ANGIOBLASTIC MENINGIOMAS
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In 1928 Bailey, Cushing and Eisenhardt (1) described three cases of meningeal tumors which with regard to their morphology, and to some extent their clinical course, differed markedly from the usual type of meningioma. The gross appearance of the lesion in their cases was characterized by an unusual degree of vascularity, which in one case reached a degree sufficient to cause an audible bruit, and in all three cases prevented a radical removal of the tumor. Aside from the excessive vascularity, the macroscopic appearance of the tumor was identical with that of the ordinary meningioma. Microscopically, however, the cells showed numerous mitoses, and a difference in biological character from the ordinary type of meningioma may possibly be inferred from the unusual rapid recurrence of symptoms after partial removal of the tumor.

Bailey, Cushing and Eisenhardt termed these tumors angioblastic meningiomas, in other words angiomas composed of angioblasts and comparable in this respect to the angioblastomas of the cerebellum recently described by Lindau. Although we are not, for reasons to be advanced, prepared to accept the conclusion of the American authors that these tumors are composed of angioblasts, we will continue for the present to use the term angioblastic meningioma to designate these peculiar growths.

Bailey and Bucy (2) give the following description of the microscopic appearance of a tumor of this type:

"The tumor is found on microscopic examination to be very cellular. The nuclei are oval with little chromatin. Mitotic figures are commonly found. Throughout the tumor there are numerous large and small spaces. Some of these are empty; others contain a few erythrocytes and coagulated serum. The larger spaces have a definite flattened endothelial lining but no supporting connective tissue of muscular structure such as one would expect in blood vessels of this size. The smaller spaces are obviously lined by the tumor cells themselves, while the moderate-sized spaces are often lined in part by a flattened endothelium which fades off into tumor cells lining the remainder of the wall.

"Impregnation with silver discloses a tangle of fibrils of reticulin surrounding all of the capillary spaces. There is very little collagen in the cellular areas and no fibroglia nor elastin."

In our material, consisting of 124 intracranial meningiomas, there were 7 cases which differed markedly in their microscopic appearance from the usual type of meningioma. In common these 7 tumors showed the occurrence of numerous mitoses. In 4 cases the lesion was of a definite and well characterized histological type and these 4 cases should obviously be grouped together. Dr. Bailey was kind enough to send us some slides from his cases and it was then easy to see that
our four cases were of a microscopic structure identical with the angio-
blastic meningiomas.

Two of our cases (I and II) have been published in Olivecrona's (3) monograph on the parasagittal meningiomas (cases 21 and 33 in the monograph). For convenience they are briefly summarized here.

**Case Reports**

**Case I:** S. F., female, forty-five years (surgical clinic No. 697/1932. Case No. 21 in Olivecrona's monograph). Left-sided parasagittal meningioma of the middle third of the longitudinal sinus. Symptoms of five months' duration, consisting of rapidly progressing right-sided hemiplegia with slight aphasic disturbances. No general pressure symptoms. Removal of fairly vascular tumor in one stage. One blood transfusion.

**Case II:** I. O., female, three years (surgical clinic No. 1637/1933. Case No. 33 in Olivecrona's monograph). Left-sided parasagittal meningioma of the middle third of the longitudinal sinus. Slowly progressing right-sided hemiparesis of six months' duration. Severe general pressure symptoms. Removal of exceedingly vascular tumor in one stage. Resection of lateral wall of the longitudinal sinus. Six transfusions. Well a year and a half after operation.

**Case III:** H. J., female, fifty-four years (private clinic Sophiahemmet 1927). The patient had always been well until about six weeks prior to admission. She then began to have slight headache, localized to the left half of the vertex. She also complained of an occasional feeling of numbness in the left side of the face. Her memory began to fail and she felt tired and worn.

She was admitted to the clinic on Nov. 3, 1927. Examination showed a bilateral choked disc, a definite hypesthesia of the left side of the forehead with diminished corneal reflex, a right-sided lower facial weakness, a very slight sensory aphasia, and an upper homonymous quadrantie field defect to the right. Roentgenograms were negative.
A left-sided temporal lobe tumor was diagnosed, a glioma rather than a meningioma being expected.

First Operation, November 1927: Under local anesthesia the left temporal lobe was exposed by an osteoplastic flap. There was no increased vascularity of the dura or the bone. The temporal convolutions were greatly flattened. Before the exploration could be completed the temporal lobe suddenly began to protrude and the patient complained of headache and soon became unconscious. Obviously there was a hemorrhage in a vascular tumor below the surface of the temporal lobe. An incision was rapidly made in the third temporal convolution and the surface of an exceedingly vascular, very soft, hemorrhagic and friable tumor was exposed. The tumor arose from the floor of the middle fossa, which appeared to be almost completely filled out by the growth. On account of the severe hemorrhage a careful dissection of the tumor could not be carried out and it had to be removed piecemeal by curette and suction. A large part of the tumor had been removed in this way when the operation had to be abandoned because of loss of blood.

