Department of Anatomy of the Medical University in Budapest. (*Director : Prof. F. Kiss*)

MORPHOLOGICAL DATA CONCERNING THE STRUCTURE OF CEREBRAL VESSELS

F. Kiss and *J. Sattler*

(*Received December 1, 1953*)

Our latest histological studies of cerebral veins and arteries in man resulted in certain new data undoubtedly related to the specialized function of cerebral vessels, i. e. cerebral circulation.

a) *Cerebral veins.* In a transverse section, double-walled veins were found on the convexity of the cerebrum near the sagittal sinus (Fig. 1). The thin-walled vein lies in the subarachnoid space embedded between the gossamerlike fibres of the arachnoid. In the lumen of the vein there is a second, narrower lumen with no trace of blood in it. Blood is only present between the inner, narrower lumen and the original vein wall. Figs. 2 and 3, to be discussed below, reveal that the narrower lumen communicates with the subarachnoid space filled with cerebrospinal fluid. Fig. 2 shows the longitudinal section of a vein with the inner tube (the cerebrospinal fluid funnel) just forming within it. It is clear that the connective tissue of the arachnoid is turning the funnel inside as though pushing before it the media and the intima of the vein, proving that the blood is in contact with the original intima only.

Fig. 3 is a longitudinal section of the cerebrospinal fluid funnel in its entire length. The original vein is once more seen to be lying in the subarachnoid space with the inner lumen penetrating funnel-like into the original one, and communicating substantially with the space filled with cerebrospinal fluid.

Fig. 4 shows another double-walled vein in transverse section. Here the blood is seen inside the inner lumen. The perivenous space communicates with the subarachnoid one and is enclosed by a well developed ring of connective tissue. Accordingly, in this case the pressure of the cerebrospinal fluid acts upon the lumen of the vein from without, in contrast with the previously described formation on which it exerts its effect from within, by way of the cerebrospinal fluid-funnel.

Also, it has been observed that in the thin wall of the cerebral veins the strong fibers of connective tissue run in undulations extending over the whole width of the wall (palisade fibers). This, in itself, would permit to conclude substantial variations in the width of the lumen. This conclusion is further

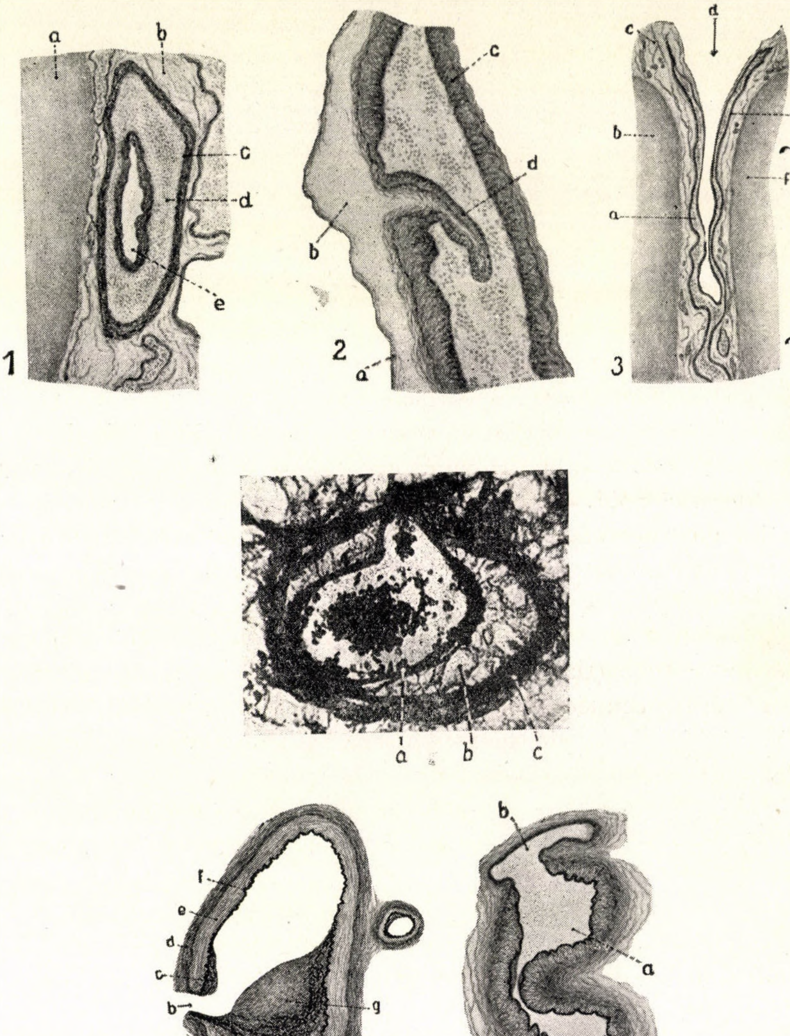

Fig. 1—6

supported by the observation that the whole wall of the large veins shows a similar undulatory pattern in its entire thickness.

