ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Effect of Forced Freshwater and Cold Water Swimming Stress Induced Changes in Selected Physiological and Biochemical Parameters in Wistar Albino Rats.

Jithina Krishnan[1], Kumar Sai Sailesh[1], Archana R[2], and Mukkadan JK[3]*.

[1]Department of Physiology, Little Flower Institute of Medical Sciences and Research, Angamaly, Kerala, India.
[2]Department of Physiology,, Saveetha Medical College, Thandalam, Chennai, Tamilnadu, India.
[3]Research Director, Little Flower Medical Research Centre, Angamaly, Kerala, India.

ABSTRACT

The objective of the present study was to observe the effect of cold water and fresh water swimming stress on physiological and biochemical parameters. 42 adult male 'albino rats of wistar strain with body weight ranging between (50-125g) were subjected to fresh water and cold water swimming stress. The body weight was measured before and after the stress period in all the rats. The animals were sacrificed by decapitation and blood samples were collected. The wet weight of the organs (heart, right and left kidneys, liver, spleen) was expressed per 100g of body weight. Total leucocyte count, red blood cell count, Platelet count, and Hemoglobin were estimated by standard physiological methods. Blood sugar level and serum total cholesterol level were measured by colorimetric method. We conclude that body weight, liver weight, spleen weight increased significantly followed by cold water swimming stress. Significant hypoglycemia was observed followed by both Fresh water and cold water swimming stress. Platelet count decreased significantly followed by both Fresh water and cold water swimming stress. Total leucocyte count increased significantly followed by Fresh water swimming stress.

Keywords: Fresh water swimming stress, Cold water swimming stress, physiological and biochemical parameters.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Stress is the generalized, nonspecific response of the body to any factor that overwhelms or threatens to overwhelm, the body's compensatory abilities to maintain homeostasis [1]. Excessive stress will cause physiological, biochemical and behavioral changes. Stress may be acute (single or short exposure to stress) or chronic (long-term exposure to stress) [2]. Chronic stress may cause depression [3].

The forced swimming test developed by Porsolt et al 4 is widely accepted model for studying physical stress in animals. Water temperature is an important factor in the forced swimming test. Rats could survive as long as 80 hours in lukewarm water (36°C). Increasing or decreasing the water temperature above/ below this point influences the overall behavior of the animal and changes the involvement of glucocorticoids [5, 6].

Forced Cold water swimming stress results in significant increase in the weight of adrenal gland and decrease in spleen weight [7]. It was reported that cold water and fresh water stress causes decrease in whole body weight and increase in the weight of kidneys. Henry and stephens reported cardiac hypertrophy followed by Cold water swimming stress and fresh water swimming stress [8]. A significant elevation in the lipid peroxidation in liver, kidneys, adrenal glands, and different brain regions like cerebral cortex, cerebellum, and hypothalamus was also observed after forced swimming stress [9]. RBC count, Hemoglobin levels, hematocrit value (HCT), mean cell volume (MCV), mean corpuscular haemoglobin concentration(MCHC), serum total protein, glucose, cholesterol increased significantly after cold water swimming stress [10]. The objective of the present study was to observe the effect of cold water and fresh water swimming stress on physiological and biochemical parameters.

MATERIALS AND METHODS

The present study was approved by institutional animal ethical committee. (23-05-2014, No EC/3) 42 healthy, adult male 'albino rats of wistar strain with body weight ranging between (50-125g) were used in the present study. Rats were housed under standard laboratory conditions with food and water provided ad libitum.

Control Group: This group of rats (n=6) were kept under ideal laboratory conditions served as normal control animals.

Fresh water swimming stress: Rats were forced to swim in the plastic tubs (height : 60 cm, diameter : 40 cm) containing tap water, maintained at 28°C. Depth of the water in the plastic tub was 30 cm. The swimming session lasted for 45 minutes daily. Experiments were done between 9 AM and 12 NOON to minimize the circadian variability [2].

