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A CASE OF INTRAVENTRICULAR TERATOMA DERIVED FROM THE CHOROID PLEXUS

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According to INGRAHAM and BAILEY [6], two or three of every thousand brain tumours are intracranial teratomas or teratoids. They mostly occur in boys and male adults. Their point of departure is most frequently the pineal gland, less often the hypophyseal region, and rarely some other place such as the choroid plexus in the lateral ventricle, the tela chorioidea of the third ventricle, the cerebrum, the area of the tuber cinereum, and the spinal cord. In size they vary from a pea to a fist, quite exceptionally they are even larger. They are not infrequently cystic. Mostly ectodermal and mesodermal, occasionally entodermal elements are encountered in them.

Teratoma in the lateral ventricle is very rare. In the HENKE—LUBARSCH Manual, HENSCHEN FOLKE mentions in all 12 intraventricular teratomas (BURMEISTER [2], DERMAN [3], GAUPP [4], GÜTHERT [5], MAIER [9], STRASSMANN and STRECKER [10], ZISKIND and SCHATTENBERG [12], each with one case; INGRAHAM and BAILEY [6] with 3, and WEBER [11] with 2 cases). In most of these cases the relation to the choroid plexus was distinctly perceptible. Predominant in the pictures were mainly the ectodermal and mesodermal elements of the tumours. In GÜTHERT's [5] case the early embryonic prominences of all three primary germ layers were clearly observable.

In the 2nd Institute of Pathological Anatomy of the Medical University in Budapest, post-mortem examination of a one-month old infant revealed in the cavity of the right ventricle a tumour weighing 125 g. It proved to be a choroid plexus teratoma, which, in addition to its rarity, merits some interest on account of its developmental mechanics.

The infant, a girl weighing 3400 g at birth, had been found to feed and develop satisfactorily in the first 10 days, when she turned somnolent and mostly refused to be fed.[1] Notwithstanding the treatments applied, her state gradually deteriorated, her cranial circumference increased, and symptoms of progressive hydrocephalus began to show. At the age of one month the infant died with circulatory failure.

Post mortem the female infant, who at death weighed 2700 g, was 52 cm long, and had a skull 45 cm in circumference showed wide open anterior and posterior fontanels. The cranial bones varied in thickness from 0.5 to 1.0 mm. The dura mater was tight, the pia mater congested. The myocardium was oedematous and there was bronchopneumonia in both lungs. Apart from the brain lesions, no particular pathological changes were observed.

The brain weighed 410 g. In relation to the left, the right cerebral hemisphere stood out conspicuously. The gyri were everywhere markedly flattened. The cavity of the right

[1] For the clinical data we are sincerely indebted to Professor P. Gegesi Kiss.

ventricle was filled by a tumour of an uneven bumpy surface (Fig. 1). The left ventricle was markedly dilated, with the cerebrum thinned to an average of 3 mm in thickness. The left lateral ventricle was also dilated, but much less so than the right one. The corpus callosum was forced to the left, and of the thickness of card paper. The cavity of the third ventricle was close-spaced and compressed. The choroid plexus was massive and closely connected with the tumour in the right ventricle. Tumour and plexus together were easily lifted from the ventricle, with the wall of which they showed no connection whatsoever. The fourth ventricle was narrow. The pineal body was the size of a lentil, oviform, betraying no connection with the tumour. The hypophysis was moderately flattened.

