A C T A T H E R I O L O G I C A

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Organon Subfornicale in the Roe-deer

[With Plate III]

Organon subfornicale in the roe-deer, *Capreolus capreolus* (Linnaeus, 1758) is situated on the anterior wall of the third ventricle. It lies exactly along the median line of the brain, on the ventral surface of the fornix. In the roe-deer examined it was 3.1 mm long and 1.16 mm broad. The anterior end of the organ is located at the level of the branching of *corpus fornix* into rami. Over the whole surface in the direction of the ventricle the organ is covered by a layer of ependymal cells, which beyond its limits pass into the ependyma of the third ventricle. Nerve cells, granular cells, glial cells, parenchymal cells, vacuoles and blood vessels located in the glio-nerve network were found in the organ (the nerve fibres were fully or scantily myelinated). All the cells in *organon subfornicale* are distributed irregularly, as are the vacuoles. The most numerous group is formed by glial cells, and the least numerous nerve and granular cells. Blood vessels are distributed evenly over the whole organ.

I. INTRODUCTION

The structure of *organon subfornicale* has been described both for man and numerous species of animals. Descriptions of the structure of this organ have been given for man by Cohrs (1936) and Kappers (1955); for domestic animals by Pines (1926), Cohrs & Knobloch (1936) and Scevola (1939); and for wild animals by Pines (1926), Cohrs (1936), Wislocki & Leduc (1952), McLardy (1955) and Dellman & Fahmy (1955, 1967).

Studies of the picture obtained of the subfornical organ using an electronic microscope have been made *inter alia* by: Andres (1965), Rohr, Sandri & Akert (1965) and Rudert (1965).

Certain differences in the structure of this organ in domestic and wild animals suggested that specific characters occur in the structure of this organ in the roe-deer *Capreolus capreolus* (Linnaeus, 1758). In view of this fact I undertook studies on the structure of this organ, in comparison with domestic ruminants. The present paper deals with the topography of the subfornical organ as seen in the light microscope picture.

II. MATERIAL AND METHODS

The material used for these observations was the brain of a freshly killed fully mature roe-deer (female). The brain was fixed in formalin, then the appropriate part excised and embedded in paraffin and sectioned to 15 μ in the frontal plane. Every second preparation was used for examination. The sections were stained by the Klüver-Barrer method, the modified Landau method for the paraffin sections and also the Nissl method.

III. RESULTS

The subfornical organ in the brain of the roe-deer lies in the medial line near the ventral surface of *corpus fornicis*, on the level of the intraventricular foramina of the lateral ventricles. The anterior end of this organ is situated at the level of the division of *corpus fornicis* into its rami. In the roe-deer examined it was 3.1 mm long and 1.16 mm wide. In these animals it projects very distinctly into the lumen of the third ventricle, particularly in its central part, where its height was 0.9 mm.

In the cross-section this organ first appears as a rounded formation thrusting almost completely into the fornix (Fig. 1). In consequence it appears to be located in a very shallow sulcus on the ventral surface of the fornix. In the posterior direction this organ takes the form of a fairly regular triangle, the apex of which is directed into the lumen of the third ventricle. For 1/3 of its posterior part the organ is rectangular in shape in the cross-section and projects completely into the lumen of the ventricle, but only its perifornical wall is attached to the fornix. The posterior pole of the *organon fornicale* appears in cross-section as a low ridge attached to the fornix.

The microscopic picture of the organ shows far-reaching differentiation. Nerve cells, granular cells, glial cells, nerve fibres, numerous vacuoles and blood vessels.

A. Cytoarchitectonics

The whole of the ventriculad surface of the subfornical organ is covered with a very distinct layer of ependymal cells, which beyond its limits passes into the ependymal layer of the ventricle (Fig. 2 Se); The ependymal layer in the median part of the organ is less clearly defined and its cells in this place are rounded and smaller than the cells of this layer at the ends of the organ.

Apart from the layer of ependymal cells *organon subfornicale* does not exhibit any differentiations into layers. Under the ependyma it is formed by a compact network of glia and nerve fibres. Nerve cells, a few granular cells, vacuoles and very numerous blood vessels are located in

this network. Typical nerve cells, in addition to granular cells, form the least numerous group of cells of this organ. In the roe-deer they are distributed irregularly over the whole organ, although it is possible to observe larger groups in its lateral parts and in the dorsal part.