FWS stress was studied in three subgroups: In the first subgroup of rats (n=6) the stress period lasted for 15 days. The second subgroup (n=6) was subjected to FWS for 7 days and in the third subgroup (n=6), the forced swimming stress in fresh water was done for 45 minutes only and this was taken as one day fresh water swimming subgroup

Cold water swimming stress: Rats were forced to swim in the cold water maintained at 10°C [11]. Cold water swimming stress was also studied in three different subgroups for a period of 15 days, 7 days and one day respectively with each subgroup containing 6 animals.

The body weight was measured before and after the stress period in all the rats. The animals were sacrificed by decapitation and blood samples were collected. The wet weight of the organs (heart, right and left kidneys, liver, spleen) was expressed per 100g of body weight. Total WBC count, RBC count, Platelet count, and Hemoglobin were estimated by standard physiological methods. Blood sugar level and serum total cholesterol level were measured by colorimetric method.

Data analysis

Statistical analysis was done by Tukey's Multiple Comparison. P value less than 0.05 was considered statistically significant.

ISSN: 0975-8585

RESULTS

The results were presented in figure no 1-3. There was a significant increase in the bodyweight after 7 days and 15 days of cold water swimming stress (CWS stress) . No significant difference was observed after 1 day, 7 days, 15 days of fresh water swimming stress (FWS stress). In CWS stress body weight increased significantly in 7 days and 15 days when compared to 1 day. No significant difference was observed in heart weight and kidney weight of all the subgroups of both FWS stress and CWS stress.

Liver weight increased significantly after 7 days and 15 days of CWS stress. No significant difference was observed after 7 days of FWS stress and significant increase was observed after 15 days of stress in FWS stress. Liver weight increased significantly after 7 days and 15 days of CWS stress when compared with 1 day CWS stress. Spleen weight increased significantly after 7 days and 15 days of CWS stress. No significant difference was observed after 7 days of FWS stress, however significant increase was observed after 15 days. Spleen weight increased significantly after 7 days and 15 days of CWS stress when compared with 1 day CWS stress. No significant difference was observed in RBC count of all the subgroups of both FWS stress and CWS stress.

Total leucocyte count increased significantly after 1 day of FWS stress. No significant difference was observed in total leucocyte count of all the subgroups of CWS stress. Significant increase was observed after 15 days of CWS stress when compared to 7 day stress. Platelet count decreased significantly in all the three subgroups of both FWS stress and CWS stress. Hb level increased significantly in all the three subgroups of both FWS stress and CWS stress. In case of CWS stress a significant increase was observed after 15 days when compared with 1 day stress. In FWS stress group, a significant increase was observed after 15 days when compared with 1 day and 7 days stress. A significant decrease in blood sugar level was observed in all the three subgroups of both FWS stress and CWS stress. No significant difference was observed in total serum cholesterol of all the subgroups of both FWS stress and CWS stress.

