

The Content of Plasma Selenium in Early Admitted Septic Patients

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INTRODUCTION

For the first time in 1817, selenium was discovered by Swedish chemist.^[1] Since then, it has been recognized as an essential trace element with antioxidant, immunological, and anti-inflammatory properties.^[2] Dietary intakes of selenium vary between geographical regions depending on selenium content of crops used by animals. In most areas of North America and Japan, intake is high (100–200 μ /day) while in Australia, New Zealand, and the majority of European countries, intake is only marginally adequate (30–90 μ /day), but in some eastern European countries and certain regions of China, intake is very low (7–30 μ /day).^[3] A previous study revealed that serum selenium levels in Iranian healthy population is in normal range.^[4] Although there are some reports in Iranian women, in which selenium status was in borderline status.^[5]

Selenium depletion has been reported in critical illness with systemic inflammatory response syndrome that correlates with an increased mortality and morbidity. Several studies have been shown that the supplementation of selenium either as monotherapy or in an antioxidant micronutrient combination was able to reduce illness severity, improve clinical outcome, reduce infectious complications, and decrease mortality.^[6,7]

ABSTRACT

Objective: Selenium depletion has been reported in critical illness correlates with an increase in mortality and morbidity. In this study, we aimed to access the selenium plasma levels of septic patients early at the Intensive Care Unit (ICU) admission in order to compare with reference range.

Methods: We conducted a cross-sectional study in a university affiliated hospital aiming to assess the early plasma level of selenium in ICU admitted patients. eighty patients diagnoses with sepsis were included and considered for characteristic evaluation, monitoring criteria assessment and also blood sampling. All blood sampling was performed during 48 hours of the ICU admission in order to determined the plasma Selenium level by atomic absorption method.

Findings: The mean plasma levels of selenium in male and female was 98.14 ± 23.52 and 78.1 ± 24.46 μ /L, respectively. Although selenium plasma levels was higher in the ICU male patients significantly, both had near normal range (80 μ /L).

Conclusion: In this study we found that in early admitted Iranian ICU patients in Tehran, selenium deficiency has not routinely seen but probably will happen during ICU hospitalization.

KEYWORDS: Critical ill patients, intensive care unit, Selenium, sepsis

Knowing the plasma levels of trace elements in a particular population for predicting possible nutritional deficiencies that might otherwise go unnoticed is important. Recently, several research projects investigate the effect of metals on health and their levels in body fluids.

In this study, we aimed to access the serum levels of selenium in septic patients early at the Intensive Care Unit (ICU) admission in one of referral hospitals, Iran. Any probable selenium deficiency would help to consider the selenium supplementation during inflammatory cytokines and oxidative stress released during sepsis.

Moreover, our evidences toward selenium administration are still inconclusive but have been supported in several studies.^[7,8]

METHODS

This cross-sectional, descriptive analytic survey was conducted in the internal and surgical ICU of Rasool-e-Akram hospital, affiliated to Iran University of Medical Sciences, from August 2013 to the end of June 2014.

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The study protocol was approved by the Local Ethics Committee of Iran University of Medical Sciences. Patients or their legal surrogates provided written informed consent forms (number: IR.26929).

This study included 80 ICU patients over the age of 18 years old diagnosed with sepsis consistent with the Society of Critical Care Medicine (SCCM) guideline.^[9] According to SCCM, sepsis is defined as life-threatening organ dysfunction caused by a deregulated host response to infection ranging from infection and bacteremia to sepsis and septic shock, which can lead to multiple organ dysfunction syndrome and death.

The demographic data of patients such as age, gender, comorbidity, serum creatinine, and Acute Physiologic and Chronic Health Evaluation (APACHE) II score at the time of admission were collected in checklist. We defined having comorbidity in the patients by suffering from one of chronic diseases such as diabetes, ischemic heart disease, chronic liver/lung, or kidney disease.