b) *Cerebral arteries.* In the trunk of the choroid artery a marked thickening of the intima (a crista) has been found acting as a regulator of the lumen (Fig. 5). Its structure agrees in every detail with the apparatus described by one of us (Kiss) in the arteries of the male genital organs and in those of the Fallopian tube. We call it a crest, because serial sections revealed this structure to extend lengthwise in the lumen of the artery in the manner of a crest. The internal elastic membrane exhibits here the usual fibrous ramification. Smooth-muscle cells embedded in sheaths of connective tissue lie between the elastic fibers. The inner parts of the crest consist of collagenous connective tissue. In Figure 5 a small lateral branch (ramus) is seen to originate at the height of the crest. At its point of origin, opposite the main crest, another thickening of the intima (c) can be seen, which in essence is of a similar construction. This being just opposite the major crista, the ramus, on the analogy of other vessels, is under the influence of the regulatory apparatus in the main vessel.

Fig. 6 shows a characteristic arteriovenous anastomosis on the convexity of the brain. While such anastomoses are known to occur all over the body, none have, to the best of our knowledge, as yet been described from the cerebral area and certainly none of so large a size, almost visible to the naked eye. Thickness and structure of the arterial wall differ substantially from that of the vein.

c) *Conclusions.*

1. Running a good distance longitudinally in the subarachnoid space, cerebral veins and the cerebral blood circulation, respectively, are exposed to the pressure of cerebrospinal fluid both from within and without. These findings support the earlier statement of one of us (Kiss), that the dominant function of the spinal fluid is a pressure effect.

2. It is suggested that the palisade fibres and their undulatory pattern in the veins bear some relation to the regulatory action of the fluid pressure as described under 1. This may also have a compensatory function regulating the fluctuations in the arterial and venous pressures.

3. It is believed that the powerful lumen-regulating mechanism found in the choroid artery is in some manner correlated with the control of cerebrospinal fluid production.

4. The arteriovenous anastomoses observed on the convexity are indicative of some hitherto unknown regulatory mechanism of cerebral blood circulation.

REFERENCES

F. Kiss: (1919) The Blood-vessels of the Fallopian Tube. Magyar Orvosi Archiv. V. XX. (Hung. only). — **F. Kiss**: (1921) Anatom.-histol. Untersuch. ü. die Erektion. Zeitschr. f. Anat. u. Entwg. I. Abt. B. 61. H. 5—6.

МОРФОЛОГИЧЕСКИЕ ДАННЫЕ К ВОПРОСУ СТРОЕНИЯ МОЗГОВЫХ СОСУДОВ

Ф. Кишш и Е. Саттлер

Резюме

а) На выпуклой поверхности больших полушарий вблизи сагиттального синуса имеются двустенные вены. Двойная стенка возникает путем вдавления из подпаутинного пространства длинной воронки в просвет вены. Это образование можно назвать »воронкой спинномозговой жидкости«. Авторы сделают вывод, что с помощью этих воронок давление спинномозговой жидкости оказывает регулирующее влияние на вены.

б) В стволе артерии сосудистого сплетения авторы нашли высокое утолщение (рейка) внутренней оболочки, регулирующее просвет сосуда, похоже на утолщение, описанное одним из авторов (Кишш), в артериях пещеристого тела мужских половых органов (1921). На выпуклой поверхности больших полушарий авторы нашли крупные артерио-венозные анастомозы. Эти образования вен и артерий участвуют в регулировании мозгового крово-обращения.

A kiadásért felel: Mestyán János Műszaki felelős: Farkas Sándor
Kézirat beérkezett: 1954. III. 9. Terjedelem: 10 (A/5) ív, 43 ábra, 1 melléklet

Akadémiai nyomda, Gerlóczy-u. 2 — 30478/54 — Felelős vezető: ifj. Puskás Ferenc