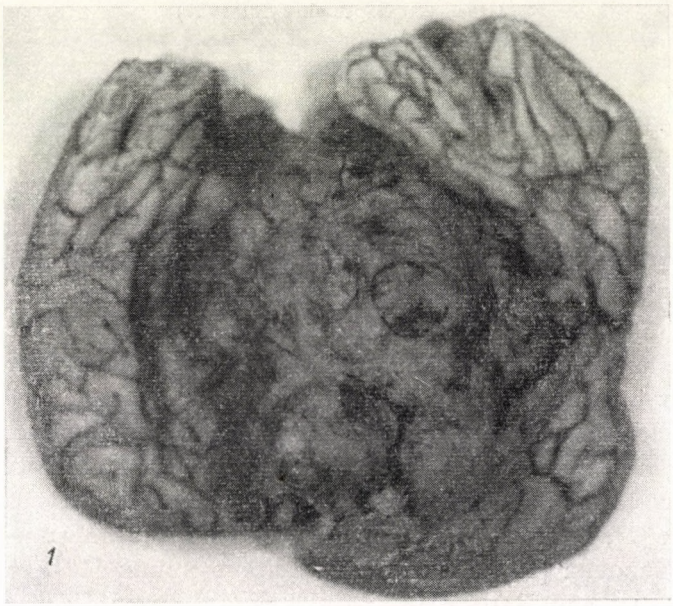


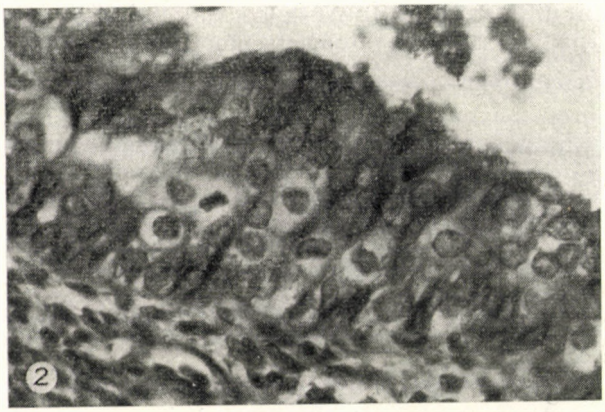
Fig. 1. Tumour filling the ventricle

The tumour lifted from the ventricle weighed 125 g and showed an uneven surface with protrusions the size of half a filbert, occasionally half a walnut. This surface displayed numerous sharply demarcated dark-red spots. At some places, the tumour was of dense consistency, on the whole greyish-white, and traversed by many pinprick-, peppercorn- or pea-sized cysts occasionally replete with dark-red contents. At other places the tumour was of a uniform, soft myelinic, or of a rather closely fibrous structure. In the greyish-white or greyish-yellow tumour, haemorrhages the size of a lentil or sixpence were encountered.

Histological examination showed that, in addition to variously differentiated tissues, the tumour enclosed rudimentary organs and parts of organs, many of which were in an advanced organisational state. This state mostly corresponded to that of the third or fourth month in the foetus. This means, that some rudimentary organs had almost attained the organisational level of the newborn. Organisation of the nervous system was found to have been

moving within much wider limits : almost all the intermediates were encountered, from the rudimentary medullary tubes, *via* the organisation of a two-month old spinal cord, to the characteristic degree of differentiation of the retina.

Single and multi-layered epithelial tissue occurred, even epithelia of higher differentiation, such as ciliated epithelium and urothelium. In areas



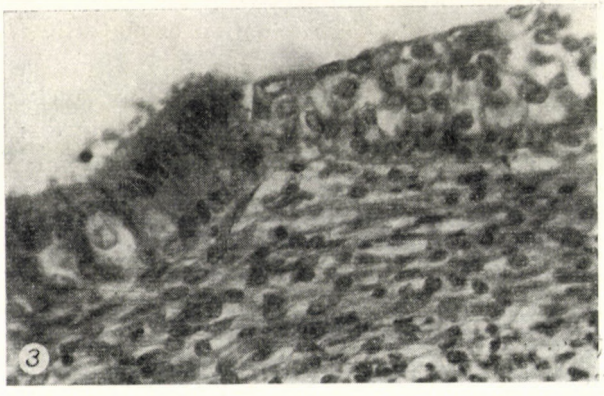


Fig. 2. Multilayered invading ciliated epithelium (Zeiss apo. 40× obj. [corr.] 8× oc.)

