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Malignant Meningioma

— Clinical, Radiologic and Pathologic Characteristics —

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This is a report of the clinico-pathologic findings in six cases of histologically verified malignant meningiomas-three hemangiopericytic and three anaplastic types. They were three males and three females and two of them were reoperated for recurrence. The hemangiopericytic types had similar angiographic and macroscopic features and malignant characteristics such as increased mitoses. The anaplastic types lacked typical arrangement, but had a large number of mitoses, increased cellularity, focal necrosis, pleomorphism, anaplasia, and the adjacent normal parenchymal infiltration. However the metastasis was not yet proven in these cases.

Key Words: Malignant meningioma, hemangiopericytic meningioma, anaplastic meningioma.

INTRODUCTION

Meningioma is a common intracranial neoplasm in western as well as in oriental countries and is the most frequent nonglial intracranial tumor[1]. The distinction between benign and malignant meningiomas is equivocal. A history of rapid recurrence, even after apparently complete removal, overt histological anaplasia, and finally the appearance of metastases are the usual criteria of malignancy[2]. Histologically, high cellularity, mitosis, pleomorphism, necrosis, and abnormal stromal reactions are features of malignancy, but the presence of only one of those features does not always indicate a malignancy[3]. For a clear description of malignant meningioma, hemangiopericytic and anaplastic meningiomas according to the WHO classification[4] are evaluated clinicopathologically.

*This study was presented at the case discussion Session during Spring Meeting of the Korean Society of Pathologists (May, 1986).

MATERIALS AND METHODS

During the period of three years, from March, 1985 to February, 1988, there were total six malignant meningiomas that were examined and diagnosed at the Department of Pathology of Korea University Hospital. Of these, three were hemangiopericytic and three anaplastic meningiomas. One case of anaplastic meningiomas have been proved to be for it to change from the benign to the anaplastic type at recurrence, and the remaining two were diagnosed at the time of the first operation.

The medical records of all patients were reviewed and obtained the information regarding the ages and sexes, the symptoms and signs, the radiologic findings, the locations of the tumors, the extents of resections and the follow-up data. All the microscopic slides of the cases were reviewed again regarding histologic type, mitotic activity, cellular pleomorphism, invasive characteristics, necrosis, and cellularity. In some cases, reticulin stain was

performed and used to define the distribution of the cells in the connective tissue meshwork and to emphasize the vascular pattern of the tumor.

RESULTS

Clinical features(Table 1)

This study includes six patients, three men and three women. Ages ranged from 22 to 60 years, with an average of 39 years. Symptoms were present for several months except one, that had for two years. Symptoms and signs were the similar to those commonly seen in benign meningiomas; all six patients had headache, three presented vomiting, and two dizziness. Three patients had nystagmus, two abnormal visual field, and one among these hemiplegia. Five tumors were located in the cerebral hemispheres; two in the temporoparietal lobes, one in the frontal lobe, one over the sphenoid ridge, one in the occipital lobe and the sixth in the posterior fossa.

Radiological features

The three hemangiopericytic meningiomas showed the similar radiological findings. Angiographically, the irregular tortuous tumor shadows were demonstrated in all tumors (Fig. 1) and the CT scans were enhanced homogeneously. In three cases of the anaplastic type, the CT scan revealed a low to high density mass with a homogeneous enhancement and two tumors had central low density areas (Fig. 2). By angiography, bizarre fine vascular shadows were

