International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Effect of Exercise in Biochemical Parameters in Athletes

Dr. Asha Kumari[1], Dr. Deepika Dalal[2], Dr. Rajesh Kumar[3], Mr. Prasantha Saha[4], Dr. Kiran Dahiya[5]

[1]Assistant Professor, Department of Biochemistry, SHKM, GMC, Mewat, Haryana, India
[2]Demonstrator, [3]Postgraduate Student, [4]Biochemist, [5]Professor,
Department of Biochemistry, PGIMS, Rohtak, Haryana, India

Corresponding Author: Dr. Asha Kumari

ABSTRACT

Exercise is advised for improving overall health and preventing many chronic diseases. Professional sportspersons practice regular strenuous exercise schedules for competitions. To maintain good performance high protein diet along with antioxidants is taken. Duration and severity of exercise affects various routine biochemical parameters. Biochemical tests including Blood Urea, Serum Creatinine, Serum Uric Acid, SGOT, SGPT, ALP, Serum Calcium, Serum Phosphorus, Serum total Protein, Serum Albumin, Lipid Profile(Triglycerides, Total cholesterol, HDL-Cholesterol, LDL-Cholesterol, VLDL-Cholesterol), Blood Glucose, Amylase and Serum Lactate was assessed in fifty professional athletes before and after exercise. Some parameters like urea, creatinine, glucose, lactate, calcium, ALP were affected by exercise and trainings which need to be considered for correct interpretation.

Keywords: exercise, biochemical, reference, urea, creatinine, protein, glucose

INTRODUCTION

Regular physical exercise is known to improve metabolism, delay aging, reduce incidence of myriad diseases like obesity, type 2 Diabetes risk, cardiovascular disorders. Exercise done by normal individuals to maintain good health is different from strenuous long duration trainings underwent by professional athletes. Diet of athletes also include ample amount of proteins to cope for damage of muscle during workouts. These adaptations may lead to alterations in levels of some metabolic markers which need to be interpreted with great caution to avoid unnecessary investigations. Clinicians must understand the perturbations caused by mild, moderate and strenuous exercises, before and after competitions. Rhabdomyolysis and hemoconcentration precipitated in such events can cause results to fall outside reference ranges. Data on exercise effects in athletes in India is scarce. Indian athletes should not be compared with foreign counterparts because of environmental, diet and genetic differences. This study was planned.

MATERIALS AND METHODS

This study was conducted by the collaboration of Department of Biochemistry, PGIMS, and Rohtak with Maharshi Dayan and University during the period of August and September 2016. Fifty athletes including 10 elite athletes and females were enrolled for this study after taking informed written consent. Anthropometric measurements were recorded and history of any chronic illness was elucidated. Athletes on dietary restriction or diet supplements, smokers and alcoholics were excluded from this study.

All the subjects in morning were asked to give a fasting blood sample at 6.00 AM and then perform a thirty minutes moderate speed running. Second blood sample was taken fifteen minutes after completion of running. Blood samples were taken aseptically from anticubital vein in the BD red capped vacutainer, labeled as pre-exercise and post exercise. We maintained the samples in cold storage till they reached departmental laboratory. Samples were centrifuged and the serum was analyzed for routine biochemical tests including Blood Urea, Serum Creatinine, Serum Uric Acid, SGOT, SGPT, ALP, Serum Calcium, Serum Phosphorus, Serum total Protein, Serum Albumin, Lipid Profile(Triglycerides, Total cholesterol, HDL-Cholesterol, LDL-Cholesterol, VLDL-Cholesterol), Blood Glucose, Amylase and Serum Lactate. Auto analyzer Randox Suzuka Cobas C300 was used for analysis of all tests spectrophotometrically except Serum Lactate which was done colorimetrically. Results were collected and statistics were applied.

Statistics: Data was presented as mean, SD, and range. Paired t test was used to compare pre and post exercise samples.

