POSSIBLE SOURCES OF REGENERATION OF INTERRENAL TISSUE IN MAMMALS

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Most authors consider that in mammals the main source of regeneration of interrenal cells is to be found in the external layers of the adrenal cortex. These layers include the internal layers of the capsule of the organ (subcapsular layer of Bachmann), the glomerular zone, and the intermediary layer [4-7,10-13,15].

Many authors have observed that the ability to generate new cells is maintained to some extent in the cells of all the cortical zones. The evidence for this statement is the presence of mitotic figures in all zones [9]. However, such figures are rare [12,14] because in all the adrenal cortical zones mitoses are found only up to the time of the final development of the organ after which they can be seen only in the external cortical layers and their number is very small.

We have obtained abundant material from white mice and rats, guinea pigs, rabbits, dogs, pigs, boars, goats, and cattle which has enabled us to discover yet a further source for the renewal of the adrenal cortex in the postnatal period.

EXPERIMENTAL METHOD

For microscopic study we used pieces of adrenals taken from freshly killed male or female animals; they were promptly fixed in mercuric chloride (Susa) or in 10% formalin containing 1% potassium chloride. A portion of the material was fixed at the same time in Bouin. After fixation in formalin sections were cut on a freezing microtome, stained in a mixture of Sudan III and IV in Sudan Black B, and tested for ketosteroids using the method of Ashbel and Zeligman as modified by Vvedenskii, Simon, and Yusfina [2]. After fixation the remainder of the material was embedded in the normal way in paraffin. Sections 4-6 μ thick were stained in hematoxylin-eosin, or in azocarmine, or in Mallory (in certain cases the azocarmine was replaced with erythrosine). Histochemical reactions for amino acids were carried out by Danielli's method, and Barnet and Zeligman's tests for active COOH-groups and for SH and S—S-groups were made.

EXPERIMENTAL RESULTS

In the present work it seemed necessary to study serial sections which were always made in a plane perpendicular to the long axis of the organ.

Microscopic study of the sections of the adrenals almost always revealed islets of cortical cells in the substance of the medulla. They are usually regarded as transversely cut outgrowths of adrenal cortex which have penetrated into the medulla. However we must notice that from their structure and histochemical characteristics the cells of the islets may clearly be distinguished from the reticular zone of the adrenal cortex to which they would be expected to belong.

In studying serial sections we were convinced that the islets represented transverse sections of cellular cords which had penetrated into the medulla. In many cases and in many animals these cords originate from the wall of the central vein of the adrenal body or from its branches; in such cases a layer develops directly by the wall of the vessel and contains cells at various stages of differentiation which repeat the pictures described for the subcapsular layer of the adrenal cortex [4].

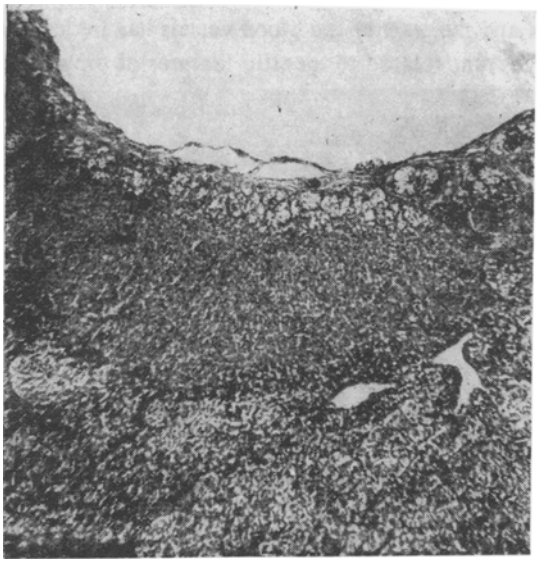

Fig. 1. Part of the adrenal medulla of a goat. Formation of cortical substance from the central vein of the adrenal body. Hematoxylin-eosin. Objective 3.5, ocular 15.