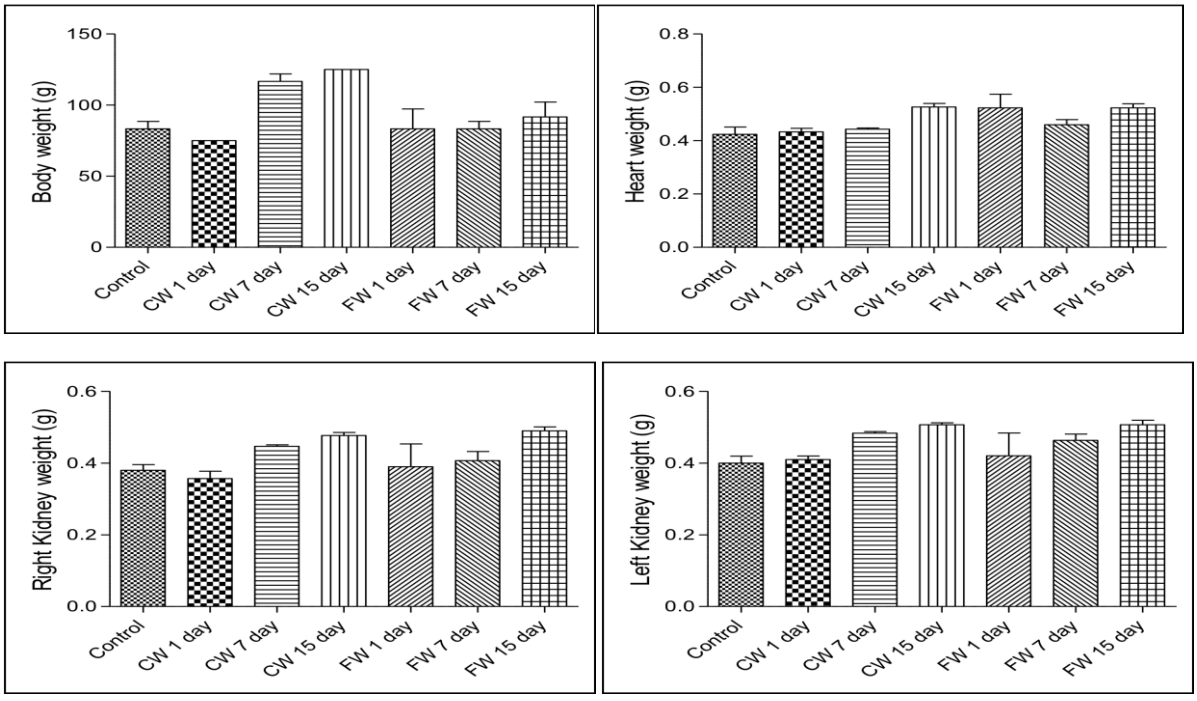

Figure 1: Body weight, Heart weight, right and left kidney weight in control, fresh water and cod water swimming stress groups.

ISSN: 0975-8585

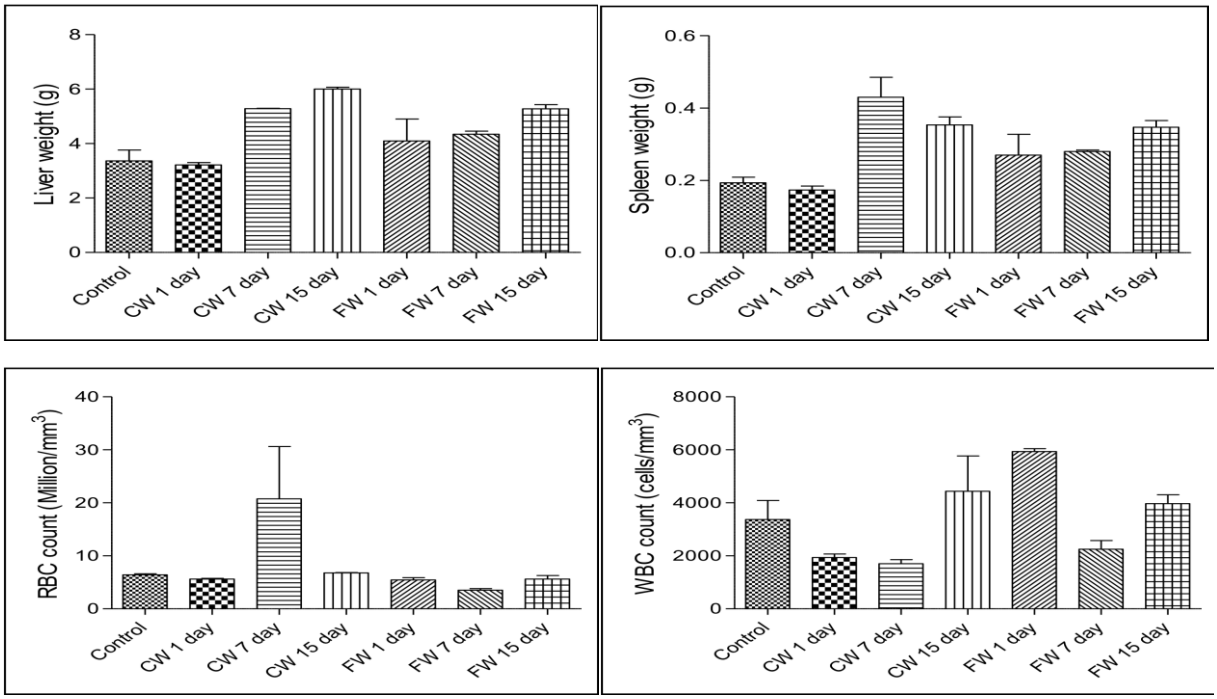

Fig.2: Liver, spleen weight and RBC, WBC count in control, fresh water and cod water swimming stress groups.

