SERUM AND TISSUE SODIUM/POTASSIUM CHANGES IN ESTROGEN TREATED FEMALE ALBINO RATS

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Summary : Five control and ten estrogen treated albino rats were studied for changes in sodium and potassium in serum, heart, muscle, uterus and brain. The serum levels of sodium depleted significantly in the estrogen treated rats. Of the tissues studied, only uterus and brain had significant sodium retention effect. The potassium levels on the other hand decreased significantly, both in serum and tissues following treatment with estrogen.

Key words : serum electrolytes tissue electrolytes estrogen effects Na/K ratio

INTRODUCTION

The salt and water retention properties of estrogen and the mechanism of action in this regard has been extensively worked out by several workers (2, 3, 7, 9). Also there are several reports in literature regarding the psychological, emotional and adverse effects of estrogen on heart, (3, 4, 8). Electrolyte play an important role maintaining the normal function of almost all parts of the body (3, 5, 10, 11). Whether estrogen produces significant electrolyte changes in tissues also has not been studied extensively. It is with this view that the present study was planned. The effect of estrogen on serum and tissue electrolytes was studied in female albino rats.

MATERIALS AND METHODS

Fifteen female albino rats (4 day cycle) weighing 150–200 *gms* were used in the study. The rats were fed on standard cube diet and were kept under identical conditions of environmental temperature, and lighting time (L:D/14:10) in the animal house. Five rats served as control and the remaining ten as test. Estrous cycle of each rat was determined by examining the vaginal smears daily. The test group of rats were treated with

estrogen (5 *mg/kg* body weight, in Sesame oil given intraperitoneally). The first injection was given in the estrous phase followed subsequently with two more injections at 24 hrs interval each. The control group was treated with vehicle only (sesame oil) in the same manner.

After 24 hrs of the last injection, all the rats were sacrificed by Concussion method. Thorax was opened immediately by a V shaped incision to collect blood from the heart directly. After drawing out the blood, the heart, brain, skeletal muscle and uterus were removed. The tissues were cut into small pieces and dried on filter paper so as to remove all the blood from it and then weighed. All the tissue samples were then digested seperately in 4 *ml* of conc. HNO_3. The estimations of serum and the digested tissue solutions for sodium and potassium were carried out within an hour of sacrificing the animals by the method of flame photometry (1).

Estrogen was obtained from the German Remedies Ltd., India (as Estradiol Vabrate U.S.P.).

RESULTS

Serum sodium increased significantly in the rats treated with estrogen compared to the control rats ($P<0.001$). The sodium content of all the tissues increased but the change was statistically significant ($P<0.001$) only in uterus and brain. On the other hand the potassium levels decreased significantly in serum as well as all the tissues studied (Table I).

TABLE I : Changes in serum and tissue elctrolytes following estrogen therapy.

		Blood	*Heart*	*Muscle*	*Uterus*	*Brain*
Sodium :						
Control	Mean	68.0	1.50	1.57	1.75	1.55
	S.D.±	6.6	0.90	0.16	0.66	0.39
Test	Mean	85.0	1.82	2.14	3.43	2.86
	S.D.±	7.1	0.16	0.33	0.31	0.11
	P	<0.001	>0.05	>0.05	<0.001	<0.001
Pottasium :						
Control	Mean	3.23	2.13	1.60	1.48	0.98
	S.D.±	0.21	0.29	0.19	0.17	0.11
Test	Mean	2.44	0.55	0.98	0.71	0.42
	S.D.±	0.09	0.11	0.21	0.11	0.09
	P	<0.001	<0.001	<0.001	<0.001	<0.001

Values expressed as mEq/Lt for serum and mEq/gm weight of tissues.
S.D. : Standard deviation.
P : Statistical significance calculated by the Students 'T' Test.
Number of animals in Control —5, and in Test —10.

DISCUSSION

The electrolyte metabolism of the tissues studied are closely related to their functions of impulse formation (8), excitation process (11) and contractility of muscles (5). Sodium and potassium are the main ions responsible for maintaining the functional equilibrium of the tissues. The action potential is dependent on the resting sodium/potassium ratio and on the intracellular, and extra-cellular gradient of these ions. Potassium depletion impairs the muscle conductivity, augments the duration of action potential and makes the tissue more excitable (5). The changed ratio of serum electrolytes which has been observed to induce a mosaic of different types of clinical signs and symptoms which range from neurogenic, psycological to nerve and muscle dystrophy or excitability (6).

In the present study, the changes in serum and tissue electrolytes following estrogen administration were not parallel (Table I). While significant ($P<0.001$) depletion of potassium was observed in serum and all the tissues in the test group of rats, the increase in sodium was confined to serum and, uterus and brain. This discrepancy is perhaps due to the fact that the normal serum potassium: sodium ratio is 1:35, and therefore even a slight change in serum potassium is likely to affect the tissue potassium significantly, whereas the change in serum sodium has to be of a very high degree to cause a similar change in tissues (11). The significant increase in uterus and brain sodium in the test group of rats, but not in the heart and muscle in the same group could be due to the high degree of vascularity of the former.

Therefore, electrolyte imbalance in serum and tissues could be one of the contributory factors towards the development of various cardiac, psychological and emotional malfunctioning following exogenous administration of estrogen.

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