Aluminium- Related Disorders In Hemodialysis Patients

Dr. Mahnaz Edalatnejad

Aluminium, A Well Defined Toxic Metal in Nature

- About 5–10 mg of aluminium enters human body daily through different sources like water, food, occupational exposure to aluminium in industries, and so on. In people with normal kidney function, serum aluminium is normally lower than 6 microgram/L. Baseline levels of serum aluminium should be <20 microgram/L. Standard aluminum levels in the dialysis fluid should be less than 0.01 milligram/L.
-

Hidden Sorces of Aluminium

Aluminum is used in a wide variety of household items, from cookware to deodorant to tap water to salt, sugar and flour as an anticaking agent.Four major sources of aluminum are :

1. Aluminum Cookware and Aluminum Foil

One study found that steaming rhubarb (a highly acidic vegetable) in an aluminum steaming pot caused 170 mg/kg of aluminum –170 times the safe weekly intake limit — to leach into the food

2. Antiperspirant Deodorant

3. Aluminium-containing medications (particularly antacid/antiulcer and buffered aspirin formulations)

4. Tap Water

Continue …

- Most aluminium consumed will leave the body in feces; most of the small part of it that enters the bloodstream, will be excreted via urine.
- Aluminum toxicity occurs in dialysis patients or CKD patients with GFR <30 mL/min/1.73 m^2 (CKD Stages 4 and 5) because aluminum that is absorbed from the gut or that enters the body from dialysate or another parenteral route is not excreted, or is inadequately excreted by the diseased kidneys.
- When aluminum accumulates in dialysis patients, it is only slowly removed by dialysis because 90% of aluminum is bound to serum proteins (primarily transferrin).
- The aluminum entering the body accumulates in various tissues, including bone, brain, parathyroid glands, and other organs. Such accumulation of aluminum can produce toxicity with several distinct syndromes, depending on the rate and magnitude of aluminum loading.

Aluminium-Related Disorders

* Aluminium Overload
* Aluminium Toxicity
    - Acute
    - Chronic
        - Microcytic Anemia
        - Dialysis Encephalopathy
        - Bone disorders
* Hypercalcemia

Acute Aluminum Toxicity

- Acute aluminum neurotoxicity is diagnosed based on
- Clinical features &
- Elevation of serum aluminum levels to 400-1,000 µg/L.

- Causes
- Aluminum contamination of dialysate, often to levels of 150-1,000 µg/L.
- Aluminum gels (to control hyperphosphatemia) plus citrate . Various citrate salts, including citric acid, sodium citrate, or calcium citrate, markedly enhance intestinal absorption of Al.
- After the start of treatment with DFO in doses of 20-40 mg/kg.

Chronic Aluminum Toxicity
Dialysis encephalopathy

- An insidious disorder with symptoms generally appearing after patients have undergone dialysis for 12-24 months or even longer.
- Subtle personality changes /Speech disorder/Motor disturbances
- Substantial elevations of serum aluminum, usually 150-350 µg/L & Electroencephalogram (EEG) finding.

Aluminum-related bone disease

- Presented with bone pain, a characteristic “waddling” gait, proximal muscle weakness, and fractures
- Often exhibit hypercalcemia
- radiographic features of subperiosteal erosions and, when parathyroidectomy was done, the clinical features worsened.
- Bone biopsies revealed typical aluminum-related bone disease, and the term pseudohyperparathyroidism was applied to such patients

Diagnosis

- The DFO infusion test, using DFO in doses of 5 mg/kg,
- the presence of bone surface staining for aluminum of >15%-25% showed a close association with clinical symptoms and with bone biopsy features of reduced bone formation and even osteomalacia, the histological features of aluminum bone disease.
- Population studies suggested that the combination of the increment of serum aluminum after DFO combined with PTH levels <150 pg/mL (16.5 pmol/L) provided better sensitivity and specificity to predict aluminum bone disease than the DFO test alone.

Serum Aluminum Levels and Frequency of Monitoring

- **12.1 To prevent aluminum toxicity, the regular administration of aluminum should be avoided and the dialysate concentration of aluminum should be maintained at <10 µg/L. (EVIDENCE)**
- **12.1.a CKD patients ingesting aluminum should not receive citrate salts simultaneously. (EVIDENCE)**
- **12.2 In CKD Stage 5, to assess aluminum exposure and the risk of aluminum toxicity, serum aluminum levels should be measured at least yearly and every 3 months in those receiving aluminum-containing medications. (OPINION)**

Serum Aluminum Levels and Frequency of Monitoring *continue*

- **12.2.b Baseline levels of serum aluminum should be <20 µg/L. (OPINION)**
- **12.2.c If levels of serum aluminum are between 20-60 µg/L, a search for and elimination of all sources of aluminum should be performed. (OPINION)**

Deferoxamine (DFO) test

- **12.3 A deferoxamine (DFO) test should be performed if there are elevated serum aluminum levels (60-200 µg/L) or clinical signs and symptoms of aluminum toxicity , or prior to parathyroidectomy if the patient has had aluminum exposure for at least 4 months or more. (OPINION)**
- **12.3.a The test is performed by infusing 5 mg/kg of DFO during the last hour of the dialysis session with a serum aluminum measured both before DFO infusion and 2 days later, before the next dialysis session. (OPINION)**
- **12.3.b The test is considered positive if the increment of serum aluminum is ≥50 µg/L. (OPINION)**

Deferoxamine (DFO) test continue

- **12.3.c A DFO test should not be performed if the serum levels of aluminum are >200 µg/L to avoid DFO-induced neurotoxicity. (OPINION)**

- **Complications**

  Acute neurotoxicity

  mucormycosis

LETTER TO THE EDITOR

Year : 2014 | **Volume** : 25 | **Issue** : 2 | **Page** : 412-414

Aluminum overload: Still as a source of concern in hemodialysis patients

Mahnaz Edalat-nejad, Reza Ghasemikhah, Mostafa Delavar
Arak University of Medical Sciences, Arak, Iran

In this cross-sectional survey, serum aluminum level was evaluated in 136 patients with a mean age of 59 ± 15 years (range 20-88 years) and an average duration on dialysis of 44.6 ± 46.8 months (range 3-296 months).

Aluminum overload: Still as a source of concern in hemodialysis patients

- Patients with a recent history of taking aluminum hydroxide (within two weeks) as phosphate binder were excluded from the final analysis. Seventy-two subjects (52.9%) were male and 47 patients (34.6%) were diabetic. The majority of subjects (76.5%) attended hemodialysis for 4 h three times weekly.
- Thirty patients (22%) had a history of short course (one week) aluminum hydroxide taking in the previous month. Mean serum aluminum was 15.63 ± 13.9 µg/L (range 0.73-75.59 µg/L), but the values in 22 patients (16.2%) were higher than 30 µg/L (41.8 ± 12.9 µg/L), and, in three cases, values were higher than 60 µg/L.

  There were no significant differences by gender, age, underlying diabetes, recent history of taking aluminum hydroxide and biochemical parameters between the two groups of aluminum-overloaded and non-overloaded patients [Table 1]. In diabetics, there were moderate correlations between serum phosphorus value and aluminum log (r = 0.427, *P* = 0.003).

Summary

- Unfortunately, our findings were far different from ideal. In our survey, the prevalence of aluminum overload (serum aluminum >30 µg/L) was 16.2% and, also, in 26% of the cases serum aluminum values were greater than the re-commended baseline level of <20 µg/L by NKF-KDOQI. Serum aluminum was higher than 60 µg/L in three patients.

THANK YOU FOR YOUR ATTENTIONS