RESULTS AND OBSERVATIONS

Mean age of athletes including 46 Male and 4 female was 17.6 years (SD 3.11), with a range of 15 to 30 years. Mean Weight was 57.6kg (SD 8.7, range 39-76). Mean height of subjects was 170 cm ±2.06 (SD 7.2) ranging between 154 to185. BMI was mean 19.67±0.58 (SD 2.02). Mean waist circumference was 29.6cm ± 0.42 (SD 1.49). Mean duration of training was 2.07 years±0.68 (SD2.16). 52% of participants were vegetarian.

Blood urea was significantly increased (p value 0.04) in post exercise sample. Mean pre and post exercise Blood Urea were 29.68 ± SD 8.5 mg/dL and 31.65± SD 7.1mg/dL. S.Creatinine was significantly increased after exercise (p=0.003), mean pre exercise 1.04±0.164mg/dL and post exercise 1.13±0.15mg/dL. Calcium (p 0.01) and ALP (p 0.045) were decreased significantly. Significant decrease (p value 0.002) was observed in A:G ratio, amylase (p<0.05). Plasma Glucose (P 0.002) was significantly increased with mean pre exercise 85.76±9.7mg/dL post exercise 93.43± 13.01mg/dL values. Serum lactate was also increased as expected in second sample. Serum Uric acid, phosphorus, AST, ALT, Serum Protein and Albumin, TG, cholesterol, HDL, LDL were not changed significantly after workout.

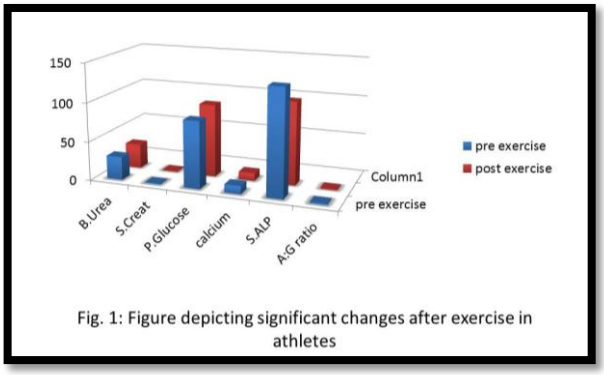

Fig. 1: Figure depicting significant changes after exercise in athletes

Table 1: Biochemical parameters after 30 minutes moderate intensity exercise in athletes

S. No	Biochemical analyte	Pre exercise value	Post exercise value	P value
1	B. Urea	29.68 ±8.5	31.65 ±7.1	0.04
2	S.Creatinine	1.04 ±0.16	1.13 ±0.15	0.003
3	S.Uric acid	6.15 ±1.95	5.65 ±1.98	0.01
4	S.Calcium	10.37 ±0.63	10.12 ±0.63	0.01
5	S.Phosphorus	4.66 ±0.73	5.11 ±0.63	2.14
6	S.AST	46.05 ±12.65	45.77 ±14.69	0.86
7	S.ALT	34.45 ±23.61	34.89 ±24.49	0.93
8	S.ALP	135.25 ±85.71	106.19 ±52.77	0.05
9	S. Total Protein	8.83 ±1.19	8.11 ±0.54	0.24
10	S. Albumin	4.91 ±0.70	4.81 ±0.37	0.21
11	A:G ratio	1.61 ±0.23	1.58 ±0.26	0.002
12	S. TG	127.45 ±60.22	105.82 ±45.15	0.19
13	S.Cholesterol	163.66 ±25.43	158.91 ±27.06	0.11
14	S.HDL	44.12 ±14.21	45.58 ±11.32	0.79
15	S.LDL	97.30 ±25.40	96.41 ±25.23	0.20
16	S.VLDL	24.26 ±12.19	23.59 ±18.36	0.24
17	S.Amylase	77.41 ±28.71	65.16 ±23.55	0.05
18	P. Glucose	92.10 ±15.57	90.17 ±12.08	0.002
19	S.Lactate	0.30 ±0.05	0.46 ±0.07	0.003

DISCUSSION

This study was conducted to study the effect of moderate intensity exercise on routine biochemical parameters and lactate in athletes. We found a significant elevation of urea, creatinine, glucose and lactate in serum after 30 minutes of moderate intensity exercise. Calcium, ALP, A:G ratio and amylase were decreased significantly after performing exercise.

