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Serum magnesium and zinc level in patients with chronic renal failure

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Abstract

Background: To assess serum zinc and magnesium level in patients with chronic renal failure. **Methodology:** Forty- five chronic renal failure patients of both genders were selected. Group I (45) had CRF patients undergoing hemodialysis and group II (45) had age matched control subjects. 5 ml of venous blood was obtained under aseptic conditions. Serum samples were separated and analysed using atomic absorption technique. **Results:** Group I had 25 males and 20 females and group II had 22 males and 23 females. The mean magnesium level before dialysis in group I was 2.78 µg/L and after treatment was 1.94 µg/L. In group II, the mean magnesium level before dialysis was 2.04 µg/L and after treatment was 1.90 µg/L. The difference was significant (P< 0.05). The mean zinc level before dialysis in group I was 276.2 µg/L and after was 172.4 µg/L. In group II, the mean zinc level before dialysis was 294.2 µg/L and after was 214.6 µg/L. The difference was significant (P< 0.05). **Conclusion:** The level of zinc and magnesium in patients with chronic renal failure falls after dialysis. It may be beneficial to assess serum zinc and magnesium levels in CKD patients.

Keywords: Chronic renal failure, Magnesium, Zinc.

INTRODUCTION

Chronic renal failure (CRF) provokes imbalances of elemental status in physiological fluids and tissues and can lead to deficiency in or raised levels of these nutrients, but the mechanisms responsible for these changes are poorly understood, and the contribution of toxicity or deficiency in some elements to the symptoms of CRF is uncertain.[1] Among the causes of these alterations are reduced food intake and the low element content of some low-protein diets recommended in CRF to delay the progression of kidney damage.[2]

The kidney has a vital role in magnesium homeostasis: regulation of magnesium excretion is determined by filtration and reabsorption.[3] In individuals with normal renal function, ∼74–100 mmol (1800–2400 mg) of magnesium are filtered everyday. About 70–80% of plasma magnesium is ultrafilterable, and ∼95% of the filtered magnesium load is subject to tubular reabsorption with 5% excreted in urine.[4] The renal handling of magnesium depends to a great extent on the plasma magnesium concentration: in hypermagnesaemia, the fractional excretion of magnesium is high, while during hypomagnesaemia, it is low.[5]

Dyslipidaemia is associated with rapid decline in renal function and commencement of RRT in CKD patients. The precise mechanism is unknown, but it has been postulated that mesangial cells bind and take up oxidized LDL which then causes injury to mesangial, epithelial and endothelial cells by favouring recruitment of inflammatory cells such as macrophages which release cytokines, chemokines and growth factors.[6] Low circulating zinc concentrations have been described in CRF. The cause of the decrease is unclear but may be a consequence of the low-protein diets recommended for these patients.[7] Zinc deficiency in CRF may also be partly due to impaired intestinal absorption, alterations in tubular transport or loss of ion-transporting plasma proteins.[8] Considering this, we assessed serum zinc and magnesium level in patients with chronic renal failure.

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METHODS

A sum total of forty- five chronic renal failure patients of both genders were selected in this prospective, observational study. Ethical committee of the institute approved this study. All were enrolled once they agreed to participate with their written consent.

Demographic data such as name, age, gender etc. was recorded. Patients were randomly divided into 2 groups. Group I (45) had CRF patients undergoing hemodialysis and group II (45) had age matched control subjects. 5 ml of venous blood was obtained under aseptic conditions. Serum samples were separated and analysed using atomic absorption technique. The results were compiled and subjected for statistical analysis using Mann Whitney U test. P value less than 0.05 was set significant.

RESULTS

Table 1: Gender wise distribution of subjects in both groups.

Groups	Group I	Group II
Male	25	22
Female	20	23

Group I had 25 males and 20 females and group II had 22 males and 23 females [Table 1].

Table 2: Assessment of magnesium before and after hemodialysis.

Groups	Before	After	P value
Group I	2.78	1.94	0.01
Group II	2.04	1.90	0.04
P value	0.05	0.92	

The mean magnesium level before dialysis in group I was 2.78 µg/L and after treatment was 1.94 µg/L. In group II, the mean magnesium level before dialysis was 2.04 µg/L and after treatment was 1.90 µg/L. The difference was significant (P< 0.05) [Table II].

Table 3: Assessment of zinc level before and after hemodialysis.

Groups	Before	After	P value
Group I	276.2	172.4	0.02
Group II	294.2	214.6	0.04
P value	0.05	0.01	

The mean zinc level before dialysis in group I was 276.2 µg/L and after was 172.4 µg/L. In group II, the mean zinc level before dialysis was 294.2 µg/L and after was 214.6 µg/L. The difference was significant (P< 0.05) [Table 3].