In spite of the loss of blood, the patient made a good recovery; there was no increase of aphasia. She left the clinic three weeks later with the choked dim's subsiding. The fields of vision were normal and the slight aphasic disturbances had disappeared. The facial and trigeminal palsies, however, remained unaffected.

During the following years the patient received numerous series of x-ray treatments and remained well and free from discomfort until December 1931, when she began to have attacks of vomiting without preceding nausea. She became dull and listless but did not have any headache. She was admitted to the Serafiner hospital on Jan. 7, 1932.

The decompression which had been left after the previous operation had filled out a little but was still quite soft. The disc margins were slightly hazy but without measurable protrusion. There was a definite hypesthesia of the left side of the face with loss of the corneal reflex; the right-sided facial weakness was a little more apparent than it had been during the preceding years. No aphasic disturbances were demonstrable. The visual fields showed a crescent-shaped upper homonymous defect to the right.

The tumor exposed at the first operation, four years previously, had had the appearance of a typical, though very vascular meningioma. The histological diagnosis at that time had been, however, a malignant tumor, probably a sarcoma. We were therefore somewhat surprised at the long delay before symptoms again appeared and we thought at the time that the growth of the tumor had been checked by the x-rays. However, the symptoms now indicated that the tumor was again actively growing and a second operation was therefore decided upon.

Second Operation, Jan. 13, 1932: Under local anesthesia the old flap was re-elevated and an exceedingly vascular tumor, which apparently filled most of the middle fossa was exposed. The tumor was soft and friable, and the contents could easily be sucked out. This procedure, however, was attended by excessive bleeding from innumerable large vessels in the tumor and within a few minutes the blood pressure could no longer be measured. The cavity was temporarily packed with cotton, and a transfusion was done. It was then found that the growth had its dural attachment near the gasserian envelopes and extended across the sphenoidal ridge into the anterior fossa. The attachment of the tumor to the base of the skull was coagulated between two large, flat electrodes, and the tumor masses in the middle and anterior fossae removed. It was then found that the growth extended further posteriorly and probably had perforated the tentorium. As the patient now was completely unconscious and in a very poor condition, it was thought best to postpone the complete extirpation for a possible second session. The patient, however, failed to rally and died a few hours after operation.

At the autopsy it was found that the tumor had been broken off where it sent an extension through the meissura tentorii into the posterior fossa. Here was found a tumor the size of a plum, compressing and distorting the pons.

As already mentioned, the tumor in this case was first diagnosed, on account of the numerous mitoses and a certain degree of poly-
morphism of the neoplastic cells, as a malignant tumor, probably sarcoma. The gross appearance, however, was that of a typical though very vascular meningioma. The long survival period and the absence at the second operation of any indications of invasive tendencies of the growth did not favor the view of a truly malignant tumor. It is interesting to note that at the time of the second operation the tumor had a more benign appearance, mitoses being less numerous and the cell polymorphism largely absent. Possibly this change was brought about by the radiation.

Had this tumor been attacked by modern methods, i.e., electrosurgery and repeated blood transfusions, at the time of the first operation, it is quite possible that it might then have been completely removed. As it was, the condition at the second operation was hopelessly inoperable because of the extension of the tumor into the posterior fossa.

Case IV: G. C., female, twenty-two years (surgical clinic No. 2433/32). The patient had had a bump on the head two and a half years before, but otherwise had been quite well until the present illness began with headache about a year earlier. The headache was usually very severe, coming on in attacks of several hours' duration, at first at intervals of several days, later becoming almost continuous, beginning in the early morning and lasting all day. It was often accompanied by vomiting. Four months before admission vision began to fail. Double vision was noted two months later and shortly afterwards the patient observed a transient weakness of the left leg. She was admitted to the clinic on Oct. 1, 1932.

There was a bilateral choked disc with blindness on the left side and vision was reduced to 0.1 on the right. The neck was somewhat stiff. There was a bilateral abducent weakness and a very marked tenderness on percussion of the posterior part of the left frontal bone. The x-rays showed in this region changes typical of a meningeal tumor with erosion and formation of new bone.
A diagnosis of a meningioma of the left frontal region was made.

