LEAD - AN ESSENTIAL TRACE ELEMENT

Pages with reference to book, From 48 To 48

William W. T. Manser (Baqai Medical College, Karachi.)

"**One man's meat is another man's poison".**

Doom and gloom were spelt out for Karachi in a previous editorial[1] on lead: "Plumbum!- Karachi Quo Vadis?" I think that most who read JPMA are familiar with the toxic effects of lead and that if the present trend is not checked, Karachi appears to be hell-bent on eventual self-destruction. But supposing if there were absolutely no lead in our environment what would be the effects? Disaster! I will leave you to decide which of us is loony, myself for writing this article or the author of "Plumbum! Karachi Quo Vadis?" Lead, hitherto regarded as a highly toxic non-essential element is generally supposed to have no beneficial biochemical role to play. The same can be said for other supposedly toxic elements, arsenic, aluminium, cadmium, molybdenum, nickel, tin and vanadium as was said about selenium until 1957[2]. However, all of these have recently been found to be essential trace elements and it is only now that their roles in life processes are being investigated. Kirchgessner, Reichimayr - Lais and their group[3] in Freising (Germany) have found that the milk of lactating rats which had been fed on a diet very low in lead (about 30 ppm) and which was otherwise normal, was deficient in calcium, sodium, potassium, iron, zinc and magnesium and that there was a 30% reduction in the activities of NaK-ATPasc and CaMg-ATPase in the erythrocyte membranes of their offspring. In mothers and offspring there were disturbances in iron and lipid metabolism and in enzyme activities and trace element concentrations in various tissues. The pups suffered from growth retardation and microcytic anaemia presumably as a result of mineral deficiencies in the milk and reductions in the activities of the ATPases. Diets containing about 850 ppm of lead produced normal results. They found that piglets fed on a similar lead deficient diet even when allowed to feed ad libitum suffered from a 16% reduction in growth rate and there were abnormalities in the metabolisms of cholesterol, phospholipids, bile acids and also of sodium, potassium, zinc, copper and manganese. The carcasses contained less fat than normal. Anke et al[4] in Leipzig, found that among goats and guinea-pigs, dietary deficiencies produced the following results. Aluminium deficiency, reduced life expectancy, arsenic deficiency, sudden death from myocardial insufficiency, calcium deficiency, myasthenia; molybdenum deficiency, growth depression, disturbed reproduction and lowered milk yield and skin and skeletal lesions; vanadium deficiency, skeletal damage Nielsen[5] in U.S.A. found that, in rats, arsenic was required to metabolise cystine, polyamines and taurme from methionine, tin enhances growth, vanadium is involved in iodine metabolism and lead in haemoglobin biosynthesis. Is there, then, a truly toxic non-essential element? On the other hand, is there a safe blood level for lead? Paradoxically, the answers to both appear to be "No". In the case of lead, there is a continuum of effects from possible sudden death at 120 mg/dl6 down to growth retardation in children at 4 ug/dl via anaemias at 25 ug/dl or above[6] (cf. lead deficiency[3,5] produces anaemia!). Extrapolation appears to give a safe blood lead level of zero[7]. Pre-historic man appeared to have a level of 0.2 ug/dl and, if this can be taken as the baseline, even in the remotest areas of the world, the inhabitants now have levels of four times this[7] and modernised man of 200 or over. However, as more and more sensitive methods of estimation are found, more and more elements are found to be essential. We can now measure elements in body fluids and tissues in parts per billion. Soon it will be in parts per trillion, perhaps eventually in parts per quadrillion. By then probably all elements from hydrogen to uranium or even to lawrencium may be found to be essential. Concerning toxicity, all common essential trace elements exhibit toxicity when conditions lead to high enough levels, sodium, calcium, zinc, etc. not excluded. Now we have the so-called toxic non-essential elements, lead, aluminium, arsenic, etc. as being essential and deficiency is possible at very low levels. Hence, the essentiality of any element: from deficiency to toxicity is another continuum either in a relatively small or a large range of dose response. Existing criteria of essentiality need revision as there is probably no clear-cut distinction between essential and non-essential or between toxicity and non- toxicity in life processes.

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