Nerve cells vary from 18—30 microns in size; they are round, triangular or fusiform (Fig. 5 cn). The nucleus, which stains very faintly, almost completely fills the cell. Inside the nucleus the deeply staining nucleolus is clearly visible. The cellular cytoplasm, pushed to the periphery of the cells, cannot be observed at all in some cases, which creates the impression of the nucleus itself being located in the glio-nerve network (nerve fibres).

A small number of granular cells, irregularly distributed occur in *organon subfornicale*, either singly, or less often in small groups of 3—5 cells (Fig. 3, 4 cgr).

The most numerous group is formed by the glial cells (Fig. 7, 8 cg). These cells almost completely fill the whole organ; an exception to this is the perifornical part and a small area halfway up the height of the organ, where these cells occur in small numbers. The large number of these cells give the impression that they only, together with the nerve fibres, form the whole organ.

The glial cells exhibit distinct differences in respect of both size and shape. Some of them are small, from 3—5 microns in diameter, while others may be as large as 9—12 microns in diameter. They are rounded (more or less regular), triangular or fusiform. The round-shaped cells are mainly macroglial cells (astrocytes). The remaining are oligodendroglial cells, which form the great majority of all glial cells (about 80%).

In addition to nerve cells, granular cells and glial cells, a relatively large number of round or oval-shaped cells, with a large light nucleus, containing one or two nucleoli, are found in this organ. Some of these cells have nuclei slightly smaller than the nuclei of other glial cells and it is then possible to observe a dark layer of cytoplasm surrounding them. Pines (1926) termed them »parenchymal cells«; this term has been accepted by many authors. Like all the cells of the subfornical organ the parenchymal cells are distributed irregularly in this organ (Fig. 4, 6 cp).

B. Fibroarchitectonics

The nerve fibres of *organon subfornicale*, whether fully or scantily myelineted, are of fornical origin. They can be divided into four groups. The first of these groups consists of fibres running longitudinally — that is, running along the axis of the organ. The second is formed by fibres running obliquely to the long axis of the organ, which pass from the

fornix to the organ and end in its subependymal layer. The third group consists of bundles of fibres arranged round the blood vessels; a description of these fibres will be given in the discussion of the angioarchitectonics of the organ. The fourth group is formed by irregularly running fibres.

The majority of the nerve fibres belong to the first group, and in the roe-deer they are clearly visible, particularly in the subependymal layer, where they run in the form of large flattened bundles. The bundles of the fibres are mainly situated on the right side of the organ in its anterior and median parts. The fibres of the second group are located mainly in the perifornical part in the form of bundles radiating convergently from the fornix towards the subependymal layer in which they end. In the roe-deer the inward radiation of these fibres is particularly distinct in the median and posterior parts of the organ (Fig. 2 fn). The fourth group, as already mentioned, consists of fibres taking an irregular course (Fig. 3 fn). These fibres run in different directions either single or in very small bundles. They frequently interlace with each other and also with the fibres in the other groups, and it is therefore difficult to determine either the beginning or end of these fibres.

C. Vacuoles

There is very considerable vacuolization of the *organon subfornicale* in the roe-deer. Vacuoles which are situated in the glio-nerve network occur chiefly in the central part and the marginal parts of the organ, but fairly large groups of vacuoles are also found in the perifornical part. They either occur singly or several form a group (Fig. 8 v); they vary in size within limits of 10—50 microns. They are either round or oval. These vacuoles are particularly clearly visible in preparations stained by the Klüver-Barrer method. In addition to vacuoles, there are empty elongated spaces, about 50 microns long, particularly in the marginal parts of the organ (Fig. 6 sp). They are encountered over the whole length of the organ. It did not prove possible to find any contents in either vacuoles or paramarginal spaces in any of the preparations stained by the methods given above.

D. Angioarchitectonics

Blood vessels occur in very large numbers in the organ examined, and are distributed evenly over it. The great majority are vessels measuring from 40—60 microns in the cross-section, but broader ones are also found, measuring 90—100 microns in the cross-section — there are very few of the latter and they occur mainly in its central part (Fig. 2, 7 vs). In the

cross-section of this organ laminated cells can be seen near the blood vessels, which they surround fairly closely (Fig. 7 cl). The length of these cells varies within limits of 10—15 microns and they are about 3 microns wide. The nuclei of these cells are layered and almost completely fill the whole cell, and it is only in a few places in the cell that it is possible to observe a thin layer of cytoplasm. Near these cells we find bundles of myelinated fibres which (in the cross-section) surround the vessels from one, two or sometimes all sides. The occurrence of these fibres is particularly characteristic of vessels of greater size (Fig. 7 fn).

