Effect of Prolonged Restriction of Motor Activity on Primates Hydration Homeostasis

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It has been assumed that restriction of motor activity (hypokinesia) induces significant changes in body hydration homeostasis. Thus, the objective of this study was to measure body hydration level during prolonged hypokinesia (HK).

The studies were done on 12 male Macaca Mulatta (rhesus monkeys) aged three to five years (4.75 to 6.96 kg) during a 15-day period of pre HK and a 90-day period of HK. All primates were divided equally into two groups: monkeys placed under vivarium conditions served as vivarium control primates (VCP) and monkeys subjected to HK served as hypokinetic primates (HKP). For simulation of the HK effect, the HKM group was kept for 90 days in small individual cages that restricted their movements in all directions without hindering food and water intakes. During the pre HK period of 15 days and the HK period of 90 days the following parameters were measured: total body water (TBW), extracellular fluid volume (EFV), intracellular fluid volume (IFV), circulating plasma volume (CPV) and interstitial fluid volume (ISFV), urinary and plasma sodium and potassium, fluid consumption and elimination in urine, and body weight.

Significant (p ≤ 0.01) decrease in the TBW, IFV, and CPV was observed in the HKP group when compared with the VCP group. In the HKP group EFV and ISFV decreased significantly (p ≤ 0.01) when compared with the VCP group only in the initial seven days of the HK period, while after the 7th day progressive increase could be observed. Fluid loss, urinary electrolyte excretion and plasma electrolyte concentration increased significantly (p ≤ 0.01), while fluid intakes decreased significantly (p ≤ 0.01) in the HKP group when compared with the VCP group. In the HKP group body weight decreased significantly (p ≤ 0.01) when compared with the VCP group. In the VCP group the measured parameters did not change significantly when compared with the baseline control values.

It was concluded that prolonged exposure to HK induces significant changes in body hydration homeostasis while body dehydration in monkeys caused primarily due to decreased CPV.

Introduction

Living conditions and the degree of comfort associated with modern civilization have strongly reduced the level of motor activity of urban population and rendered hypokinesia one of the most important problems of modern civilization. Prolonged restriction of motor activity is of interest from the standpoint of hypokinetic, clinical, experimental, applied and sports physiology.
It has been repeatedly shown that prolonged restriction of motor activity is a factor of induction of catabolism [5–7]. Prolonged restriction of motor activity is associated with a sequence of functional reactions. For instance, decreased energy expenditure and increased muscle breakdown, negative fluid and electrolyte balances, nutritional imbalances, negative nitrogen balance, fluid redistribution, body dehydration and body weight loss. In this list of functional changes caused by prolonged exposure to HK, some functional disturbances referable to body fluid compartmentalization have an important role [3, 14, 15].

As is known the average water content of the human body can vary from 40% to 70% of the total body weight, depending on the amount of fat contained in the tissues. Water may be found in extracellular fluid, plus intravascular fluid of plasma and interstitial cell fluid and intracellular fluid. These compartments contain electrolytes that cross the membranes by energy consuming active transport processes and by diffusion or passive transport. Presently there is a basis for assuming that the body hydration homeostasis and metabolism of water electrolytes are determined in the last analysis by status of water balance in the body and thus are dependent on extracellular accumulation of water. It is obvious, therefore, that functional changes in hydration homeostasis of the body may have a direct and indirect effect on the condition and function of different organs and systems, including the condition of body fluid compartments and fluid and electrolyte metabolism [3, 14, 15].

Though some advances have been made in the understanding of body hydration homeostasis during prolonged HK, some important theoretical and practical questions still received little attention. For instance, the mechanisms, roots and nature of the formation of body hydration homeostasis during prolonged exposure to HK have not been definitively identified; there is extremely sparse information on the infrastructural and relationship between fluids and other tissues, organs, systems, and functions of the body including fluid and electrolyte metabolism. This can be primarily attributed to the fact that for the time being, there are some difficulties in conducting extensive and comprehensive studies of this highly dynamic function of body hydration homeostasis in either animals or human beings during prolonged exposure to HK. Meanwhile, experimental studies on animals and human beings, which are presently carried out in different laboratories, might offer significant contribution to the solution of many problems referable to body hydration homeostasis and its effect to other functions and organs and systems of the body during prolonged exposure to HK.

As is known, body fluid compartmentalization is greatly dependent on body hydration homeostasis and the level of restriction of motor activity. Meanwhile, the understanding of fluid transfer between body fluid compartments and its regulating mechanisms during prolonged HK are presently of high scientific interest. Thus, the objective of this study was to establish how prolonged HK may change fluid balance and the respective distribution of fluids between body compartments in primates subjected to prolonged restriction of motor activity.

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