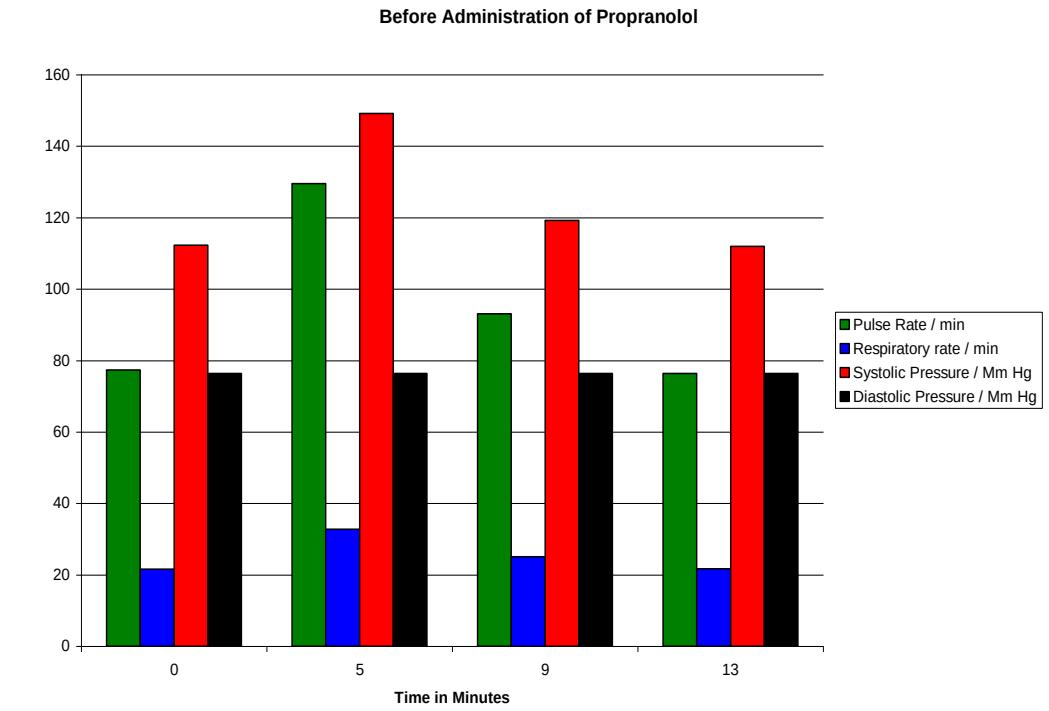
Table No. III Comparative Study of Systolic Blood Pressure