IV. DISCUSSION

The structure of *organon subfornicale* in the roe-deer and other mammals exhibits very great similarity. In all the animals examined this organ is located on the ventral surface of the fornix at the level of the interventricular foramina of the lateral ventricles. It is situated most dorsad in the horse — Cohrs & Knobloch (1936) — in which the vascular plexus covers it completely. In cattle also it is located above the branching of *corpus fornicis* into rami (Cohrs & Knobloch, 1936). In the roe-deer the topography of this organ is similar to that found in sheep, goats and pigs, in which its anterior end is situated in the place where the fornix divides into rami; in *Eptesicus fuscus fuscus* it is located in the dorsal, posterior part of *commissura hippocampi* and in *Saimiri sciureus* it lies between the rami of the fornix at the level of *commissura hippocampi* and about 1 mm above *commissura anterior* (Akert *et al.*, 1967).

Differences in the microscopic structure of *organon subfornicale* between the roe-deer and other species of animals are slight. In the case of the roe-deer it is impossible to divide *organon subfornicale* into the layers which Andres (1965) described in relation to young dogs, in which he distinguished 3 layers: (1) *zona basalis*, (2) *zona medialis* and (3) *zona subependymalis*.

Fairly important differences occur in the fibroarchitectonics of *organon subfornicale* in the roe-deer in comparison with other animals. No division of the nerve fibres such as presented in this article has so far been encountered in literature. Cohrs & Knobloch (1936) describe the occurrence of nerve fibres in domestic animals as similar to that in the roe-deer, but do not divide them into distinct groups. In addition these authors draw attention to the characteristic group of nerve fibres occurring in cattle, the course of which in cross-sections is bow-shaped — they run obliquely from the left side to the right side of the organ. This group of fibres was not observed in the roe-deer.

No significant differences in respect of either angioarchitectonics or vacuolization of *organon subfornicale* in the roe-deer are observed in comparison with other animals.

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NARZĄD PODSKLEPIENIOWY (*ORGANON SUBFORNICALE*) U SARNY

Streszczenie

Opisu budowy narządu podsklepieniowego dokonano na podstawie parafinowych skrawków poprzecznych (grubości 15 mikronów) mózgowia dojrzałej płciowo sarny. Skrawki barwiono według metody Klüvera-Barrera, zmodyfikowanej metody Landau oraz metody Nissl'a.

Narząd podsklepieniowy sarny leży w linii pośrodkowej mózgowia, przy brzusznej powierzchni *corpus fornicis*, na wysokości otworów międzykomorowych komór bocznych. Wystaje on bardzo wyraźnie do światła komory III. Jego przedni koniec znajduje się w miejscu podziału trzonu sklepienia (*fornix*) na ramiona. Powierzchnia dokomorowa narządu podsklepieniowego pokryta jest wyraźną warstwą komórek ependymy, która poza jego obrębem przechodzi w ependymę komory III. Warstwa ta w wielu miejscach poprzebijana jest pustymi przybrzeżnymi przestrzeniami (Ryc. 6).

Budowa komórkowa narządu podsklepieniowego wykazuje daleko idące zróżnicowanie. Występują w nim nieliczne małe komórki nerwowe i niewielka ilość komórek ziarnistych (Ryc. 4, 5). Większość stanowią komórki glejowe oraz „komórki parenchymy" (Ryc. 4). Wszystkie komórki w narządzie są rozmieszczone nieregularnie.

Włókna nerwowe narządu podsklepieniowego (zarówno zmielinizowane jak i skąpo zmielinizowane) są pochodzenia sklepieniowego. Podzielono je na cztery grupy. Do pierwszej grupy zaliczono włókna o przebiegu podłużnym, a do drugiej włókna o przebiegu poprzecznym do długiej osi narządu; grupa trzecia obejmuje włókna o przebiegu nieregularnym, a czwarta włókna układające się wokół naczyń krwionośnych (Ryc. 2, 3).

Narząd podsklepieniowy zawiera liczne wakuole, które są rozmieszczone w nim w sposób nieregularny. Wielkość ich waha się w granicach 10—50 mikronów. W wakuolach nie stwierdzono żadnej zawartości (Ryc. 8).

W narządzie podsklepieniowym występuje duża ilość naczyń krwionośnych. Wokół nich umieszczone są komórki o kształcie płytek (Ryc. 7).