Asian J. Exp. Sci., Vol. 22, No. 3, 2008; 401-404 **Short Communication**

Age Related Changes in Electrolytes (Na^+, K^+ and Ca^{2+}) with Relation to Age in Rat

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Abstract : In the present study **a**n attempt has been made to ascertain electrolyte levels (sodium, potassium and calcium) in extracellular fluids taking as replica of their levels in the blood and the status of level of these ions in blood at different ages. It establishes that as the age advances the levels of these ions (Na^+,K^+ and Ca^{2+}) rises . The rise in sodium in serum could be on account of possible decrease in intracellular entry of sodium. The rise in potassium and calcium could be on account of spilling over of these ions from intracellular to extracellular space. The deviation of values of sodium, potassium and calcium from control values in the rest four groups of varying age is highly significant at 0.001 P-value i.e. 99 per thousand confidence limit. The rise in all the three parameters from control group is quite significant.

Key words : Rat, Age, Electrolytes, Myocardium, Bio-chemical

Introduction

It is well established that biophysical principles underlying the functional status of cardiac tissue depends fundamentally on the two monovalent cations and one divalent cation those are viz. sodium, potassium and calcium. They play a major role in genesis of bioelectricity and also electromechanical coupling which functions are effected dramatically with their concentrations in extra and intracellular fluids of cardiac tissue. An attempt has been made to ascertain their levels in extracellular fluids taking as replica of their levels in the blood and the status of level of these ions in blood at different ages.

Material and Methods

Rat (*Rattus norvagicus*) bred in breeding centre of J. N. V. University duly licensed and registered for the purpose by expert committee of social justice, Govt. of India under Prevention of Animal Cruelity Act were subjected to study from day one of the birth. The rats were maintained under identical condition. All animals were given standard diet with free access to drinking water. New animals were obtained after breeding. A total of 20 recently bred animals were selected. Tagging of date of birth was also done. Investigations were performed on the rats bred in rigid condition at fix time of life cycle. Those are (1) one month (2) three months (3) six months (4) nine moths and (5) twelve months.

In the present study, the animals from each age group were sacrificed at the age of one month, three months, six months, nine months and twelve months. At the time of sacrifice, every third month blood was taken directly from aorta for the estimation purpose. Blood was taken in tube and kept for electrolytes analyses purpose without mixing the anticoagulant reagent. After it, blood was centrifuged and serum was separated out. Electrolytes were analysed in hospital

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laboratory by ion specific electrode method. These electrodes form the principal component of the equipment as peripherals. The instrument was semiautomatic Beckman E_{4A} (Autoanalyzer).

In this procedure the specific sodium electrode used is made up of specialised glass selective for sodium. A liquid ion exchange membrane electrode incorporating the antibiotic valinomycine as potassium binder is the most selective for potassium. These electrodes form the principal component of the equipment as peripherals.The instrument was semi automatic (auto-analyzer) Beckman E4A.

In this study, values of electrolytes were selected for statistical observation.

Results

The value of biochemical correlates in terms of levels of sodium, potassium and calcium have been shown in Table 1. The test of significance was applied using the levels in one month group as control. The deviation of values of sodium, potassium and calcium from control values in the rest four groups of varying age is highly significant at 0.001 P-value i.e. 99 per thousand confidence limit. The rise in all the three parameters from control group is quite significant.

It establishes that as the age advances the levels of these ions rise. The rise in sodium in serum could be on account of possible decrease in intracellular entry of sodium. The rise in potassium and calcium could be on account of spilling over of these ions from intracellular to extracellular space.

Discussion

It establishes that as the age advances the levels of these ions rise. As the sodium and potassium are concerned, this may be coupled with sodium and potassium dependent pumps situated on the cell membrane whereby for retention of potassium intracellular space seems to have become gradually disabled. The sodium level deviations could possibly be due to reduction in sodium excretion through excretory routes, which is also in part an active process. The most dramatic variation of calcium ion concentration to the extent of more than 200% rise with advancement of the age, is well correlated with reduction in contractility. It is a common observance that with advancement of age there is right ventricular hypertrophy culminating into congestive heart failure. The calcium ions have been considered to be essential for the heartbeat. The calcium ions control the excitability, rhythmicity and contractility of the heart. The calcium ions also influence the electrical property of the excitable tissue Included the heart.

Table 1 : Levels of Na^+, K^+ and Ca^{+2} in blood at different age group of rat

Serial No	Age groups (in months)	Sodium (mEq/dl)	Potassium (mEq/dl)	Calcium (mEq/dl)
1	One n = 4	100.51±0.00155 A	3.23±0.00556 A	3.12±0.000076 A
2	Three n = 4	125.02±0.000076 A	5.02±0.000519 A	5.02±0.000519 A
3	Six n = 4	130.02±0.000076 A	5.43±0.01403 A	6.02±0.0000155A
4	Nine n = 4	141.02±0.0005196A	5.90±0.000076 A	7.03±0.000076 A
5	Twelve n = 4	145.65±0.0004811A	0.000533±0.000307A	7.46±0.000307 A

Values are mean ± SE from four animals in each group.
A = P≥ 0.001 highly significant

Present observations are in conformity with the study of Hennessy (1988) who supported an age related decline in sodium and potassium, adenosine triphosphatase activity in arotic and tail artery tissue without a significant change in cardiac sodium and potassium, adinosine triphosphatase activity between twelve, eighteen and twenty seven month old fisher rats.

Kennedy *et* al. (1996) found that aging is associated with a decline in the sodium pump capacity of myocardium. Larsen and Kjeldsen (1995) studied about sodium, potassium, calcium and ATP-ase in crude homogenale of rat myocardium.

Maciel *et* al.(1990) observed that the level of calcium, adenosine triphosphatase and mRNA of sarcoplasmic reticulum were 60% lower in old rats as compared with young rats. This observation also is in conformity with the pattern observed in this study and could be attributed to the role of oxidents and antioxidents status related to aging as suggested by the study of Rao *et* al.(1990) Study of Guarnieri *et* al.(1993) indicated that the cardiac mitochondrial phosphorylating system of aged rats is poorly sensitive to variation in external free calcium.

Leblanc *et* al. (1998) examined the issue of status of contractility, electrophysiological properties and calcium ion transients in the papillary muscles and freshly dissociated ventricular myocytes of rat heart at different ages. The action potentials and macroscopic currents were recorded by them using the whole cell patch clamp technique. The action potentials did not exhibit any age or gender dependent functions. It presented worthy observations about inward rectifier, transient outward and sustained potassium ion currents independent of age and sex. Significantly calcium ion transients exhibited reduced magnitude in 10-months old female rats and on the basis of their observations they concluded the gender coupling after attainment of puberty and suggested that it could be due to difference in calcium ion handling capabilities at the level of sarcoplasmic reticulum. Hoddad *et* al. (1997) concluded that electrophysiological response to metabolic inhibition is determined by the relative importance of the metabolic pathway which is dependent on the development state of the cells (cardiocyte).

Our observations indicate that the alteration in calcium ion levels is supporting the view that sarcoplasmic reticulum alters its calcium ion handling capability with age.

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