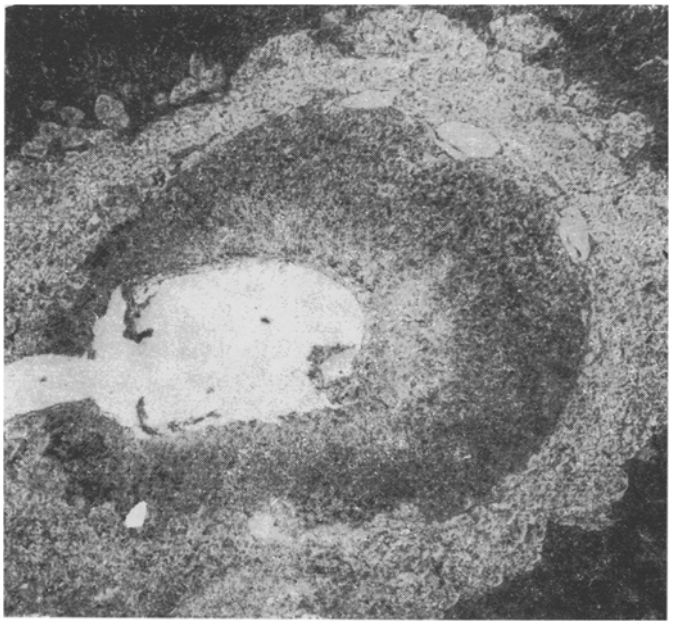

Fig. 2. Adrenal medulla. The circular formation of adrenal cortex from the wall of the central vein is shown. Azan–Mallory. Objective 3.5, oxular 12.5.

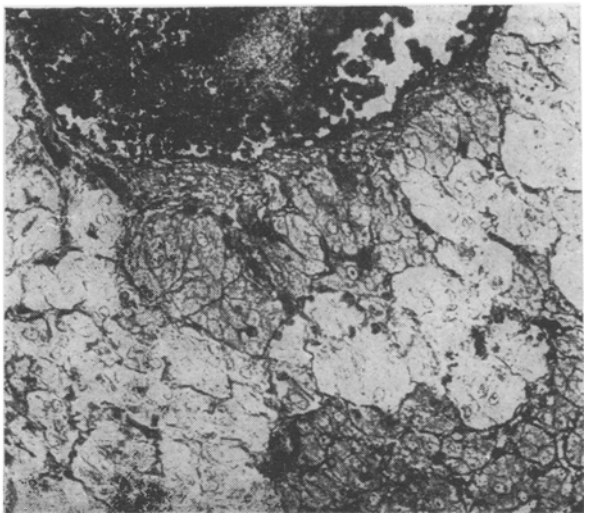

Fig. 3. Portion of the adrenal cortex of rabbit No. 1. The growth of interrenal tissue from the wall of the central vein is illustrated. Azan–Mallory. Objective 40, ocular 7.

Fig. 1 shows the adrenal cortex. New interrenal tissue lies up against the wall of the central vein, and in this case it repeats completely the microscopic structure and histochemical properties of the adrenal cortex with the usual division into zones arranged in the reverse order and directed from within outwards. The cortex may grow so vigorously from the wall of the central vein that it surrounds the latter on all sides (Fig. 2).

This picture was most clearly shown in goats; similar effects were observed in pigs and in large-horned cattle.

In rabbits the growth of the interrenal tissue originating from the wall of the central vein is well shown but shows certain special features (Fig. 3). In them there is no zonal differentiation of newly forming cells, which were more or less of the same type. These voluminous cells were polygonal and had a nucleus with a clearly defined structure; it contained a nucleolus and the cytoplasm had a foamed appearance throughout and contained small weak Sudanophil inclusions distributed throughout the whole cell body. The difference between these cells was in the number of such inclusions. In such cells the reaction of the cytoplasm for ketosteroids was positive. Cords of these cells penetrating into the cortex reach as far as its inner layer where they come to lie directly up against the cells of the reticular zone on the inner side; they form a true layer of interrenal cells which are distinct from those of the reticular zone.

These observations have suggested to us that besides the known methods whereby the cellular constitution of the adrenal cortex is made good there are other means of regeneration of cortical elements whose source is the wall of the central vein of the adrenal body.

A close relationship between the formation of interrenal cells and the wall of the blood vessels has frequently been pointed out, for example by A. A. Bogomolets [1]. Apparently it was related to specific features of the vascular wall of a particular region, for example the retroperitoneal tissue [3].

In the lower vertebrates (bony fishes) the formation of interrenal tissue is associated with the wall of the veins to such an extent that the interrenal cells are formed even in the wall itself [8]. Our material shows that the wall of the veins of the adrenal body may be a source of formation of cortical tissue in the higher vertebrates also.

SUMMARY

It has been shown that in higher vertebrates the wall of the central vein of the adrenal gland and its branches may constitute an additional source of interrenal cells. Variation in different mammalian species is described.

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