Fig. 3. Sharp transition from multilayered epithelium to ciliated columnar epithelium (Zeiss apo. 20× obj. 8× oc.)

of rudimentary organs, epithelia characteristic of the third or fourth foetal month were observed, in which the ciliated (more ancient) epithelium began to cede its place to the multi-layered epithelium, as, for instance, in the normal histogenetic process of the oesophagus (Figs. 2 and 3). In several places, epithelial differentiation showed either in the form of rudiments of ramifying glandular tubules corresponding to the developmental stage in the 2nd to 3rd month, or in that of glandular "anlagen" corresponding to the 3rd to 4th month.

In the latter case the structure was already a tubuloalveolar one, with the mesenchymal elements participating in the build-up, which is the prerequisite of organic differentiation (Figs. 4 and 5).

Finally, extreme differentiation of the epithelium-like elements was represented by hepatic cells that showed no sign of organic integration, and by cell groups that corresponded to adrenal cortex (Fig. 6).

Appearing independently, outside organic structures, mesenchymal tissues were seen differentiated in various degrees ; connective, chondroid, osseous, and reticulate tissue, and even smooth and striated muscle. The desmogenic and chondrogenic forms of ossification were equally recognisable (Fig. 7). Still more pronounced was the differentiation which manifested itself within organic units in the loose connective tissue of the submucosa, the connective-tissue coat of mucous membranes, the smooth musculature, and the muscularis mucosae.

Two outstanding organogenetic examples are presented in Figs. 8 and 9. In Fig. 8 stellate lumina lined with columnar epithelium, tunicae propriae, and circular, occasionally longitudinal, smooth muscles are clearly distinguishable, forming a complete whole of some kind of a tubule that corresponds to the area of the urogenital system. Fig. 9 illustrates the advanced organisation of differentiated parts to form an integrated whole corresponding to the area of the embryonic cardia, with the participation of epithelium, tunica propria, muscularis mucosae, and cardia glands.

The ground tissue of the tumour, as the medium enclosing all the variously differentiated tissues and organic parts, consisted of more or less differentiated neural elements and glia. Medullary tubes varying in size were encountered in large numbers (Fig. 10) with neuroblasts ; elsewhere rosettes and groups of cells mimicking ependymomas were visible (Fig. 11). The highest organisational grade of neural elements manifested itself in a cytoarchitecture corresponding to the wall of the 3 to 4 months old embryonic telencephalon (Fig. 12), and in the form of a process simulating the structure of the 2 months old spinal cord (Fig. 13). In some places the two layers of the optic cup, the pigment and the neuroblastic layer, were also traceable (Fig. 14).

The case under review invites special interest from the point of view of histogenesis and developmental mechanics ; it gives rise to the question of germ-layer specificity on the one hand, and dependent- and self-differentiation on the other.

Evidence is accumulating to show that a strict concept of the specificity of germ layers is no longer tenable. In our case, epithelial growths and rudimentary organs characteristic of all three primary germ layers were observed, e. g. mucous membrane of gall bladder (Fig. 15), liver (Fig. 6), cardia (Fig. 9), etc., as structures containing entodermal elements in normal histogenesis.