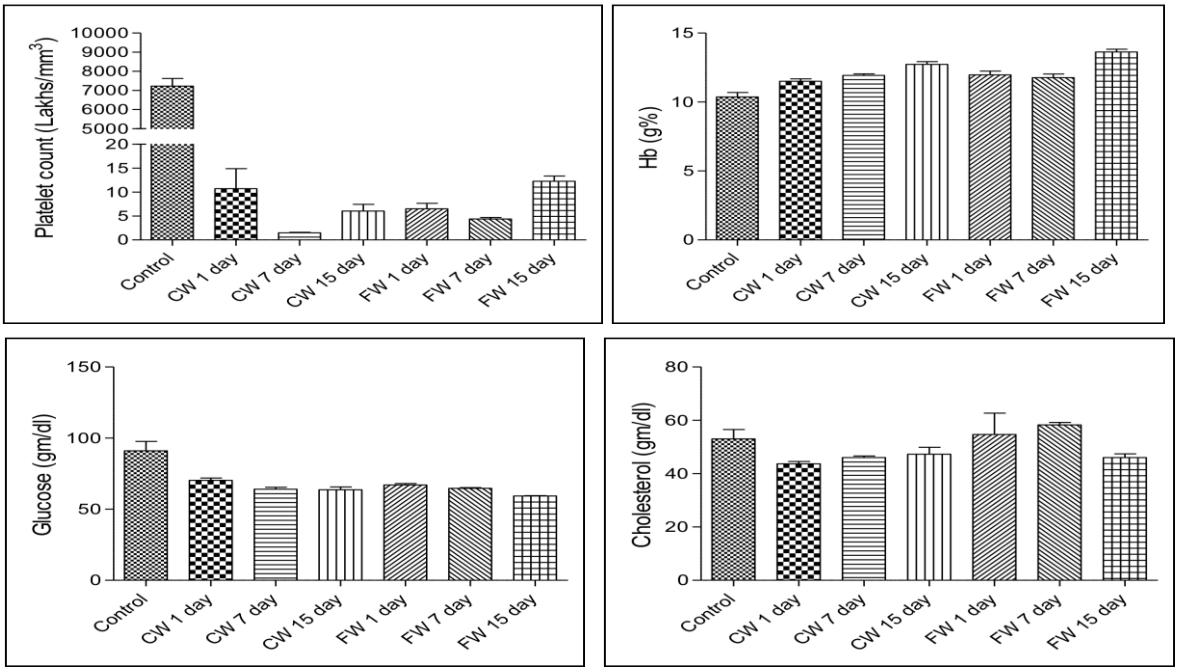

Figure 3: Platelet count, Hemoglobin, Glucose, Cholesterol levels in control, fresh water and cod water swimming stress groups

DISCUSSION

It was reported that body weight of animals decreased significantly in the initial period of exposure to the stress [2]. However, in the present study significant increase in body weight is observed after 7 days of CWS stress and no significant difference in FWS stress. Increase in the body weight in CWS stress may be due to dysregulation in the HPA axis [12] No change in the body weight in FWS stress may be due to adaptation. Cardiac hypertrophy followed by stress was observed in the previous studies [2]. In the present study increase

in the heart weight is observed after 15 days of CWS and FWS stress. However it is not statistically significant. Increase in the kidney weight followed by forced swimming was observed in the previous studies [13] It may be due to increase in the water intake during forced swimming which increase in the load on kidneys. In the present study increase in the kidney weight is observed after 7 days and 15 days of FWS and CWS stress. However it is not statistically significant. Increased weight of liver after FWS and CWS stress supports the earlier reports [14]. This may be due to increase in stress hormones which increases metabolic process and increases mRNA levels in hepatic cells [17]. It was reported that stress will cause decrease in the weight of spleen [18]. However in the present study significant increase in weight of spleen was observed after FWS and CWS stress.