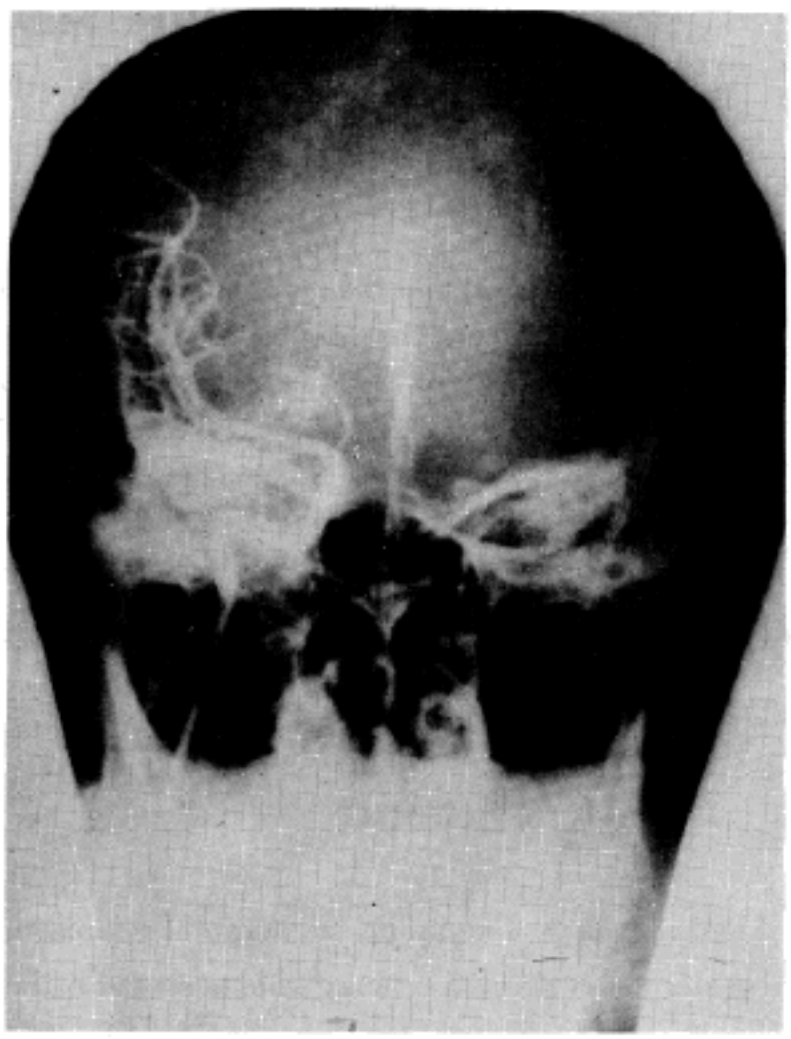

Fig. 1. Angiography of case 2. Note irregular tortuous tumor vessels with smoke-like shadow in right frontal region.

Table 1. Clinical summary of malignant meningiomas

	Age	Sex	Location	Operation number	Radiation
Hemangiopericytic type					
Case 1.	37	F	Temporo-pari-eto-occipital	2*[a]	—
Case 2.	22	F	Frontal	2*[b]	+
Case 3.	35	M	Posterior fossa	1	+
Anaplastic type	changed from bening type				
Case 4.	29	M	Temporo-parietal	2*[b]	+
Anaplastic type					
Case 5.	60	F	Occipital	2*[a]	+
Case 6.	53	M	Sphenoid ridge	1	—

Abbreviations : *a : reoperation due to incomplete excistion
*b : reoperation due to recurrence