Operation, Oct. 10, 1932: Under local anesthesia, the posterior part of the left frontal lobe was exposed by an osteoplastic flap and the bone in the temporal region rongeured away to the base of the skull. The bone was very vascular, as was also the dura, particularly in the region of the Sylvian fissure, where a firm tumor could be palpated. The tumor, which was the size of a tangerine, had the appearance of a typical though very vascular meningioma. It had a comparatively small dural attachment and had separated the lips of the Sylvian fissure and deeply indented the frontal lobe. With electric loop and suction as much as possible of the contents of the tumor were cleared out in order to make possible the delivery of the growth without confusion to the brain. This procedure was attended by terrific bleeding from large vessels within the tumor, and two transfusions had to be given before the operation could be proceeded with. The shell of the growth could then be removed without difficulty and further loss of blood.

The blood pressure was still very low and, as no other donor was available at the moment, an infusion of saline was given during the closure of the wound. The blood pressure, however, soon fell again and before a donor arrived the patient died from loss of blood.

This patient could no doubt have been saved had the supply of donors been better organized than it was at the time or had the operation been abandoned at an early stage for a second intervention. As matters stood, the small additional loss of blood attending the closure turned the scales and unfortunately no more blood could be provided at the moment.

Discussion

On microscopic examination all four of our cases proved to be of an identical and very characteristic structure and from comparison with the slides sent us by Dr. Bailey we are convinced that we are dealing with the same kind of tumor described as angiohlastic meningioma. However, from our studies of the histological structure of these tumors we conclude that they are not blood vessel tumors, as has been assumed by Bailey, Cushing and Eisenhardt, but that we are dealing with a peculiar variety of the ordinary meningioma.

The distribution of tumor cells and blood vessels is similar to the arrangement seen in the ordinary meningioma. The tumor cells lie in groups surrounded by a network of blood vessels. The blood vessels are more numerous than in the ordinary meningioma but otherwise quite similar (Fig. 1).

However, even in the ordinary meningioma one may often find a similarly well developed vascular network in some part of the tumor (Fig. 2). In the angiohlastic meningioma this tendency to an uneven development of the vascular supply is also found. Different parts of the tumor may therefore show striking differences with regard to the vascular supply. This fact is demonstrated in Fig. 3, showing sections from two different parts of the tumor in Case I. In the lower photomicrograph blood vessels surrounded by an abundant supply of collagen connective tissue divide the neoplastic tissue into alveoli. This is in complete accord with the appearance of an ordinary meningioma. The upper part of Fig. 3 shows a quite different picture. Here we find an exceedingly rich capillary network and between the capillaries fine strands of collagen connective tissue are seen. The histological
appearance is, as is pointed out by Bailey, Cushing and Eisenhardt, of striking similarity to the one characteristic of the cerebellar hemangioblastomas when impregnated according to Perdrau.

The authors cited above hold that the neoplastic cells themselves constitute the walls of the blood vessels and therefore regard them as angioblasts. This is not true in our cases. A thin membrane of collagen connective tissue is always found between the neoplastic cells and the lumen of the blood vessels if the sections are stained, for instance according to Mallory's method. Bailey, Cushing and Eisenhardt express the opinion that these fibrils are reticulin. It is possible that chemical analysis would show that they are actually reticulin fibrils. However, since they may be stained by any connective-tissue stain, we do not think there is sufficient evidence to disclaim for them the name of collagen.

The neoplastic cells themselves are of a fairly uniform appearance and do not show the polymorphism of a malignant growth. They may vary somewhat in appearance in different cases, but it is characteristic that, at least in some parts of the tumor, they are arranged in a way

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**Fig. 3. Photomicrographs from Two Different Parts of the Tumor in Case I**

Above the tumor tissue is very rich in capillaries and strands of fine collagen fibers or reticulin, characteristic of an angioblastic meningioma. Below the tissue is divided in alveoli surrounded by vessels enclosed in coarse collagen fibers, just as in an ordinary meningioma.
resembling the whorls and strands characteristic of the structure of the ordinary meningioma (Fig. 4). This arrangement is often only suggested and may therefore easily pass unobserved. For the interpretation of the nature of these tumors, however, the above mentioned arrangement of the neoplastic cells appears to be of importance.

