

Changes of Mucopolysaccharides in the Epiphyseal Plates of Mice Following Neonatal Thymectomy

We reported a remarkable retardation of the enchondral and the endochondral ossification, and a severe generalized bone atrophy besides the depression of the immunological capacity in mice suffered from wasting syndrome following neonatal thymectomy¹⁻⁵.

The purpose of this present communication is to discover the mucopolysaccharides change in the growth plates of the wasted animals.

Material and method. Our prior publications concerning to the strain of the experimental animals and thymectomy are referred to^{1,2}. 10 wasted animals were selected for the histochemical examinations, during the 6th-7th post-operative weeks. 10 sham-operated littermates of the same age acted as controls.

The earlier examinations were completed by a qualitative histochemical analysis, referring to the oxygenization of bone. The Ritter-Oleson method used, it is preferable for the simultaneous demonstration of the neutral and acid mucopolysaccharides. The acid is blue, and the neutral is reddish coloured in the histological specimens. This reaction of the epiphyseal plates of the distal end of femora was observed.

Results and discussion. A preponderance of the acid mucopolysaccharide in the intercellular substance of cartilage was seen in the growth plates of femora of the control animals which has Hale positivity. A faint PAS positivity (red colour) in the degenerative zone of the epiphyseal plates could be seen. There is an intensive blue colour in the intermediate zone of the growth plates also (Figure 1).

A marked PAS positivity in the matrix of the epiphyseal plates of the wasted animals could be observed. The cartilaginous remaining hyalin pillars are also reddish coloured, and PAS positivity may be seen subperiosteally at the lateral edges of the growth plates (Figure 2). There are similar colours in the intercellular substance of the epiphyseal plates of vertebrae. These

changes were demonstrable in all animals with the wasting syndrome.

From the observations, there is a preponderance of the neutral mucopolysaccharide in the growth plates of mice suffering from wasting syndrome following neonatal thymectomy as seen, by this qualitative histochemical analysis. These phenomena refer to bradytrophy, i.e. the deficiency of the oxygenization of the tissue mentioned. The diminished cellular activity and matrix production in the growth zone, and the preponderance of PAS positivity indicates the considerable alteration of the oxygenic processes of the epiphyseal plates⁶.

It is known that the plates, not unlike other organs during growth, are sensitive to the general body changes, hormonal influences and the lack of nutrients essential for specific oxygenic processes. Malnutrition and starvation, vitamins, acute and chronic illness, infections, the various hormonal effects, and the lack of these deprive the plates of the adequate essential substances which are necessary for growth⁷. The lack of thymic function is manifested in the depression of the immunological

¹ L. BEREK, Zs. BÁNOS, I. SZERI, P. ANDERLIK and K. ASZÓDI, *Experientia* 24, 721 (1968).

² L. BEREK, Zs. BÁNOS, I. SZERI, P. ANDERLIK and K. ASZÓDI, *Kisérlet. Orvostud.* 20, 240 (1968).

³ L. BEREK, Zs. BÁNOS, P. ANDERLIK, I. SZERI, K. ASZÓDI and K. GEFFERTH, *Immunologische Beziehungen der Knochenveränderungen bei Säuglingsatrophie im immundepräsentativen Modellversuch*. Magyar Pédiaiter, Kongress-No. 2, 46 (1968).

⁴ I. SZERI, Zs. BÁNOS, P. ANDERLIK and L. BEREK, *Die Rolle des Thymus bei der Säuglingsatrophie*. Magyar Pédiaiter, Kongress-No. 2, 47 (1968).

⁵ L. BEREK, *Experientia* 25, 633 (1969).

⁶ L. JÓZSA, *Orvosképzés* 78, 386 (1968).

⁷ R. S. SIFFERT, *J. Bone Jt Surg.* 48, 546 (1966).

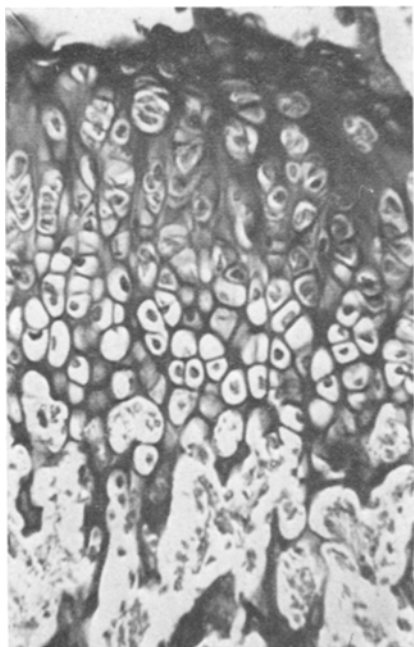


Fig. 1. C3H sham-operated littermate. There is an intensive blue colour (Hale positivity) in the intermediate zone of the distal growth plate of femur. Ritter-Oleson staining. $\times 60$.