Blood sampling was performed during 48 hours of the ICU admission in patients with sepsis diagnosis. Fasting blood samples were drawn by venipuncture in the morning. Trace element-free tubes containing ethylenediaminetetraacetic acid were used. Plasma was separated by centrifugation at 3000 ×g for 15 min at 4°C. After that, plasma was sent to laboratory for selenium content analyses. Selenium concentration was determined in plasma samples using hydride generation atomic absorption spectroscopy.^[10]

Statistical analysis was performed using SPSS® 19 Software (SPSS Inc., Chicago, IL, USA). Continuous variables in each participant were expressed as mean values ± standard deviation. Comparisons were done using the unpaired Student's *t*-test and Mann-Whitney U-test for variables with normal and non-normal distributions, respectively. Chi-square and Fisher's exact tests were applied in the analyses of nominal variables in contingency tables. In all cases, a *P* < 0.05 was considered to be statistically significant.

RESULTS

In the present study, 80 ICU-admitted patients, 49 males and 31 females were chosen. Table 1 indicated the demographic characteristic of participants and also selenium plasma levels. The frequency of selenium plasma levels was depicted in Figure 1. As shown, the mean age of patients was 48.86 ± 20.76. Chronic diseases were detected in 40.6% of males and 59.4% of females, respectively. The mean APACHE II score of patients was 7.9 ± 5.58.

The mean plasma levels of selenium in all of patients was 90.37 ± 25.69 μ/L. As shown in Table 1, the mean plasma levels of selenium in males and females was 98.14 ± 23.52 and 78.1 ± 24.46 μ/L, respectively (*P* < 0.0001). Although selenium plasma levels was higher in the ICU male patients significantly, both had near normal range (80 μ/L). There was no significant correlation between selenium plasma levels and APACHE II score and comorbidity condition, respectively [Table 2].

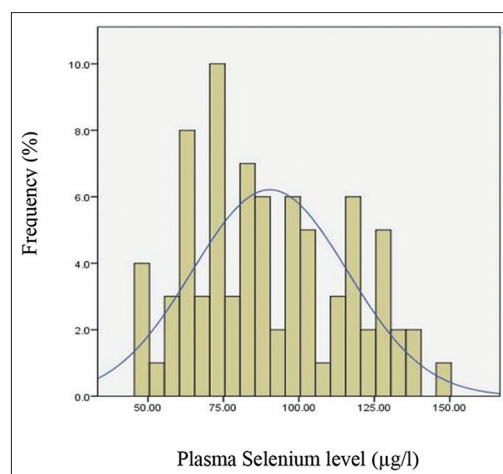


Figure 1: Frequency of participants against plasma selenium levels

Table 1: Characteristic of participants and selenium plasma levels (n=80)

Variable	Value
Gender, male (%)	61.25
Age (years)	48.86±20.76
Serum creatinine (mg/dl)	1.47±1.45
APACHE score	7.9±5.58
Se plasma levels (µg/l)	
Male	98.14±23.52
Female	78.1±24.46

Data are presented as mean±SD or number (%) of patients. SD=Standard deviation, Se=Selenium, APACHE=Acute Physiology and Chronic Health Evaluation

Table 2: Selenium plasma levels

Status	Se plasma levels (µg/l)	P
With comorbidity	89.44	0.792
Without comorbidity	91	
APACHE score		0.391
0-4	92.07±22.56	
5-9	94.48±32.48	
10-14	89.88±21.72	
15-19	75.42±19.60	
>20	72±0	

Comorbidity defined as a chronic condition such as diabetes, ischemic heart disease, chronic liver/lung, or kidney disease. Data are presented as mean±SD or number (%) of patients. SD=Standard deviation, Se=Selenium, APACHE=Acute Physiology and Chronic Health Evaluation

DISCUSSION

The benefits of selenium, an essential nutrient, and their function in human health are well established and have been extensively reviewed.^[3] Selenium status can be assessed by determining the selenium concentration of whole blood, plasma, serum, or erythrocytes. A meta-analysis of 14 selenium supplementation/depletion studies confirmed that plasma or serum levels are the most commonly used and reasonably

accurate biomarkers of selenium status, representing short-term changes in intake.^[11] Measurement is relatively easy, but trace element-free needles and collection tubes must be considered for any environmental contamination. Furthermore, in this study, we preferred to assess plasma selenium levels as it is feasible and available.