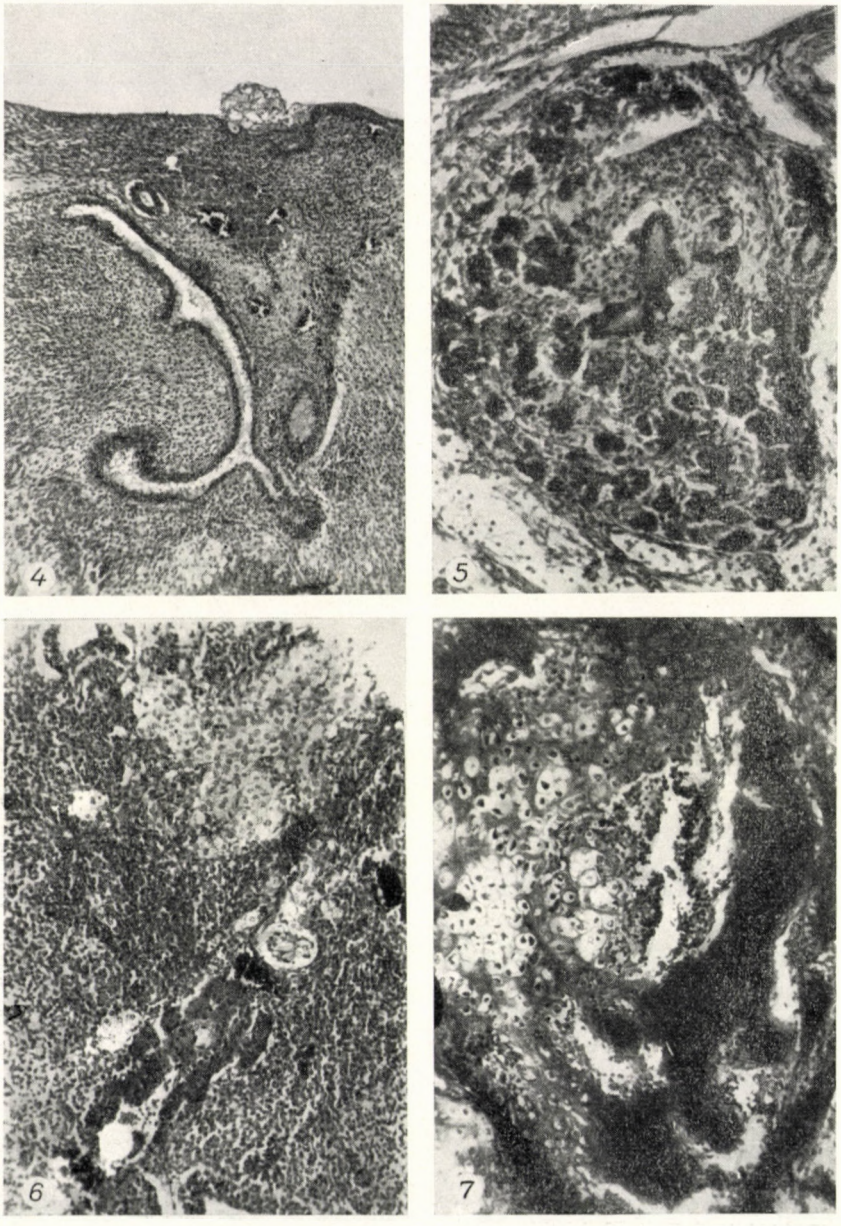
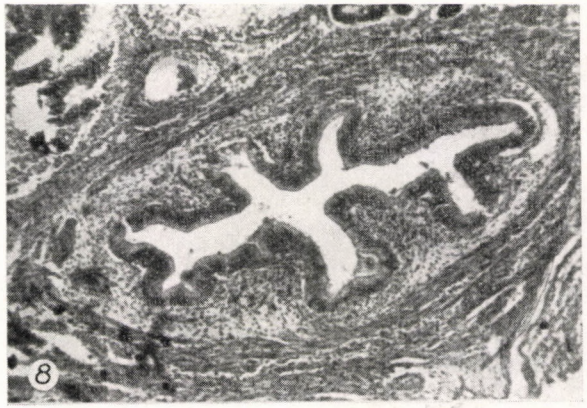


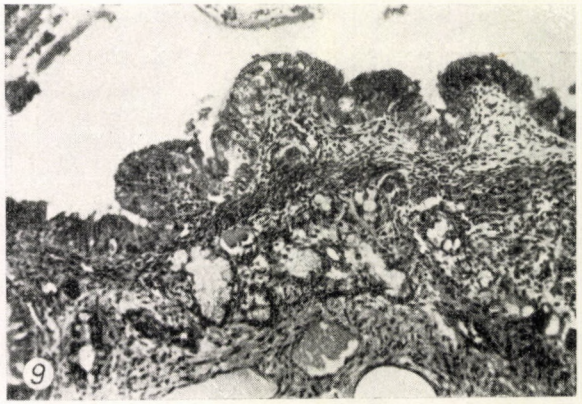
Fig. 4. Rudimentary gland (Zeiss apo. 8× obj. 8× oc.)