One might expect that a tumor showing such characteristic differences in microscopic appearance from the ordinary type of meningioma would also differ from these tumors, to some extent at least, in gross appearance. This, however, is not the case. In all our cases the tumor was encapsulated and did not infiltrate the brain, as did some of the other of our 7 meningeal tumors which had to be classified outside of the group of ordinary meningiomas. They were all of the ordinary bulbous type of meningioma and, except for their excessive vascularity, there was nothing to indicate that they did not belong to the group of ordinary meningiomas. However, meningiomas of other types may be equally vascular, and as may be the case in any kind of very vascular tumor the veins emerging from the tumor may be filled with arterial blood, indicating a wide capillary bed. We have had one instance of a meningioma of ordinary histological appearance, where the tumor was so vascular that in the course of a six-hour operation no less than 17 blood transfusions were given, and even so the complete removal of the growth had to be postponed for a second stage. We have also seen cases of meningiomas of the usual histologic appearance, which were vascular enough to produce an audible bruit. A high degree of vascularity, therefore, is a characteristic which is practically always present in cases of angioblastic meningiomas but which is fairly common in meningiomas of other types as well.

It is impossible to say that the clinical course and symptoms present in our cases differed to any appreciable extent from what might have been expected in meningiomas of the ordinary type. The preoperative history and clinical symptoms certainly did not give rise to any apprehensions with regard to the character of the tumor. This also appears to be true of the cases described by Bailey, Cushing and Eisenhardt.

With regard to the biological character of the tumor, the evidence available at present does not seem to be sufficient to warrant definite conclusions. In each of the cases described by Bailey, Cushing and Eisenhardt the tumor recurred, but that was inevitable, since the removal of the growth was admittedly incomplete in all of the cases. Bailey and Bucy state that these tumors inevitably recur. We are unable to accept this conclusion, since in every case thus far published, except that of Bailey and Bucy, where no statement on this point is made, the tumor was incompletely removed. Obviously, safe conclusions with regard to the biological character of the tumor and its tendency to recur can be arrived at only after the observation, over a sufficient period, of a number of cases where the tumor has been, as far as can be ascertained at the operation, completely removed. In our two cases where the growth was completely removed there is no sign of recurrence a year and a half and two years and a half after operation.
While we do not consider this evidence sufficient to justify a conclusion opposite to the one arrived at by Bailey and Bucy, nevertheless our experience with these cases inclines us to take a less gloomy outlook with regard to their prognosis. Moreover, there seems to be no reason why an encapsulated tumor which does not metastasize should recur after it has been completely removed. To our mind the bad reputation which these tumors enjoy is largely due to the technical difficulties attending their removal. The crux of the situation lies in the complete removal or destruction of the dural attachment of the tumor. When dealing with tumors of extraordinary vascularity, perhaps situated in places difficult of access, this is a matter of great, sometimes insur-

![Fig. 4. Photomicrograph from Case IV](image)

The nuclei show uniformity and their arrangement suggests a formation of whorls.

mountable, difficulty. This is particularly the case when the tumor happens to be attached to the falx, the longitudinal sinus, the tentorium, or the base of the skull. According to statistical probabilities one of these conditions will prevail in about three out of four cases. It is no wonder, then, that recurrences are frequent, particularly if the growth is removed by finger dissection and torn from its more or less inaccessible dural attachment. The methods upon which we have come to rely in these, as in most other tumors of great vascularity, are described in the monograph of Olivecrona, to which the reader who happens to be interested in technical matters is referred.

In our series of 23 verified intraspinal meningiomas we have found one case of the type just described. This tumor occurred in a woman forty-two years of age, who had been having symptoms of a slowly progressing spinal cord tumor for five years. At operation a tumor
compressing the cord at the level of the 4th to the 7th cervical segment was removed. The tumor arose from the dura near the intervertebral foramen between the 5th and 6th cervical vertebrae and continued with a stalk into the intervertebral foramen. It was unusually vascular for a spinal meningioma, but otherwise in its gross appearance differed in no way from the usual run of spinal meningiomas. This patient when last heard from, six months after operation, was completely well.

We finally have to discuss the nomenclature to be used with regard to these tumors. We are not dealing with angiomas but with a cellular, vascular and unusually rapidly growing type of meningioma. The term angioblastic meningioma, therefore, is unsuitable. It is, however, admittedly difficult properly to denominate these tumors, which obviously form a morphological entity apart from the ordinary meningiomas. The problem is similar to the one involved in classifying cellular myomas showing numerous mitoses. These tumors have often been called myosarcomas which, however, is a misnomer, since the term sarcoma should be reserved for malignant connective-tissue tumors. It would probably be better to apply to them the name myoma malignum, although only some of them show an infiltrating growth and produce metastases. By way of analogy one might perhaps suggest for the tumors described under the name angioblastic meningiomas, the term malignant meningioma, although in our opinion the majority of these tumors are probably comparatively benign.

Since the name angioblastic meningioma has been accepted in the literature, however, it seems more practical not to displace it. Real angioblastic tumors of the meninges may be separated under the heading angiomas.

References