Several previous studies revealed that serum selenium levels in Iranian healthy population is in normal range.^[5,8] For example, in study conducted in Tehran, selenium serum levels is estimated $104.31 \pm 24.70 \mu\text{g/L}$ in males and $94.33 \pm 17.60 \mu\text{g/L}$ in females.^[4] We have similar data $123 \mu\text{g/L}$ for adults in Mazandaran^[12] Although we have a report of selenium deficiency in women who are living in Tehran.^[5] Our results were very similar to previous study in Iran. We found that women had lower plasma selenium levels in comparison with men. The mean range of selenium plasma levels in our study was in similar manner with other reports.

Selenium deficiency was defined as a levels $<80 \mu\text{g/L}$, which is a cutoff associated with increased mortality.^[13] By considering this cutoff, in this study, septic ICU-admitted woman had normal or near normal selenium plasma levels and very near to normal, and septic ICU-admitted men had normal range.

A range of different recommendations to ensure adequate dietary intake of selenium for healthy populations has been estimated. The United Kingdom (UK) suggested the selenium intake of 75 mg/day for male and 60 mg/day for female via daily nutrition. These amount has been determined as the intake believed to be necessary to maximize the activity of glutathione peroxidase in plasma, which occurs at a plasma selenium concentration of around 100 mg/L (range 89–114 mg/L).^[12] The current UK intake is far below this. In the United State, the Food and Nutrition Board has fixed a recommended daily allowance of 55 mg/day.^[14]

Selenium deficiency is commonly reported in critically ill patients, particularly those suffering from sepsis, trauma, and burns. It is reported that low plasma levels of selenium is associated with nosocomial infections' risk^[7] and infusion of 1600 μg selenium followed by initial bolus dose of 2000 μg for 10 days categorized as a novel modality to increases selenium status, improves illness severity, and lowers the incidence of hospital-acquired pneumonia in the ICU patients.^[8] However, randomized trials failed to support parenteral selenium supplementation in critically ill patients with sepsis.^[8] Currently, we do not have concrete evidences that support the administration of selenium in septic patients.

Forceville *et al.*^[7] assessed selenium levels in 134 consecutive patients admitted to the ICU. All patients received 40 mg/day of selenium before ICU admission. The mean selenium concentration at the time of admission was 0.68–0.23 mmol/L, which was significantly less than the reference population (1.00–0.15 mmol/L; $P < 0.0001$). Berger *et al.*^[15] investigated selenium levels in 11 trauma patients admitted to the ICU. Intravenous trace element supplementation was started soon after admission including 62 mg of selenium/day for 7 days. Selenium levels were low on admission, and despite supplementation did not normalize for 7 days.

In this study, we have just found that in the Iranian population at the beginning of admission to the ICU, the selenium plasma levels is in reference range but deficiency probably will happen during critical ill condition. According to mentioned study, selenium plasma contents might have decline during ICU hospitalization, critical ill condition and selenium urinary loss as well.

This alteration must be checked in well-designed controlled blinded clinical trials by controlling nutritional state and other confounding factors. Our study has some limitations. The first one is that the cross-sectional design of the study limits our conclusions and does not provide information about effects of nutritional status on disease progression and outcome of individuals. We cannot judge about other patients in different places of our country since they may be completely having different statuses. It was better to assess the changes in selenium plasma levels not only in the ICU-admitted patients but also during ICU hospitalization.

AUTHORS' CONTRIBUTION

All authors have participated in data gathering and analyzing. A.M and S.N prepared the manuscript. A.M finalized the article.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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