DISCUSSION

Cardiovascular disease is the leading cause of hospitalization and mortality in patients with chronic kidney disease. The process of cardiovascular disease most likely started in early stages of CKD considering its severity at commencement of renal replacement therapy (RRT). Dyslipidaemia is one of the recognized traditional cardiovascular risk factors in the general population as well as CKD patients. This cardiovascular risk factor occurs commonly in patients with CKD.[9] It is reported that hemodialysis results into the loss of some trace elements such as manganese, selenium and zinc. The importance of trace elements measurement for monitoring the effect of long-term hemodialysis on the trace elements blood level, is suspicious.[10] Low circulating zinc concentrations have been described in CRF. The cause of the decrease is unclear but may be a consequence of the low-protein diets recommended for these patients.[11]Zinc deficiency in CRF may also be partly due to impaired intestinal absorption, alterations in tubular transport or loss of ion-transporting plasma proteins. Determination of essential trace elements is important for hemodialysis patients. It is because of treatment interventions, hemodialysis facilities and patient's life style.[12] CRF is accompanied by a decrease in tubular resorption of magnesium ions, lower magnesium intake and diminished intestinal absorption of this element.[13] Considering this, we assessed serum zinc and magnesium level in patients with chronic renal failure.

Our results showed that group I had 25 males and 20 females and group II had 22 males and 23 females. Sanchez et al.[14] studied nutritional status for magnesium and zinc in 40 patients with CRF. Patients were divided into two groups. The control group consumed their usual prescribed diet, and the nutritionally instructed group received dietary training to teach them how to choose foods that met their nutritional needs. Magnesium and zinc were measured in plasma at the start and at the end of the study. Participants in the nutritionally instructed group decreased their protein intake and increased that of carbohydrates, magnesium and zinc. Plasma zinc correlated with glomerular filtration rate, measured as creatinine clearance, (r = 0.37) plasma protein (r = 0.39) and zinc intake (r = 0.63). After the intervention, they observed no changes in the number of participants with hypomagnesaemia in either group, whereas hypozincaemia was found in only 1 participant in the control group and 1 in the instructed group.

Our results showed that the mean magnesium level before dialysis in group I was 2.78 µg/L and after treatment was 1.94 µg/L. In group II, the mean magnesium level before dialysis was 2.04 µg/L and after treatment was 1.90 µg/L. Our results showed that the mean zinc level before dialysis in group I was 276.2 µg/L and after was 172.4 µg/L. In group II, the mean zinc level before dialysis was 294.2 µg/L and after was 214.6 µg/L. Mahajan et al[15] in their study concluded that subnormal plasma and hair zinc and hyperzincuria, were present in patients less than 12 months post- transplant whereas patients who were more than 12 months post-transplant had plasma zinc levels, hair zinc, and urinary zinc excretions in the normal range. Zinc concentrations in plasma and hair of some patients who were more than 12 months post- transplant with renal failure, were subnormal and were similar to those in hemodialysis patients. These results suggest that abnormalities of zinc and taste persist up to 12 months post- transplant and may be related to increased urinary zinc losses.

Ejaz et al[16] found that serum magnesium is a poor indicator of the overall magnesium content of different tissues, and normomagnesaemia does not necessarily exclude magnesium depletion. Moreover, there may well be a slow continuous loss of body magnesium when using low magnesium dialysate (0.25 mmol/L) over extended treatment periods: 4, 8 and 12 months after introducing the solution, persistent hypomagnesaemia occurred in 21, 64 and 37% of patients, respectively. Ishimura et al[17] investigated the prognostic value of serum magnesium concentration for mortality in 515 patients on maintenance hemodialysis (60 +/- 12 years, 306 males and 209 females; 24% diabetics). The patients underwent follow-up for 51 +/- 17 (mean +/- SD) months, and the relationship between the baseline magnesium concentration (mean of four months) and outcomes was analyzed statistically. During the follow-up period, there were 103 all-cause deaths, including 63 non-cardiovascular deaths. Kaplan-Meier analysis revealed that mortality was significantly higher in the lower magnesium group (< 2.77 mg/dL, i.e. < 1.14 mmol/L, n = 261), compared to that in the higher magnesium group (> or = 2.77 mg/dL, n = 254) (p < 0.001). Multivariate Cox proportional hazard analysis demonstrated that serum magnesium was a significant predictor for mortality (HR [per 1 mg/dL increase], 0.485 [95% CI, 0.241-0.975], p = 0.0424), particularly for non-cardiovascular mortality (HR 0.318 [95% CI, 0.132 to 0.769], p = 0.0110), after adjustment for other confounders, such as age, gender, hemodialysis duration, and the presence of diabetes. It ws demonstrated that lower serum magnesium level is a significant predictor for mortality in hemodialysis patients, particularly for non-cardiovascular mortality, although the mechanisms remain to be explored in future studies. Factors affecting serum magnesium concentrations should be investigated in terms of better survival, including dietary magnesium intake.

CONCLUSION

The level of zinc and magnesium in patients with chronic renal failure falls after dialysis. It may be beneficial to assess serum zinc and magnesium levels in CKD patients.

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