Serum Concentration of Molybdenum in Chronic Renal Failure Patients Requiring Hemodialysis

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Summary:

Background: High serum molybdenum level may contribute to dialysis related bone disease in patients requiring long term hemodialysis in fact massive molybdenum accumulation causes joint deformity and arthritis

Objective: To asses the level of molybdenum in uremic patients requiring long term hemodialysis and impact of hemodialysis on the serum level of molybdenum before and after hemodialysis

Patients and methods: Eighty patients complain from chronic renal failure on long term hemodialysis aged (16 to 65) years, serum molybdenum was measured before and after hemodialysis

Result: The mean serum molybdenum level in 80 patients requiring long term hemodialysis was elevated before dialysis (0.29 $\pm$ 0.17 nmol/mL) and even after dialysis (0.16 $\pm$ 0.05 nmol/mL) in comparison to the normal value (normal 0.02------0.13 nmol/ml).The value significantly decrease from 0.29 $\pm$ 0.17 nmol/mL before hemodialysis to 0.16 $\pm$ 0.05 nmol/mL after hemodialysis (P.value <0.001) .

Conclusion: This study confirmed that in chronic renal failure patients who are on haemodialysis, serum molybdenum level are significantly higher than normal, because the main excretion route of molybdenum is the kidney. The level of serum molybdenum was significantly decrease after hemodialysis. It is necessary massively remove molybdenum in the future with new dialysis method or with new adsorptive agent in patients requiring long term hemodialysis.

Keywords: Serum Molybdenum, hemodialysis,

Introduction:

Molybdenum is an essential trace element in animal and human nutrition. Molybdenum is involved in the pathways of purine degradation and formation of uric acid. Molybdenum is concentrated primarily in liver, kidney, bone, and skin. Molybdenum absorption occurs readily in gastrointestinal tract, and excretion occurs primarily via the kidney. Beans, beef liver, cereal grains, dark green leafy vegetables, legumes, and peas are all good sources of molybdenum. It helps regulate iron stores in the body and is a key component of at least three enzymes: xanthine oxidase, aldehyde oxidase and sulfite oxidase. These enzymes are involved in carbohydrate metabolism, fat oxidation and urine metabolism.the average adult has about 9mg of molybdenum concentrated mostly in the liver, kidney, adrenal glands, bones and skin. Molybdenum deficiencies are associated with esophageal cancer, sexual impotency and tooth decay (1).The Estimated Safe and Adequate Dietary Intakes of molybdenum is about 75 to 240 µg/day by adults.There are many therapeutic uses of Molybdenum include Prevention of dental caries, Anti-cancer activity of molybdophosphate(2). Lowering blood glucose and free fatty acid levels (3),combination of molybdate with the medicinal plant Teucrium polium L, can improve islet cells function before transplantation (4), also is recommended for Wilson's disease in humans (5) In Huntington's disease- ammonium tetrathiomolybdate is recommended as a candidate for clinical trials (6). Massive accumulation of molybdenum contribute to joint deformity or arthritis ,kidney disease and liver disease . Molybdenum level are elevated in serum and various tissues in patients on long term hemodialysis(7).

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Patients and methods:

The study was performed in AL-Nahrain College of Medicine and in AL-Kadhmiya Teaching Hospital in dialysis unit during the period from June 2009 to December 2010. 80 patients(45 male and 35 female) were involved in this study of different age ranging from(16 to 65) years (mean ±SD of age 47.6±17.4 year) complaining from chronic renal failure on regular hemodialysis.

Each patient subjected to hemodialysis for period of 4 hours in two or three sessions per week. Using GAMBRO AK95S haemodialysis apparatus with polyflux^{TM}L dialyzer membrane with effective surface area range from 1.4 to 2.1m^2 and flow rate rang from 200 to 300 ml/min. Dialyzers were not reused and dialysis was performed with disposable kits, syringes, and needles. Disinfection of the

dialysis machines was done routinely accordingto the recommendations of the manufacturer. Patients who were HCV- positive were dialyzed in a separate room.

B. Blood samples: Ten milliliters of random venous blood were withdrawn from each patient , in supine position, without application of tourniquet. Samples were transferred into clean plane tube, left at room temperature for 15 minutes for clotting, centrifuged, and the separated serum was transferred into Eppendrof tube and was used for measurement of molybdenum. The tubes were stored at –20o C until analysis, which was done within one month after collection8.

C-Methods: Using *Flameless Atomic Absorption Spectrophotometer* (Thermoelectron Corporation, S. Series Atomic Absorption Spectroscopy), serum molybdenum was measured8.

Measurement of serum creatinine was done by enzymatic method described by Bio Merieux manual9.

D. Statistical analysis: Statistical analysis was done using Excel system version 2003 and includes descriptive statistics (mean and standard deviation) and inferential statistics (*t-test*) to test the significancy of mean difference. When P-value was less than 0.05, the difference is considered statistically significant, and the difference is considered highly significant when P-value was less than 0.001.