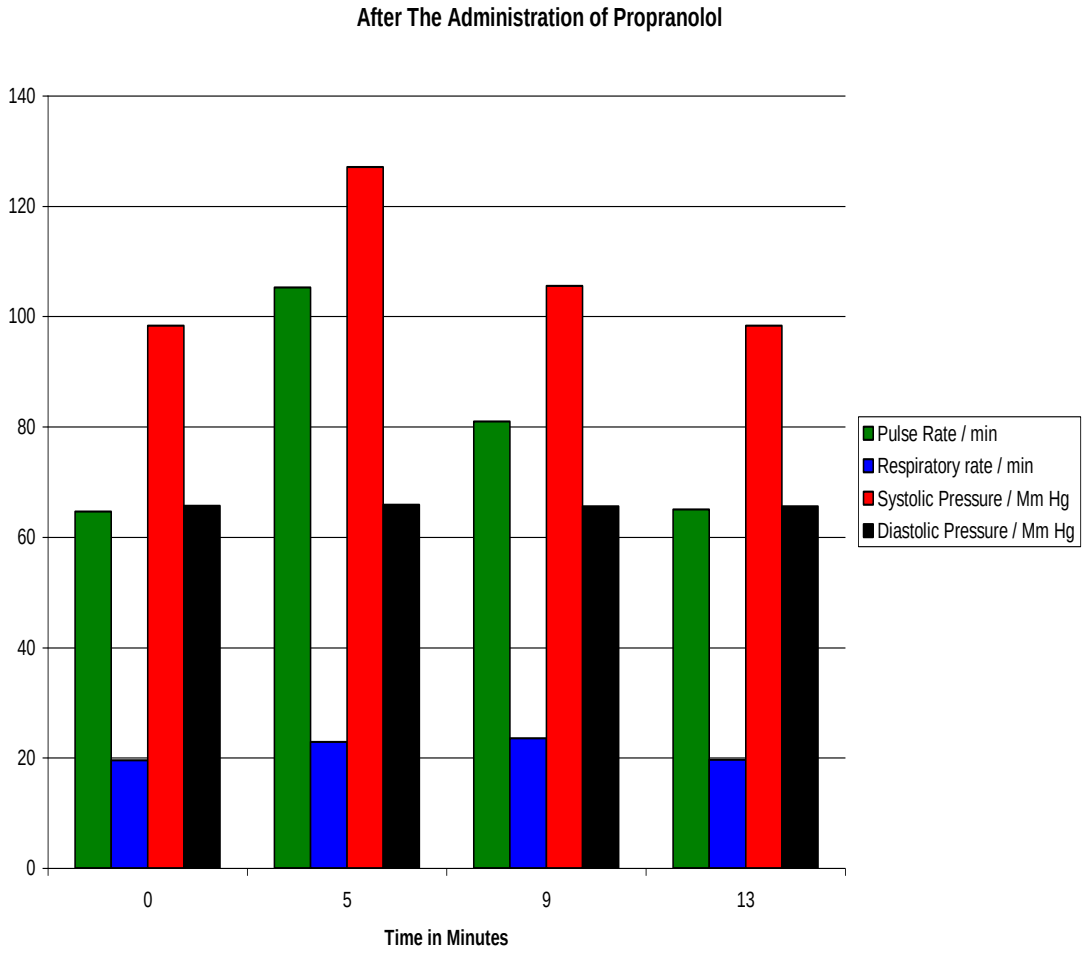
	Before Drug	After Propranolol	After Atenolol
At rest	112	98	94
1 Min exercise	134	110	110
5 Min Exercise	148	128	122
2 Min after exercise	132	114	112
4 Min after exercise	118	106	102
6 Min after exercise	114	100	96
8 Min after exercise	112	98	94

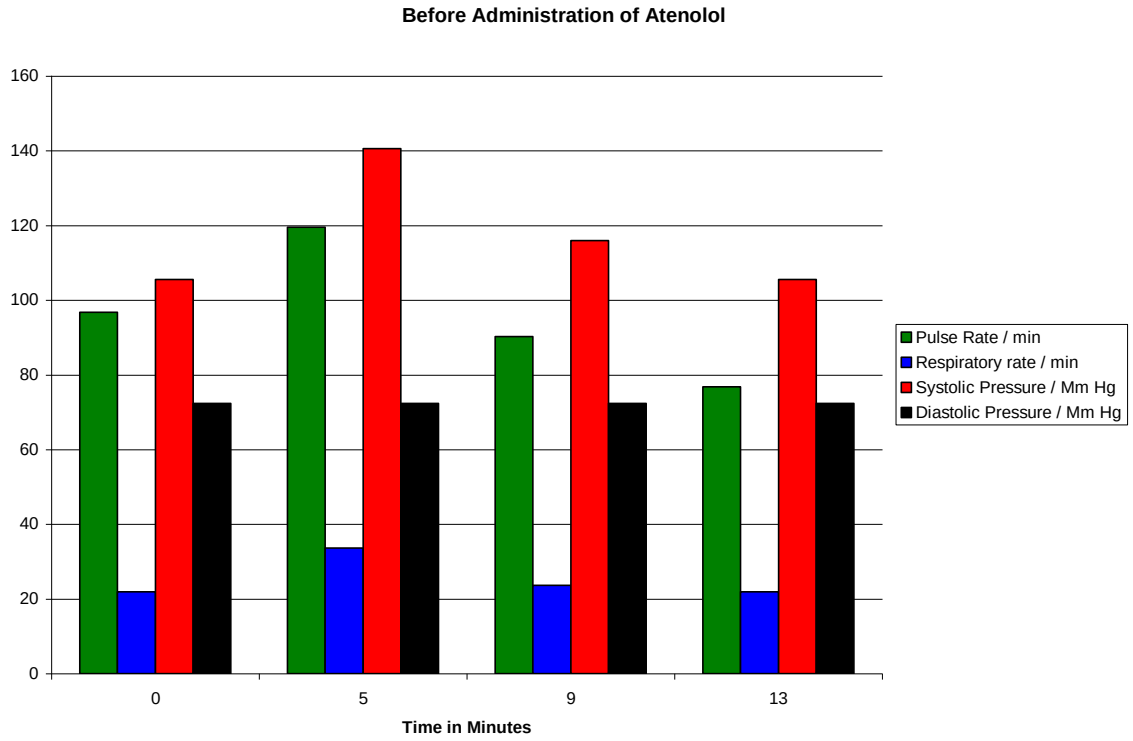
Table No. IV Comparative Study of Diastolic Blood Pressure