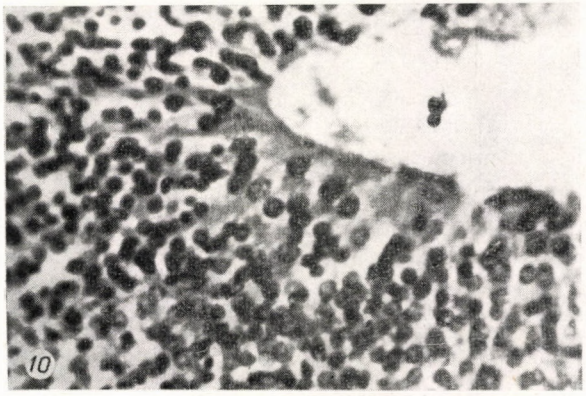
Fig. 5. Organised tubuloalveolar gland in the stage of embryonic development (Zeiss apo. obj. 8×, 8× oc.)

Fig. 6. Groups of cells corresponding to adrenal cortex, and hepatic cells of trabecular disposition (Zeiss apo. obj. 8×, 8× oc.)

Fig. 7. Cartilaginous tissue and chondrogenic osteogenesis (Zeiss apo. obj. 8×, 8× oc.)







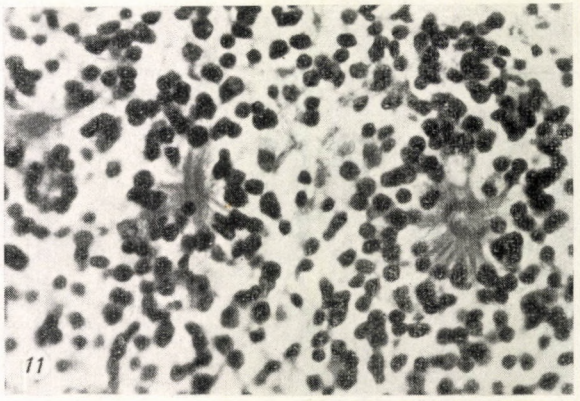
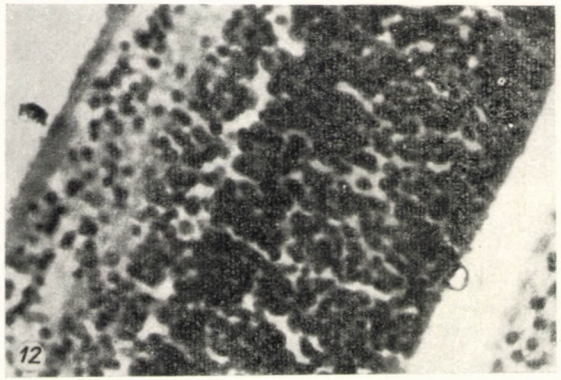
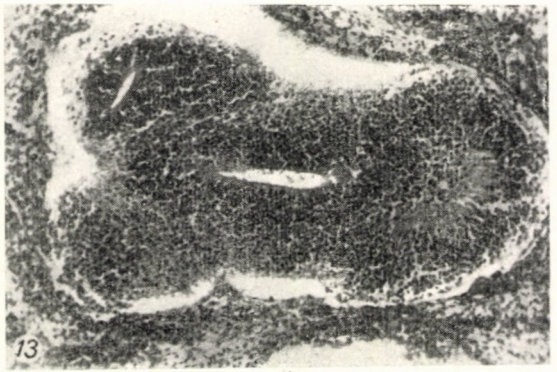
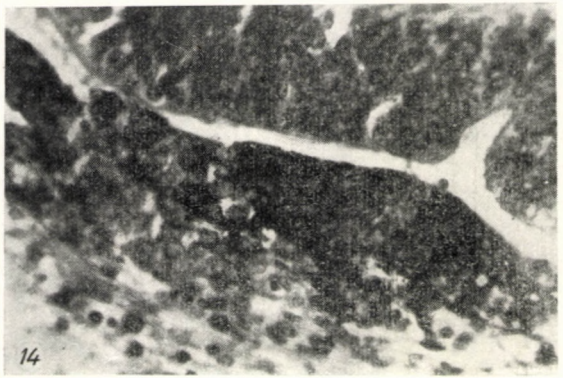


