

Original article

Effects of ageing on serum electrolytes

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Abstract

Introduction: Aging is a universal and inevitable normal biological phenomenon associated with physiological and biochemical changes that lead to functional deterioration of organs with an increased vulnerability to disease. These normal physiological changes of ageing increases the risk of electrolyte imbalance especially that of Sodium (Na⁺) and Potassium (K⁺) in elderly persons. Thus the aim of this study was to ascertain the levels of serum electrolytes i.e., Sodium (Na⁺) and Potassium (K⁺) in healthy elderly population and to view the changes in electrolyte levels that occur in aged.

Materials and Methods: In the present study 82 apparently healthy subjects were selected and serum electrolyte levels were measured using standard methods. These 82 subjects were categorized into two groups: Group I (n = 40), (Age 60 – 70 years) and statistically compared with that of Group II (n=42), (Age 30 – 40 years) by using t- test.

Results: Serum sodium levels were reduced significantly (p< 0.05) whereas serum potassium revealed highly significant (p<0.001) increase in group I subjects when compared to Group II subjects.

Conclusions: The elderly persons are more prone for electrolyte disturbances under the situations of homeostatic insults. Healthcare providers must be aware of these alterations to guide the treatment of this growing portion of the population because disorders of electrolyte metabolism can result in serious health problems in the elderly.

Keywords: Ageing, Elderly, Serum electrolytes, Sodium, Potassium.

Introduction:

Today, both the share and size of elderly population is increasing faster than any other age group. The increasing number of elderly, i.e., people aged 60 years or above which comprises about 8.0% of India's total population is expected to rise to 19% (around 323 million people) in the next four decades.¹

With age the biochemical composition and physiological capacity of cells and tissues changes, the ability to maintain homeostasis and ability in adapting to stressors declines and there is increased vulnerability to disease processes.²

Among various alterations due in the aged, electrolyte imbalance leading to disturbances in normal homeostasis has been found to be a major event in the progression of ageing. The important elements responsible for electrolyte balance,

pH, and function of enzymes include sodium, potassium, calcium and magnesium.³

These altered levels of electrolytes are also associated with the pathogenesis, treatment and prognosis of various diseases like senile cataract, diabetes mellitus, hypertension, post-surgical outcomes etc.⁴⁻⁶ But there is scarcity of evidences on whether altered levels of electrolytes in certain diseases like senile cataract, diabetes mellitus and hypertension, which are again common in old age is an effect or is involved in causation of these diseases.

Reference values have been reasonably well established for the young and middle-aged adult population, but data for those beyond age 60 years are inadequate especially in India. Thus a cross-sectional study was undertaken in elderly.

Aim and Objectives:

Aim is “To understand the effects of ageing on serum electrolytes” and the objectives were to estimate the levels of serum electrolytes i.e. Na⁺ and K⁺, in healthy asymptomatic elderly population and to compare the serum electrolyte levels between young adults and elderly group.

Material and Methods:

The study was conducted as a community based cross – sectional study. The study population was derived from the apparently healthy ambulatory persons from urban area of Pune city. The proposal of the study was put forth in the meeting of ethical committee of the institute and necessary permissions and clearance were obtained.

These subjects were selected randomly and categorized into two groups depending on their age. Group I, i.e., study group consisted of 40 elderly ambulatory individuals of either sex above the age of 60 years and the Group II, i.e., control group

consisted of 42 young ambulatory individuals of either sex between the age 30 yrs to 40 yrs. All the subjects included in the study were non-diabetic, non-hypertensive, were not on any medications or supplements and were without any documented acute or chronic systemic illness. A written informed consent in their local language was obtained from all the eligible individuals.

Fasting venous blood samples were collected from the antecubital vein without tourniquet into plain vacutainer for estimation of serum Na⁺ and serum K⁺. The samples were allowed to clot and serum was separated within 30 – 45 minutes of collection and processed immediately on the same day. Serum Na⁺ and Serum K⁺ were measured by Ion Selective Electrodes.⁷ Analysis of the data was done with the help of SPSS software and the means of the two groups were compared by t-test.

