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Studies on the Concentration of Arsenic, Selenium, Copper, Zinc and Iron in the Blood of Blackfoot Disease Patients in Different Clinical Stages

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Summary: Flame atomic absorption spectrophotometric methods were developed for the determination of zinc, copper, arsenic, iron and selenium in blood samples. Data from blackfoot disease patients in five clinical stages were compared with those from healthy controls. Copper concentrations were the same for all clinical stages. Arsenic increased in the initial three stages but decreased thereafter, although arsenic was previously considered to be the major causative agent of the disease. The decrease of arsenic in the later stages was attributed to the antagonistic effect of selenium, and the decrease of iron during the progress of the disease is thought to be due to the antagonistic effect of arsenic in the initial stages and the loose of haemoglobin in the later stages.

Introduction

An endemic peripheral vascular disease called blackfoot disease is suffered by a large number of inhabitants on the southwest coast of Taiwan (1–6). The disease has an insidious onset with numbness or coldness as the initial symptom. It progresses with the development of localized ulceration and subsequent gangrenous changes, giving the characteristic black coloration of dry gangrene. Most patients are permanently maimed as a result of spontaneous or artificial amputation of a portion of the affected extremity (7).

Blackfoot disease is thought to be related to the presence in artesian drinking water of high concentrations of arsenic, silicate, copper, nickel and certain fluorescent compounds, with arsenic as the primary suspect (8–18).

Patients with advanced clinical symptoms should therefore have a high concentration of blood arsenic, but our preliminary results showed a decrease of

arsenic in the advanced stages. In order to assess this situation, we determined arsenic, iron, selenium, zinc and copper in blood samples from blackfoot disease patients in different clinical stages. The results indicate a probable antagonistic effect between arsenic and selenium.

Materials and Methods

Blood samples

One hundred and thirteen blood samples of blackfoot disease patients at five clinical stages according to the criteria set by Drs. U. C. Huang and D. T. Lin (tab. 1), and 49 blood samples of persons with no known history of exposure to arsenic were used. As shown in table 2, there was an even distribution of age and sex between the two groups. Samples were frozen below -20°C until used.

Chemicals and biological standards

Suprapur grade reagents of E. Merck and high purity water (18 M Ω) were used. Stock solutions containing 1000 mg/l or mg/kg of iron, zinc, copper, selenium and arsenic and working