Fig. 8. Complete organisation ; section of tube consisting of mucous membrane, submucosa, muscle layer (Zeiss apo. obj. 8×, oc. 8×). *Fig. 9.* Mucous membrane and submucosa of cardia (Zeiss apo. obj. 20×, 8× oc.). *Fig. 10.* Section of rudimentary medullary tube (Zeiss apo. obj. 20×, 8× oc.). *Fig. 11.* Rosette-like aggregations of cells (Zeiss apo. obj. 20×, 8× oc.)







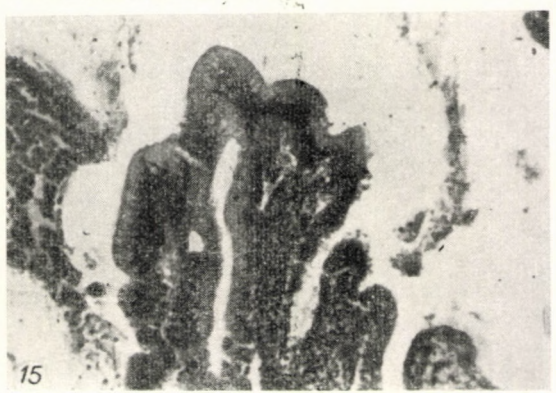


Fig. 12. Organisation showing the structure of the telencephalon wall (Zeiss apo. obj. 20×, 8× oc.). *Fig. 13.* Organisation corresponding to embryonic spinal cord (Zeiss apo obj. 20×, 9× oc.). *Fig. 14.* Structure corresponding to the external and internal wall of the optic cup (Zeiss apo. obj. 20×, 8× oc.). *Fig. 15.* Organisation imitating the mucous membrane of the gall blader (Zeiss apo. obj. 8×d 8× oc.),

The tumour originated in the region of the choroid plexus, as is borne out by the plexal portions enclosed in it. Thus the plexus epithelium might have been the source of both the "ectodermal" and "entodermal" elements. The question of what to affiliate the mesenchymal parts with, brings the concept of the mesectoderm into play, as the argument advanced now for several years against germ-layer specificity; our material does not permit us to take up a definite position in the matter.

Judging from the grade of the tissue and organic differentiation seen in the histological pictures, the origin of the tumour must be dated from the early phase of embryonic life, which corresponds to the time when the area chorioidea undergoes differentiation, i. e. when the embryio is about 11 to 12 mm in size. At later dates, the tissue elements of the choroid plexus no longer possess such multifold potentials, since by then differentiation proceeds in a direction already set for good.

Upon the developmental-mechanical aspects interest is riveted by the question whether the tumour cells and tissues had attained their high organisational level by developmental induction or self-differentiation? Since the tumour was probably formed in the area of the medullary tube, and in the early developmental stage of the latter, the primary assumption should be one of phenomena of developmental induction, which is favoured by the advanced development attaining sometimes the level of organic differentiation. Self-differentiation, however, may likewise have played its part, as was evidenced by observations of tissue cultures from the embryonic choroid plexus, and of cells in the area chorioidea in those tissue cultures. By the findings of one of us (KISZELY [8]), tissues of explanted area chorioidea, when cultured, do not reproduce the structure of the choroid plexus, but give rise to a type of cell that corresponds to glial and neural elements; rosette-like groups of these elements, reminiscent of ependymomas, display the potentials of the preceding developmental stages. The fully developed embryonic choroid plexus, on the other hand, retains its organotypic growth in the culture.