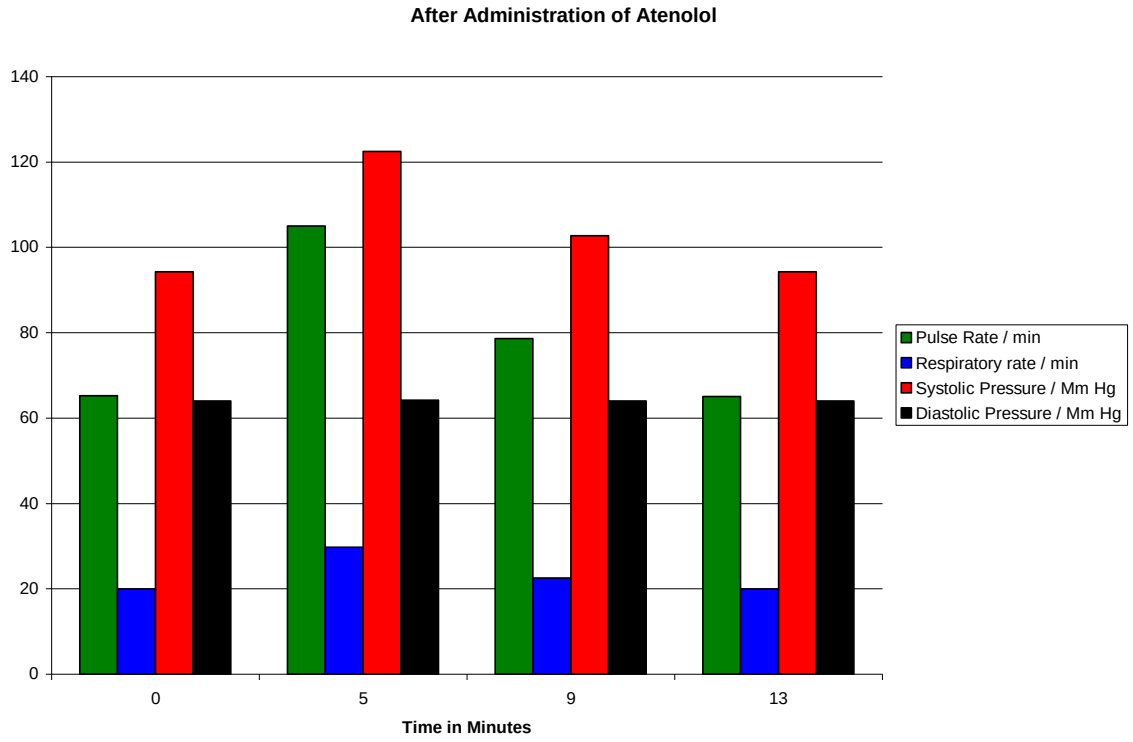
	Before Drug	After Propranolol	After Atenolol
At rest	76	66	64
1 min after exercise	76	66	64
5 min after exercise	76	68	66
2min after exercise	76	66	64
4 min after exercise	76	66	64
6 min after exercise	76	66	64
8 min after exercise	76	66	64

$P < 0.05$


Before Administration of Propranolol
160
140
120
100
80
60
40
20
0
0
5
9
13
Time in Minutes
Pulse Rate / min
Respiratory rate / min
Systolic Pressure / Mm Hg
Diastolic Pressure / Mm Hg


After The Administration of Propranolol
140
120
100
80
60
40
20
0
0
5
9
13
Time in Minutes
Pulse Rate / min
Respiratory rate / min
Systolic Pressure / Mm Hg
Diastolic Pressure / Mm Hg





