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Original Article

Serum trace elements before and 3 months after renal transplantation in kidney recipients: An Iranian study

Mohammad Reza Nikoobakht, Gholamreza Pourmand, Farzad Allameh, Hossein Dialameh, Amirsina Sharifi, Arsalan Hashemiaghdam*

Urology Research Center, Sina Hospital, Tehran, Iran

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ABSTRACT

Background: Decreased serum levels of trace elements seen in long-term hemodialysied patients, suppress immune system. The aim of this study was to find if any changes occur in trace elements after transplantation and assess the correlation between post-transplantation renal function and levels of trace elements.

Methods: Long-term hemodialysied patients with underlying ESRD were divided into two groups, who were undergone transplantation ($n = 54$) and were not ($n = 69$). Levels of lithium, magnesium, iron, zinc and copper measured 24 h before and three months after transplantation in both groups. The transplanted patients' serum levels of creatinine were assessed at same intervals as an indicator of graft function.

Results: 54 patients, 18 men (33%), 36 women (67%) with mean age of 47.67 ± 14.33 years underwent transplantation between April 2010 and April 2011. While serum iron ($p < 0.001$) and copper levels ($p < 0.001$) significantly increased after transplantation, there was a statistically significant reduction in magnesium levels ($p < 0.001$) .No significant differences were noted in zinc ($p = 0.17$) and lithium ($p = 0.080$) levels in comparison to control group .A significant relationship was noted between levels of magnesium ($p = 0.015$) and zinc ($p = 0.025$) and creatinine within three months after transplantation.

Conclusion: Our study showed transplantation alters serum levels of trace elements in long-term hemodialysied patients with underlying ESRD and affects immunity and the results of renal function (Cr levels).

1. Introduction

Patients with end-stage renal disease (ESRD) and long-term hemodialysis are at high risk for several disorders.[1,2] This is because of factors like long time dialysis, poor nutritional status, oxidative stress, inflammation and infection affecting their immune system, making them more vulnerable.[3–6] Decreased serum albumin levels and increased oxidative stress in these patients are due to poor nutrition and altered serum levels of essential trace elements.[7,8] Metabolic disorders in patients with ESRD can also alter the serum

* *Corresponding author*. Tel.: +98 9173174014 (mobile); fax: +98 2166348500.
E-mail address: hossein.dialameh@gmail.com (H. Dialameh).

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concentrations of trace elements. On the other hand, changes in trace elements can be secondary to their disrupted gastrointestinal tract function, proteinuria, consumed medications and the presence of other comorbidities such as diabetes.[9–11]

Efficient immune system function is related to appropriate intake of trace elements. Decreased serum levels of trace elements suppress immune system by affecting innate, T cell mediated and adaptive antibody responses, which is leading to alter host immune response. It can raise mortality and morbidity by increasing the chance of infection. On the other hand infection can worsen serum levels of trace elements by reduction in trace elements intake, increase in losses via GI tract and changes in metabolic pathways which is leading to misusage of trace elements. Trace elements enhance body's natural defense in three ways by supporting cellular immunity, physical barriers (skin/mucosa), and antibody production. For example zinc enhances skin barrier function and zinc, iron, selenium and copper work in synergy to advance the immune cells function. All these trace elements are needed to antibody production.[12] Long-term dialysis is linked to increased oxidative stress and reduced zinc (Zn) levels.[13] This is while Zn, because of its antioxidant and anti-inflammatory properties, can help reduce inflammation in dialysis patients.[14,15] Copper (Cu), a co-factor of ceruloplasmin and superoxide dismutase (SOD), is also reported to play an important role in the synthesis of hemoglobin and having a healthy immune system.[16,17] Some studies have indicated that uremic patients have lower selenium levels than healthy individuals.[18,19] This is mainly because uremic patients who underwent chronic dialysis lose trace elements through dialysis membrane.[20]

The aim of this study was to investigate changes in serum levels of trace elements after transplantation and determine its effects on post-transplantation renal function by evaluation of creatinine levels.

2. Methods

This descriptive prospective study was conducted between April 2010 and April 2011 on two groups of patients. Group one were all consecutive ESRD patients (of any etiology) who underwent kidney transplantation from a living donor in our hospital and group two were ESRD patients with history of chronic hemodialysis who have not kidney transplantation as control group. The study was approved by the Ethical Board Committee of Tehran University of Medical Sciences. All the patients signed an informed consent before being enrolled into the study.

The required blood samples were collected from all patients, 24 h before transplantation, to measure serum levels of lithium, magnesium, iron, zinc and copper. Three months after the transplantation, the patient's serum creatinine level and kidney function were evaluated. Also blood samples of patients in control group were taken during three months period.

The data were analyzed using descriptive statistics analysis (chi-square, Paired T-Test, Spearman correlation) in Microsoft SPSS version 20.

Baseline creatinine levels as high as 1.4 were set as the cut point to divided transplanted patients into two groups. This amount of creatinine was selected because it is the upper normal limit of creatinine in healthy individuals which could help to compare renal functional changes after transplantation to normal population.

3. Results

During the study period, 44 patients (18 males and 26 females) with ESRD who received kidney transplants from a living donor were recruited. Their mean age was 47.67 ± 14.33 years, ranging from 32 to 62 years old. The control group was 69 patients consist of 24 males and 45 females and their mean age was 35.12 ± 15.22 years, ranging from 19 to 51. Mean serum levels of the trace elements in the beginning of the study and within post-transplantation period are outlined in Table 1. Findings revealed a significant reduction in magnesium levels after the transplantation ($p < 0.001$). There was significant increase in iron and copper after the transplantation ($p < 0.001$ and $p < 0.001$, respectively). But for zinc and lithium reported increase was not statistically significant ($p > 0.05$). Mean creatinine levels was 1.4 ± 0.46 mg/dL. Based on their creatinine levels, 26 (48%) were categorized in group 1 (Cr ≤ 1.4) and the other 18 in group 2 (Cr > 1.4).

While serum levels of Li, Fe and Zn were higher in the group 1; there was no significant difference in this regard (Table 2). There was a significant correlation between post-transplantation Cr levels and serum levels of and Mg (p-value = 0.015, r: 0.355). On the other hand, an inverse and

Table 1 – Serum levels of trace elements before and three months after kidney transplantation.

	Before transplantation (mean ± SD)	3 Months after transplantation (mean ± SD)	p-value*
Lithium (mmol/L)	0.43 ± 0.27	0.53 ± 0.44	0.080
Magnesium (mmol/L)	2.30 ± 0.30	1.87 ± 0.34	<0.001
Iron (μg/dL)	66.85 ± 33.49	90.85 ± 29.60	<0.001
Zinc (μg/dL)	110.87 ± 38.12	99.48 ± 34.40	0.170
Copper (μg/L)	100.92 ± 20.69	124.07 ± 19.28	<0.001

*$p < 0.05$ = significant.

Table 2 – Post-transplantation serum levels of trace elements in transplanted patients based on their creatinine levels.

	Cr < 1.4 (mean ± SD)	Cr ≥ 1.4 (mean ± SD)	p-value*
Lithium (mmol/L)	0.60 ± 0.292	0.46 ± 0.34	0.095
Magnesium (mmol/L)	1.78 ± 0.32	1.96 ± 0.33	0.015*
Iron (μg/dL)	93.00 ± 33.78	88.85 ± 25.59	0.615
Zinc (μg/dL)	102.23 ± 34.95	96.92 ± 34.32	0.025*
Copper (μg/L)	123.92 ± 15.89	124.21 ± 22.26	0.955

*$p < 0.05$ = significant.