Stress may increase red blood cells through glucocorticoids [1]. However no significant difference was observed in the present study acute stressors (lasting minutes) were associated with potentially adaptive up regulation of some parameters of natural immunity and down regulation of some functions of specific immunity [15]. Stress increases total leucocyte count through glucocorticoids. In the present study significant increase in the total leucocyte count is observed followed by 1 day after FWS stress .However total leucocyte count decreased followed by 1 day CWS stress. Stress will increase platelet count through glucocorticoids. In the present study significant decrease in the platelet counts in all the subgroups followed by FWS and CWS stress. The reports on effect of stress on blood sugar levels are contradictory [1, 2]. In the present study it was observed that stress produced severe hypoglycemia. This may be due to dysregulation of HPA axis. It was reported that serum cholesterol level decreased significantly after forced swimming [16]. In the present study we have observed no significant difference.

CONCLUSION

We conclude that body weight, liver weight, spleen weight increased significantly followed by CWS stress. Significant hypoglycemia was observed followed by both FWS and CWS stress. Platelet count decreased significantly followed by both FWS and CWS stress. Total leucocyte count increased significantly followed by FWS stress.

ACKNOWLEDGEMENT

We sincerely thank Dr. B. Udaya Kumar Reddy, President, and International Stress Management Association [IND] for his valuable suggestions.

REFERENCES

[1] Kumar sai sailesh, Archana R, Mukkadan J K. J Clin Diagn Res 2014;8(12): BM01-BM02.
[2] H.S.Nagaraja and P.S. Jaganathan. Indian J Physiol Pharmacol 1999; 43 (1) : 53-59.
[3] Sakakibara H, Ishida K, Izawa Y, Minami Y, Saito S, Kawai Y, Butterweck V, Tamaki T, Nakaya Y, Terao J. J Med Invest. 2005; 52 Suppl:300-1.
[4] Porsolt RD, LePichon M, Jalfre M. Nature 1977; 266: 730-732.
[5] Richter C. Phychosom Med 1957; 9: 191- 198.
[6] Abel EL. Physiol Behav 1991; 49: 321-323.
[7] Anju. Res J Pharm Biol Chem Sci. 2011; 2(4): 676-684.
[8] Henry JP and Stephens PM. Clin Exp Pharmacol Physiol 1981; 8: 483-487.
[9] Nayanatara A K , Nagaraja H S , and Anupama B K. Thai J Physiol Sci 2005;18(1): 3-9.
[10] Khaled Saeed Ali Abdo. Res J Pharm Biol Chem Sci 2013; 4(3):1059-1063.
[11] Archana R, et al. J Ethnopharmacol 1999; 64: 91.
[12] Kumar Sai Sailesh. Int J Pharm Bio Sci 2014; 5(3): (B) 1069 – 1073.
[13] Chang L T, Kras K, Suzuki k, Strasburg G, Rodger C D, Shemmel R A. Pysiol Behav 1995;57:501-508.
[14] Sardessai SR, Abraham ME, Mascarenhas JF. Indian J Physiol Pharmacol 1993 Apr;37(2):104-8.
[15] Kumar Sai Sailesh, Archana R, Antony N J, Mukkadan J K. Res J Pharm Biol Chem Sci 2014;5 (5): 612-615
[16] Tsopanikas C,Tesseromatis C. Pharmacol Biochem Behav 1991;38:813-816.
[17] Nayanatara A K , Nagaraja H S , and Anupama B K. Thai J Physiol Sci 2005; 18(1): 3-9.
[18] N.Neelima, M Sudhakar, BVS Lakshmi. Pharmanest 2014;5(1): 1859-1865.