ANALYSIS OF RESULTS

Before the administration of the β-blockers like propranolol which is non cardio selective and atenolol which is cardio selective to the individuals the resting parameters are shown in table 1 according to the table no1

Similarly the same group of people after the administration of propranolol has shown a fall in the mean systolic pressure at rest from 112.24mm Hg to 98.36 (±9.072) mm Hg. The percentage of fall is 12.36 there is rise in systolic pressure in relation to exercise for 1mt to 5mt before drug

administration is 134.6 mm Hg. (±11.52) and 149.2 (±11.44) mm of Hg and after the administration of the propranolol 80mg the values are 111.52 (±9.759) mm Hg and 127.08 (±10.346) respectively. This shows that there is no much change in systolic pressure value in 1mt exercise, but there is relative change observed in 5mts exercise.

The systolic blood pressure after the administration of atenolol has fallen to 94.28 (±10.0054) mm of Hg from the resting value 112.24 (±10.168) mm Hg. The rate of all is 16% and the rise in relation to exercise for 1mt and for 5mts are 110.32 (± 10.628)mm of Hg & 122.48 (± 13.02)mm of Hg. The percentage of all is 13.13 & 12.86 respectively.

As shown in the comparative table there is no much difference between the values of systolic blood pressure after administration of propranolol and atenolol. When compared these values with the values of resting condition i.e., before the administration of drug, there is considerable fall in the values after the administration of the drugs.

As shown in the comparative table 4 the diastolic pressure has no much difference after administration of propranolol than atenolol administration.

The mean pulse rate for the group of people before the drug administration is 77.38 (±5.1708). The mean pulse rate has risen at the end of the exercise for 1 mt and 5 mts 104.22 (±12.786) & 129.56 (±12.964) respectively as shown in table 1.

After the administration of drugs propranolol and atenolol the mean values of pulse rate at rest has fallen to 64.62 (±5.29) and 65.16 (±5.646) respectively. Though the rise is observed in relation to exercise after the administration of the drugs the rise is not much more than the rise in the values in the corresponding values before the administration of the drugs as shown in the comparative table.

The mean respiratory rate before the drug administration is 21.636 (±3.335). This mean value has risen to 26.66 (±2.721) and 32.8 (±5.3716) with relation to isotonic exercise of 1mt and 5mts respectively.

The values of respiratory rate after administration of drugs in relation to isctonic exercise for (1mt, 5mt) are less when compared to resting values. But these values are almost equal in both drugs in relation to isotonic exercise.

The values of pulse rate, respiratory rate and blood pressure changes are compared in these groups using students ‘t’ test and statistical significance assigned at $P<0.05$ in general.

SUMMARY

The subjects for study are divided into two groups.

1. Propranolol Group - 50 Volunteers
2. Atenolol Group - 50 Volunteers.

The average blood pressure, pulse rate and respiratory rate of resting level is compared with the values obtained after the administration of drugs – propranolol and atenolol. It is found that there is a fall in the values after the administration of drugs.

In case of propranolol the fall in systolic blood pressure at rest is 12.36%, Diaslostic blood pressure at rest is 14.031%. After administration

of Atenolol the fall in systolic pressure at rest is 10.69% and fall in diastolic pressure at rest is 11.60%. After 1mt isotonic exercise the % of all is 17.14% in case of Propranolol 13.13 and 11.60 in case of Atenolol.

The percentage of fall in pulse rate after propranolol is 16.49 at rest and 16.59% after 1 mt exercise. In case of Atenolol the pulse rate at rest is 15.08% and after 1mt exercise 12.73%. In relation to propranolol the values are maintained but the effect of Atenolol shows the percentage of all is less which is observed.

The percentage of fall in respiratory rate is less in case of propranolol than Atenolol. In case of propranolol the fall at rest is 9.77% and after 1mt exercise 6.67%. In case of Atenolol the fall at rest is 9.1 and after 1mt exercise it will be 13.81.

Comparatively the changes in systolic pressure is more than diastolic pressure in relation to exercise and in relation to the drugs there will be gross decrease in systolic pressure than diastolic pressure. After administration of propronolol the rate of fall will be more in systolic pressure. After administration of Atenolol the rate of fall will be less in systolic blood pressure.

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