Summary

A teratoma, weighing 125 g, located in the right ventricle and originating from the choroid plexus of a 1-month old infant, has been described. The ground tissue of the tumour consisted of more or less differentiated glial elements. The epithelium-like elements in it showed extreme degrees of differentiation, as, for instance, hepatic and adrenal cells, and a high level of organisation, e. g. the formation of the tube corresponding to the embryonic cardia with glands and submucosa, and the urogenital system. The origin of the tumour must be dated from the early phase of foetal life when the area chorioidea underwent differentiation, i. e. when the embryo measured about 11 to 12 mm. The tumour enclosed epithelial and organic growths characteristic of all three primary germ layers, and it may be assumed that the elements of the latter were derived from plexus epithelium. Phenomena of developmental induction were probably responsible for the origin of the tumour, but not without a part played in it by self-differentiation.

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ИНТРАВЕНТРИКУЛЯРНАЯ ТЕРАТОМА, ИСХОДЯЩАЯ ИЗ СОСУДИСТОГО СПЛЕТЕНИЯ

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Дается описание тератомы, весом в 125 г, исходящей из сосудистого сплетения правого желудочка мозга грудного ребенка возрастом в 1 месяц. Основную ткань опухоли образовали более или менее дифференцированные нервные элементы, а в основной ткани опухоли оформлялись крайние ступени дифференциации эпителиоподобных элементов, напр. образование печеночных и надпочечных клеток, далее примеры высшей организации, напр. эмбриональная кардия с железами и подслизистым слоем и соответствующая мочеполовой системе трубочка. Возникновение опухоли можно отнести к раннему периоду внутриутробной жизни, т. е. к периоду дифференциации хориоидальной области, что имело место в зародыше величиной прибл. в 11—12 мм. Тератома содержала характерные для всех трех зародышевых листков образования эпителия или же органов и можно предположить, что эпителий сплетения был источником элементов различных зародышевых листков. Возникновение опухоли предположительно можно привести в связь прежде всего с явлениями индукции развития, однако, на основании исследований *Кисели* является весьма вероятным, что в образовании опухоли роль играла также и самодифференциация.

INTRAVENTRIKULARES TERATOM, AUSGEHEND AUS DEM PLEXUS CHORIOIDEUS

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Es wird ein im rechten Gehirnventrikel gelagertes, aus dem Plexus chorioideus ausgehendes, 125 g schweres Teratom eines 1 Monat alten Säuglings beschrieben. Das Grundgewebe der Geschwulst bestand aus mehr oder weniger differenzierten Nervenelementen; im Grundgewebe des Teratoms entwickelten sich auch extrem differenzierte epithelartige Elemente, z. B. Leber- und Nebennierenzellen, ferner auch Beispiele einer höheren Organisation, wie embryonale Cardia mit Drüsen und Submucosa, sowie eine dem Urogenitalsystem entsprechende Röhre. Die Entstehung der Geschwulst erfolgte aller Wahrscheinlichkeit nach in der frühen Periode des embryonalen Lebens, in der Periode der Differenzierung der Area chorioidea, also im 11—12 mm großen Embryo. Das Teratom enthielt die für alle drei Keimblätter charakteristischen Epithel- bzw. Organbildungen, und es kann angenommen werden, daß das Plexusepithel den Ausgangspunkt für die Elemente der verschiedenen Keimblätter bildete. In der Entstehung der Geschwulst kann man in erster Reihe die Erscheinungen der Entwicklungsinduktion annehmen, jedoch auf Grund der Untersuchungen von Kiszely ist es wohl möglich, daß in der Entwicklung des Teratoms auch die Autodifferenzierung eine Rolle gespielt hat.

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