Various studies done in marathon runners found that glucose, total protein , albumin, uric acid, calcium, phosphorus, serum urea nitrogen, creatinine, bilirubin, ALP, SGOT, SGPT, myoglobin and anion gap is increased after race. The causative factors were rhabdomyolysis and hemolysis. [1-4]

We found a significant elevation of Blood Urea and serum creatinine after exercise. Urea levels are commonly higher in athletes due to continual stress of training. [5] Performing prolonged strenuous exercise (>2 hours) causes a further elevation and may persist for following 24-40 hours. [5,6] Contributory factors for increase in Urea concentration are reduction in renal blood flow secondary to fluid volume deficiency, increased protein breakdown, bleeding in intestine and all of these. [6,7] Creatinine concentration is reported to increase after PSE. [5,7] Working muscles release creatinine, which along with dehydration and/or decreased renal blood flow and GFR leads to higher creatinine levels. This is of little concern clinically but some researchers have pointed small but significant indices of renal damage after PSE because of low renal blood flow. [8] Acute renal failure has been reported in few athletes after PSE. [9]

Ricci et al reported that after the exercise red creatinine was slightly increased in long-distance runners during basal training. [10]

Colombini et al compared the impact of a soccer match on parameters related to renal function and protein catabolism in male players. They demonstrated a rise of creatinine levels, hemoglobin levels and RBCs due to plasma volume decrease. Uric acid and urea levels were unaltered. [11]

In contrast to this some studies proposed that serum creatinine levels are not affected to a great extent by training and even in extreme sports. [12] Gerth J et al studied the effect of prolonged physical exercise on renal function, electrolyte balance and muscle cell breakdown. [13] Albumin, potassium and proteins were decreased significantly in subjects while creatinine and urea were not altered.

In our study enzyme levels like Amylase and ALP were significantly lower in post exercise samples while AST and ALT were not changed significantly. This is in contrast with another study which found that a prolonged (>2 hours) daily training in weight bearing activities lead to chronically raised serum enzyme activities. [14]

As described in literature, we found an increase in Plasma Glucose and Serum Lactate in post exercise samples. Maron et al reported increases in the lactate level after a marathon. [15]

During exercise the glucose is taken avidly by muscles along with increase in hepatic glucose production by glycogenolysis and gluconeogenesis.

In marathon runners small but significant increases in both haematocrit and haemoglobin concentration was demonstrated by Whiting et al; plasma volume was calculated to fall by 4.7%. Significant elevation of plasma glucose levels was observed in subjects drinking the glucose-electrolyte solution while no change was seen in subjects' drinking water. [7]

In our study serum protein and albumin levels were not altered significantly in post exercise samples. Studies in post marathon demonstrated otherwise due to mild dehydration, increased lymph flow, contracting muscles releasing proteins into vascular compartment. [16-18]

The difference might also lie in the intensity of exercise. Moderate intensity of exercise done by our subjects therefore did not lead to changes in protein concentrations.

AST and ALT were not changed significantly in our study. Some workers have reported elevation of AST due to exertional rhabdomyolysis and leakage from skeletal muscle. [19-22] Changes in ALT were not reported in these studies.

Advantage of this study is large sample size and a moderate intensity of exercise was assessed in athletes. Most of the other studies have used marathon runners which perform prolonged strenuous exercise. Clinicians must understand that routine workouts of trained athletes may also modulate their metabolic markers and interpret them accordingly.

CONCLUSION

This study indicates that using reference values of normal population for athletes is not wise. Some parameters like urea, creatinine, glucose, lactate, calcium, ALP are affected by exercise and trainings which need to be considered for correct interpretation. Intensity of exercise governs the alterations of blood parameters. These perturbations should be studied and established by larger studies.