Observations and Results:

The mean age and standard deviation of study group and control group were 65 ± 2.9 years and 33.9 ± 3.3 years respectively.

Table 1: Levels of serum Na⁺ and K⁺, in terms of Mean ± S.D. and its group distribution:-

Study group	Group I (n = 40) (Mean ± S.D.)	Group II (n = 42) (Mean ± S.D.)	P Value
Serum Na ⁺ (mmol/l)	137.65 ± 3.62*	139.21 ± 3.29	0.041
Serum K ⁺ (mmol/l)	4.63 ± 0.61**	4.20 ± 0.37	0.0004

*P < 0.05 - statistically significant **P < 0.001 - highly significant

According to this table mean serum sodium levels in the elderly group (Group I) are significantly decreased (*P* < 0.5) as compared to the younger group (Group II) whereas a highly significant increase is seen in mean serum potassium level (*P* < 0.01) in elderly group (Group I) as compared to younger individuals (Group II) .

Discussion:

Our study shows that there are significantly altered levels of electrolytes in elderly as compared to younger individuals. The multiple changes in homeostasis occurring in elderly may be intervening.

The etiology of significantly decreased serum sodium levels among the elderly as shown in our study is complex. In the aged kidney there is affection of distal tubular activity leading to loss of concentrating ability associated with decreased ability to reabsorb sodium. This can be due to reduced GFR or decreased tubular responsiveness to ADH. In addition there is age related decrease in renin activity with aldosterone secretion.⁸⁻¹⁰

Decreased serum sodium levels may also result from the hormonal imbalances like SIADH which is again fairly common occurrence in elderly.¹¹ Chen et al proposed the reset osmostat mechanism as reason for the decreased serum sodium levels with no signs and symptoms of hyponatraemia.¹² Thus tendency of sodium loss combined with salt restricted diet can lead to decreased serum sodium levels in elderly.

Bohnen et al¹³ also found increased incidence of hyponatraemia in ambulatory elderly. Thus our finding of decreased serum sodium in elderly were in contention with Liang Kung Chain and associates, Bohnen et al and also with F Gankam Kenge¹⁴ who found increased incidence of hyponatraemia (13.06%) in ambulatory elderly with bone fracture.

As ageing is associated with decrease in estimated GFR¹⁵ and as previously stated there is decrease in distal renal tubular function with decrease in plasma renin and aldosterone response that means a higher concentration of potassium is necessary to elicit an aldosterone response in elderly.^{10,16} In addition there is increased levels of plasma ANF, which is a potent suppressor of aldosterone.¹⁷ Since the main route of excretion of potassium is renal elimination, lowered renal function predisposes elderly to hyperkalemia.

Takayachi et al¹⁸ in their study have proposed age as an independent factor for increasing serum potassium levels in elderly. In addition dietary practices may play an important role because a significant number of elderly people are put on a salt restricted diet which can be inherently high in potassium leading to increased serum potassium levels in elderly as compared to young adults. Our finding of significantly increased serum potassium levels in elderly which predisposes them to hyperkalaemia is similar to that of C. M. Byatt and associates¹⁹ and Passare et al.²⁰ Whereas Bohnen et al found no age difference in serum potassium levels in elderly as well as in younger population.

Saxena et al suggested that ageing is closely associated with lipid peroxidation mediated destruction at molecular level affects normal ion transport causing altered electrolyte levels in elderly.

Conclusion:

Thus the main highlight of this study is that there are altered levels of serum sodium and potassium in ambulatory elderly population as compared to younger individuals due to altered homeostatic mechanisms and thus the risk of electrolyte abnormalities may increase more under the conditions of further homeostatic insults by drugs or diseases. Hence it is important for health care providers to take into account these potential electrolyte abnormalities in the elderly that can arise under these various conditions in order to prevent adverse outcomes and also these analytes should be monitored periodically along with other routine investigations in the elderly on any kind of treatment. And also the role and credibility of salt restricted diet as well as potassium supplements needs to be revised especially in elderly.

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