

Movement of Trace Elements in the Thymus and Immunodeficiency

Yasuaki Arakawa

Department of Hygiene & Preventive Medicine

Faculty of Health Sciences

The University of Shizuoka

Summary

Certain trace elements induce a severe immunodeficiency by their deficiency or exposure. Probably, these causes appear to be due to the changes in the thymus which is the immune central organ, that is to say, the depletion of thymocytes (T cells) in quantitative aspect and the degree of differentiation and maturation of thymocytes in qualitative aspect. Therefore, in this study, the thymus atrophy and the changes in the membrane surface antigens of T cells were examined by analyzing the movement of thymocytes and peripheral T cells of zinc deficiency, manganese deficiency and organotin-induced thymus atrophy in SPF Wistar-derived rats on a Fluorescence Activated Cell Sorter (FACS) with monoclonal antibodies to rat cell surface determinants. A zinc deficiency induced a severe and reversible thymus atrophy and immunodeficiency. In zinc deficient thymocytes, significant increases in percentage of CD4 antigen cells (Rat T helper cells and macrophages), CD8 antigen cells (Rat T suppressor/cytotoxic cells) and CD4 & CD8 double negative cells and decreases in percentage of CD4 & CD8 double positive cells (undifferentiated cells) and Thy 1,1 antigen cells (Total T cells) were observed. In addition, significant decreases in percentage of Thy 1,1 antigen cells, α/β (T cell receptor) antigen cells and CD2 antigen cells (E rosette forming cells), although to a lesser degree, and increase in percentage of CD4 & CD8 double positive cells were observed in peripheral T cells of zinc deficiency rats. In manganese deficiency rats, there was no significant change in quantity and subpopulations of thymocytes. However, significant increases in percentage of CD4 antigen cells and CD8 antigen cells, and a significant decrease in percentage of CD4 & CD8 double negative cells were seen in peripheral T cells. On the other hand, organotin compound such as dibutyltin dichloride induced a severe, reversible and dose-dependent thymus atrophy and immunodeficiency. In organotin-exposed thymocytes, a significant decreases in percentage of α/β antigen cells and CD4 & CD8 double positive cells, and increases in percentage of CD4 antigen cells and CD8 antigen cells were observed. In peripheral T cells, decreases in percentage of Thy1,1 antigen cells, CD2 antigen cells and CD4 & CD8 double positive cells were observed. These results shows that the immunodeficiency induced by the deficiency and exposure of certain trace elements is manifested as T cell dysfunction which is caused by not only the changes in quantity such as thymus atrophy but also the changes in quality such as the changes in the membrane surface antigens of T cells, that is, the impairment in the process of differentiation and maturation of T cells in the thymus.