REFERENCES

1. Boudou P, Fiet J, Laureaux C, et al. Variations de quelques constituants plasmatiques et urinaires chez les marathoniens. Ann Biol Clin (Paris). 1987; 45:37-45.
2. Roecker L, Kirsch KA, Heyduck B, et al. Influence of prolonged physical exercise on plasma volume, plasma proteins, electrolytes, and fluid-regulating hormones. Int J Sports Med. 1989; 10:270-274.
3. Nelson PB, Ellis D, Fu F, et al. Fluid and electrolyte balance during a cool weather marathon. Am J Sports Med. 1989; 17:770-772.
4. Maron MB, Horvath SM, Wilkerson JE. Acute blood biochemical alterations in response to marathon running. Eur J Appl Physiol Occup Physiol. 1975; 34:173-181.
5. Welsh R, Warburton DER, Haykowksy MJ, et al. Hematological response to the half ironman triathlon [abstract]. Med Sci Sports Exerc 1999; 31:s63.
6. Janssen GM, Degenaar CP, Menheere PP, et al. Plasma urea, creatinine, uric acid, albumin, and total protein concentrations before and after 15-, 25-, and 42-km contests. Int J Sports Med 1989;10(suppl 3):S132–8.
7. Whiting PH, Maughan RJ, Miller JD. Dehydration and serum biochemical changes in marathon runners. Eur J Appl Physiol 1984;52:183–7.
8. Melamed I, Romem Y, Keren G, et al. March myoglobinemia: a hazard to renal function. Arch Intern Med 1982;142:1277–9.
9. MacSearraigh ET, Kallmeyer JC, Schiff HB. Acute renal failure in marathon runners. Nephron 1979;24:236–40.
10. Acta Haematol. 1988; 80(2):95-8. Effects of exercise on haematologic parameters, serum iron, serum ferritin, red cell 2, 3-diphosphoglycerate and creatine contents, and serum erythropoietin in long-distance runners during basal training. Ricci G1, Masotti M, De Paoli Vitali E, Vedovato M, Zanotti G.
11. Colombini A, Machado M, Lombardi G, Lanteri P, Banfi G. Modifications of biochemical parameters related to protein metabolism and renal function in male soccer players after a match. J Sports Med Phys Fitness. 2014 Oct; 54(5):658-64.
12. G Banfi, M Del Fabbro. Relation between serum creatinine and body mass index in elite athletes of different sport disciplines. Br J Sports Med. 2006 Aug; 40(8): 675–678.
13. Gerth J, Ott U, Fünfstück R, Bartsch R, Keil E, Schubert K, et al. The effects of prolonged physical exercise on renal function, electrolyte balance and muscle cell breakdown. Clin Nephrol 2002; 57:425-31.
14. Noakes, T.D. Sports Medicine (1987) 4: 245. doi:10.2165/00007256-198704040-00003
15. Maron MB, Horvath SM, Wilkerson JE. Acute blood biochemical alterations in response to marathon running. Eur J Appl Physiol Occup Physiol. 1975;34:173-181.
16. Wells CL, Stern JR, Hecht LH. Hematological changes following a marathon race in male and female runners. Eur J Appl Physiol Occup Physiol. 1982;48:41-49.
17. Roecker L, Kirsch KA, Heyduck B, et al. Influence of prolonged physical exercise on

plasma volume, plasma proteins, electrolytes, and fluid-regulating hormones. Int J Sports Med. 1989;10:270-274.
18. Senay LC. Effects of exercise in the heat on body fluid distribution. Med Sci Sports. 1979;11:42-48.
19. Siegel AJ, Lee-Lewandrowski E, Chun KY, et al. Changes in cardiac markers including B-natriuretic peptide in runners after the Boston marathon. Am J Cardiol. 2001;88:920-923.
20. Thompson GR. Hazards of running a marathon: creatine kinase MB can be raised without myocardial infarction. BMJ. 1997;314:1023-1025.
21. Siegel AJ, Silverman LM, Lopez MS. Creatine kinase elevations in marathon runners: relationship to training and competition. Yale J Biol Med. 1980;53:275-279.
22. Singhal V., Lourdes Eguiguren M. de, Eisenbach L. et al. Body Composition, Hemodynamic, and Biochemical Parameters of Young Female Normal-Weight Oligo-Amenorrheic and Eumenorrheic Athletes and Nonathletes. Ann Nutr Metab 2014;65:264-271.(DOI:10.1159/000366024)

How to cite this article: Kumari A, Dalal D, Kumar R et al. Effect of exercise in biochemical parameters in athletes. International Journal of Research and Review. 2018; 5(3):101-105.

******