

STUDIES ON THE ONTOGENESIS OF THE GRANULATED CELLS OF THE JUXTAGLOMERULAR APPARATUS

GY. DAUDA and P. ENDES

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The term juxtaglomerular apparatus signifies specially differentiated cell groups of different origin and morphology, which are situated in or near the vascular pole of the glomerulus. Of the various components of the apparatus, the cells with granulated cytoplasm (JGC) which are to be found in the afferent glomerular arterioles have been most extensively studied. As far back as in 1938 did GOORMAGHTIGH assume these cells to perform a secretory function; recent investigations have borne out the correctness of this assumption by demonstrating that the JGC granules possess hormone-like properties [7].

HARTROFT and HARTROFT [8] have shown that the so-called juxtaglomerular granulation index (JGC index), *i.e.* the figure indicating the incidence of these cells and the degree of their granulation, varies inversely with the blood sodium level as also with the width and lipid content of the zona glomerulosa. According to HARTROFT [9], TOBIAN [12], and others [1, 13, 14], an inverse relation exists between the intrarenal blood pressure and the height of the JGC index. ENDES *et al.* [3] observed a rise in the index and an increase in the width of the zona glomerulosa after having experimentally damaged the hypophyseal stalk and the tuber cinereum. They examined, moreover, the changes induced in the JGC by heminephrectomy [4] and observed JGC hyperplasia and hypergranulation in the kidney of persons who had died of shock-induced renal lesions [5]. Recent investigations seem to support the assumption that renin or its precursor is produced in the JGC [2, 10, 11].

Literature contains no information as to whether the JGC are active *in utero* or in extrauterine life only. To clear the problem we have studied the appearance of granulated cells in the course of ontogeny.

Material and method

A total of 44 albino rats of our own stock were used. The age of the animals was between 1 day and 60 days, the length of the fetuses varied from 15 to 20 mm. The removed kidneys were fixed in neutral formol, embedded in paraffin and stained with ENDES' combined trichrome [6]. Of each kidney, two separate sections made in the largest sagittal plane were examined under a 600 \times magnification. We measured the frequency of the occurrence of granulated cells and the degree of their granulation by means of the HARTROFT's index-method

slightly modified in our Institute. Accordingly, the total number of glomeruli, as found in the four renal sections per animal, was referred to the number of granulated cell groups found in the same four sections, and the degree of granulation was also considered. We obtained, in this way, values which applied to about 800 to 900 glomeruli per animal.

Results

No granulated cells were encountered in any section made of foetal organ. Renal tissue showed gradual differentiation in the sections obtained from 1 to 14-day old animals without, however, granules appearing in the JGC. Granulated cells did not appear before the 14th day of extrauterine life; the average

Table 1

Age of animal	No.	JGC index %	Average of JGC index %
Fetuses Newborns	29	∅	∅
14 days	1 2 3	0.63 0.55 0.27	0.48
15 days	1 2 3	2.45 1.95 1.56	1.98
16 days	1 2 3	3.97 2.19 1.96	2.70
30 days	1 2 3	7.70 9.00 6.20	7.64
60 days	1 2 3	22.80 22.89 23.94	23.21

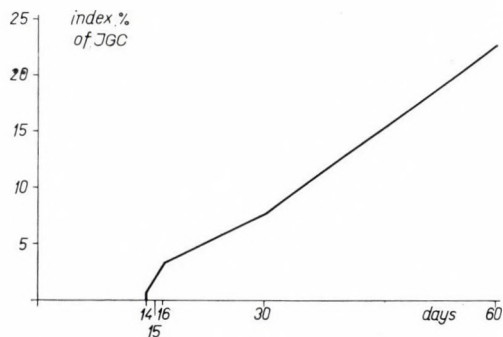


Fig. 1

index amounted to 0.48 per cent at that age and rose gradually thereafter (Table 1). As seen in the diagram in Fig. 1, the index rose rapidly until the 16th day of life, and did so slowly subsequently. The index of 60-day old rats showed the same value as that of the adult controls. This means that the full development of the JGC had been reached at 60 days. Student's "t" test showed the differences between the indexes, determined at different stages of ontogeny, to be significant, with a standard deviation below 0.1 per cent.

Discussion

The present investigations have made it evident that, in the rat, granules appear in the so-called granular cells of the juxtaglomerular apparatus on the 14th to 15th day of extrauterine life; their number increases gradually thereafter, to reach that of the adult controls at the end of the second month. The gradual differentiation of the JGC may be regarded as an additional proof that the kidneys reach full morphological and functional maturity during extrauterine life only, in the course of their adaptation to environmental conditions. The question arises whether the appearance of the cells with granulated cytoplasm coincides with the onset of JGC function. It may be assumed that — as is the case with other endocrine organs — the appearance of granules in the JGC indicates that phase of development in which cellular secretion exceeds the requirements of the organism so that the secretion accumulated and stored in the cytoplasm becomes demonstrable. It seems however more probable that the granules represent the morphological substrate of JGC function, or, in other words, that that function depends on the appearance of granules. The full elucidation of the problem needs further investigations.

Summary

The time of appearance of the granular cells of the juxtaglomerular apparatus has been studied. The kidneys of 44 albino rats — their age ranging from intrauterine life to the 60th day of extrauterine life — have been examined. The first granules were found to appear on the 14th day of extrauterine life (index of frequency and granulation: 0.48 per cent) and to reach the value of adult controls at 60 days (index: 23.21 per cent).

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BEITRÄGE ZUR ONTOGENESE DER GRANULIERTEN ZELLEN DES JUXTAGLOMERULÄREN APPARATES

GY. DAUDA und P. ENDES

Es wurde untersucht, zum welchen Zeitpunkt die granulierten Zellen des juxtaglomerulären Apparates im Laufe der individuellen Entwicklung erscheinen. Die Nieren von 44 Albinoratten wurden von der Embryonalzeit an bis zum 60. Tag des extraterinen Lebens aufgearbeitet. Die Granula erschienen am 14. Tage des extraterinen Lebens, mit 0,48 Index%-Häufigkeit, und erreichten am 60. Tag den Durchschnittswert der ausgewachsenen Kontrolltiere mit einem Indexwert von 23,21%.

ДААННЫЕ К ОНТОГЕНЕЗУ ГРАНУЛИРОВАННЫХ КЛЕТОК ЮКСТАГЛОМЕ- РУЛЯРНОГО АППАРАТА

ДЬ. ДАУДА и П. ЕНДЕШ

Изучался вопрос о том, что в ходе индивидуального развития когда появляются зернышки в зернистых клетках юкстагломерулярного аппарата почек. Авторы обрабатывали почки 44 крыс-альбиносов, начиная с эмбрионального возраста до 60. дня внематочной жизни. Зернышки появляются на 14. день внематочной жизни, частотой показателя в 0,48%, достигая средних величин развитых контрольных животных к 60. дню, когда показатель равен 23,21%.

György DAUDA
Prof. Pongrác ENDES } Debrecen, 12. Kórbonctan, Hungary