Results:

As expected for patients with renal failure (before dialysis), *serum creatinine and serum molybdenum,* were significantly elevated as compared with same patients (but after dialysis) (P-value <0.001) as seen in Table 1.

Significant positive correlation was found between serum molybdenum and serum creatinine in hemodialysis patients before (r = 0.89, *P-value < 0.001*) and after dialysis (r = 0.98, *P-value < 0.001*) as seen in Figures 1, 2 respectively.

Table (1): The mean serum (creatinine and molybdenum) in hemodialysis patients (presented as mean ± SD).

Variable	G1	G2
S.Creatinine (µmol/L)	718.7 ± 184.8*	504.8 ± 185.8
S.Molybdenum (nmol/mL)	0.29 ± 0.17*	0.16 ± 0.05

(G1): Chronic Renal Failure patients before hemodialysis.

(G2): Chronic Renal Failure patients after hemodialysis.

* t-test: G1 versus G2, $p < 0.001$

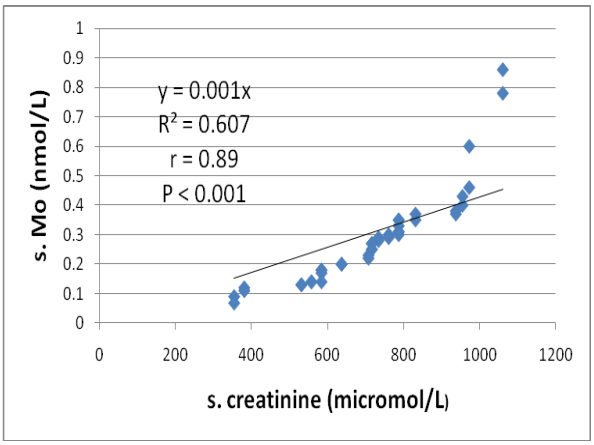

Figure (1): Correlation between serum molybdenum and serum creatinine in G1 (hemodialysis patients before dialysis) (n=80; r = 0.89; P< 0.001*).*

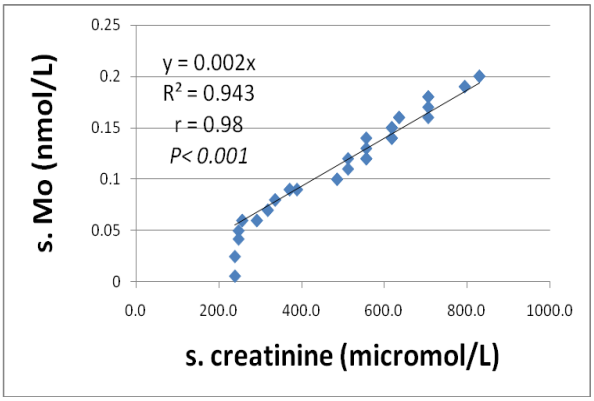

Figure (2): Correlation between serum molybdenum and serum creatinine in G2 (hemodialysis patients before dialysis) (n=80; r = 0.98 P< 0.001).

Discussion:

High serum molybdenum level may contribute to dialysis related bone disease in patients requiring long term hemodialysis, in fact massive molybdenum accumulation causes joint deformity and arthritis , it has been documented that patients on long term hemodialysis are prone to develop sever skeletal change and painful arthropathies because of hyperparathyroidism or aluminum oestomalcia. In these patients dialysis related amyloidiosis characterized by pain and stiffness usually affecting the shoulder, hand, wrist and other joint has been reported. (10) This present study confirmed that in patients on haemodialysis serum molybdenum level was significantly higher than normal, because the main excretion route of molybdenum is the kidney, as reported by other. (11) All patients involved have renal impairment supported by the finding of elevated serum creatinine before dialysis (718.7 ± 184.8 µmol/L) and after dialysis (504.8 ± 185.8 µmol/L) when compared to normal reference range for creatinine (60-120 µmol/L) In this study the mean serum molybdenum level in 80 patients requiring long term hemodialysis was elevated before dialysis (0.29 ±

0.17 nmol/mL) and even after dialysis (0.16 ± 0.05 nmol/mL) in comparison to the normal value (0.02----0.13 nmol/ml).(11)

The value significantly decrease from 0.29 ± 0.17 nmol/mL before hemodialysis to 0.16 ± 0.05 nmol/mL after hemodialysis (p.value <0.001). There are no correlation between serum molybdenum and duration of hemodialysis, age and sex of patient P.value >0.05

Conclusion:

This study confirmed that in chronic renal failure patients who are on haemodialysis serum molybdenum level was significantly higher than normal, because the main excretion route of molybdenum is the kidney. the level of serum molybdenum was significantly decrease after hemodialysis .It is necessary massively remove molybdenum in the future with new dialysis method or with new adsorptive agent in patient requiring long term hemodialysis.

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