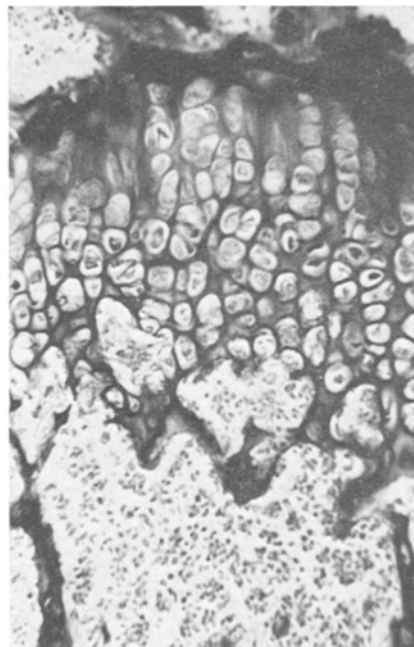


Fig. 2. C3H neonatally thymectomized wasted mouse. There is a remarkable reddish colour (PAS positivity) in the matrix of the distal epiphyseal plate of femur. Ritter-Oleson staining. $\times 60$.

capacity, and within several weeks, a wasting syndrome in neonatally thymectomized mice^{8,9}. It is uncertain whether the demonstrated retardation of the ossification and the generalized bone atrophy, with the considerable alteration of the oxygenic processes, are the result of the depressed immunological capacity or of the complex and not exactly detected processes effecting the wasting syndrome. This defect in the growth indicates that neonatal thymectomy and the developing organism is suitable for the study of the antagonistic correlation¹⁰ between the thymic function and the growth. On the other hand the lack of thymic function should be considered in the interpretation of those diseases, which are due to the defect of the epiphyseal plates.

Zusammenfassung. Es wurde eine Präponderanz der neutralen Mukopolysaccharide in der Epiphysealplatte

der neonatal thymektomierten Mäuse beobachtet und das Phänomen diskutiert.

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⁸ J. F. A. P. MILLER, *Lancet* 2, 748 (1961).

⁹ J. F. A. P. MILLER, *Proc. r. Soc. B* 156, 415 (1962).

¹⁰ M. W. HESS, in *Experimental Thymectomy Possibilities and Limitations* (Springer Verlag, Berlin-Heidelberg-New York 1968), p. 1-

Vertebral Malformations in Chicks Caused by X-Radiation During Their Embryonic Development

It is known that periods of higher sensitivity to the action of environmental factors may be stated in the development of an embryo as well as of buds of its particular organs. The periods of higher sensitivity of the embryo are often the moments at which hereditary information programming the development of the given organs are realized. Detection of those periods and the manner of the embryo's response to the acting factor is a necessary condition for understanding teratogenesis.

In the experiments presented the authors have decided to determine the periods of higher sensitivity in the development of the vertebral column in hens by means of X-radiation.

Newly laid eggs (150) of White Leghorn hens were divided into 5 equal groups (A-F) and incubated at 38°C, air humidity being 65%. The eggs were turned 5 times in the course of 24 h. The separate groups of eggs were exposed to a single dose 500 r X-radiation (obtained from the apparatus DOF, 55 kV, 7 mA, without filtre) after 25 (group A), 42 (group B), 52 (group C), 65 (group D) and 72 (group E) hours of incubation, i.e. during the formation of somites¹. In the 19th day of incubation the embryos were killed and fixed in alcohol.

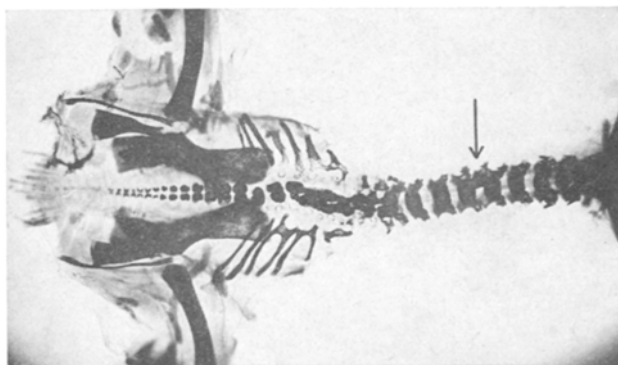


Fig. 1. An embryo of the group B. The arrow in cervical region points to deformed points and additional half-vertebra. Thoracic vertebrae are deformed and fused. The ribs associated with them are either fused along their whole length or only at their base. The centra of the last thoracic and presacral vertebrae are split out.

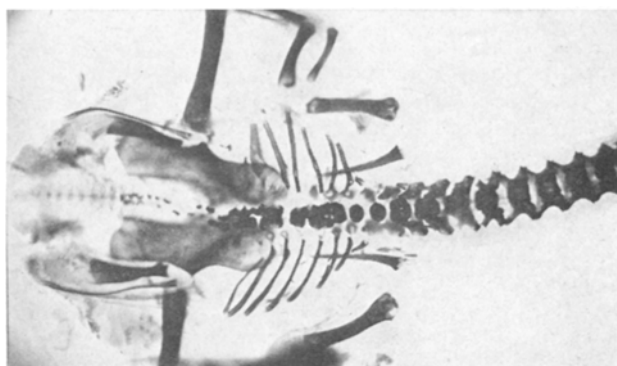


Fig. 2. An embryo of the group C. Thoracic vertebrae are deformed and interfused. In presacral region the centra and arches are not developed.

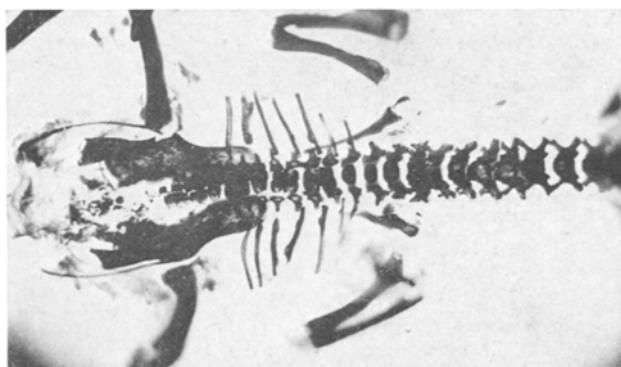


Fig. 3. An embryo of the group C. The centra of thoracic and two before last cervical vertebrae are fused. In presacral region the vertebrae are deformed and fused, the sacral and caudal regions are lacking the vertebral buds.

¹ V. HAMBURGER and H. HAMILTON, *J. Morph.* 88, 49 (1951).