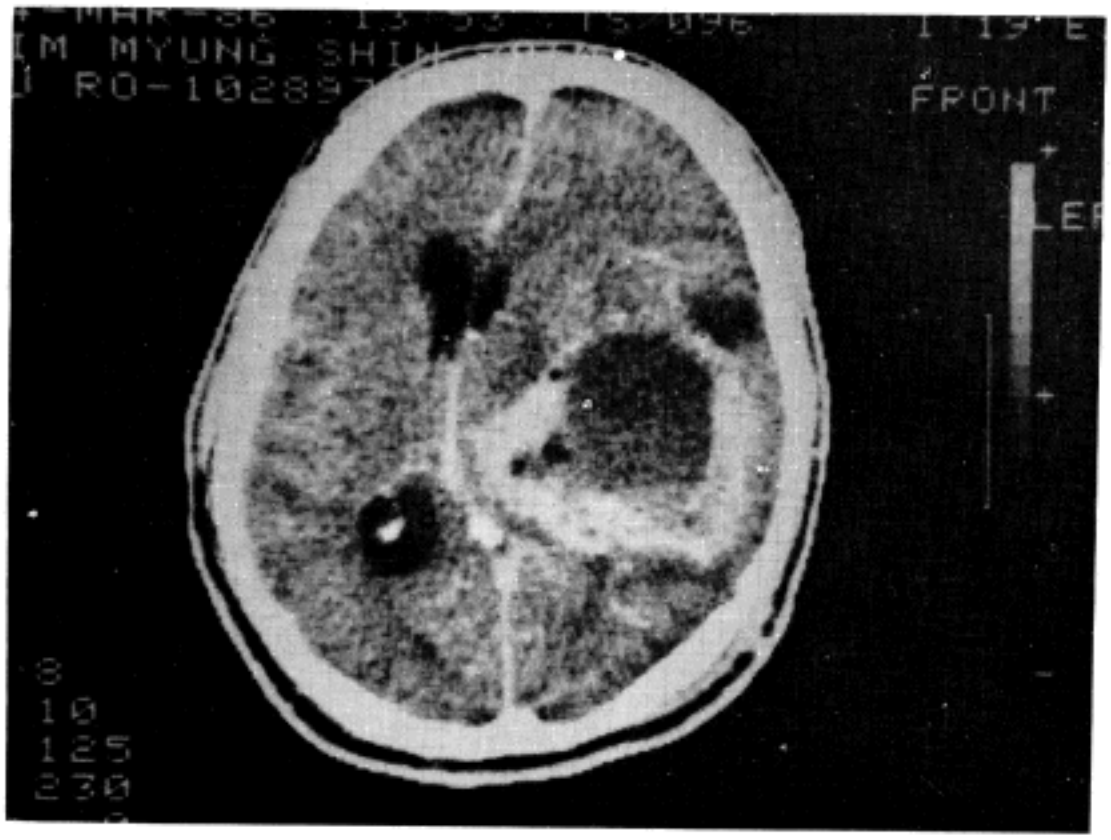

Fig. 2. Computed tomography of case 4. Note central low density with highly enhanced irregular margin and perifocal edema in left temporo-parietal area.

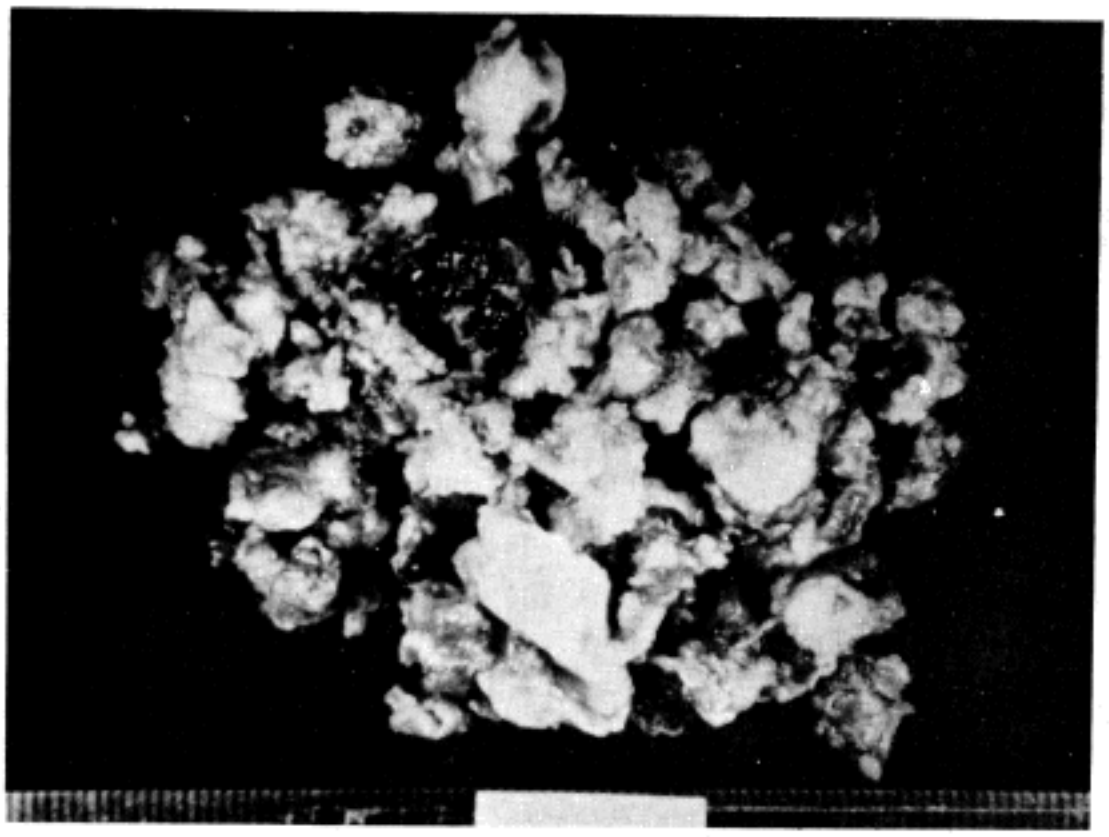

Fig. 3. Gross specimen of case 6. It is composed of several irregular fragments of yellowish soft tissue showing focal necrosis and hemorrhage.

obtained in one case, and the other had no tumor shadow.

Operative and macroscopic findings

All the hemangiopericytic type had the similar gross appearance. They showed a dark red colour, good demarcation with somewhat lobulated surfaces. Two tumors attached to the dura and one to the sigmoid sinus. There was no normal brain infiltration. They were rich in blood vessels. There was moderate to massive bleeding during the operation. All the anaplastic type were variable in color; yellowish, grayish or reddish, and variable consistency, soft to firm (Fig. 3). They were lobulated and had a good demarcation in gross, but the tumor infiltration was found in three cases to the bone and/or brain.

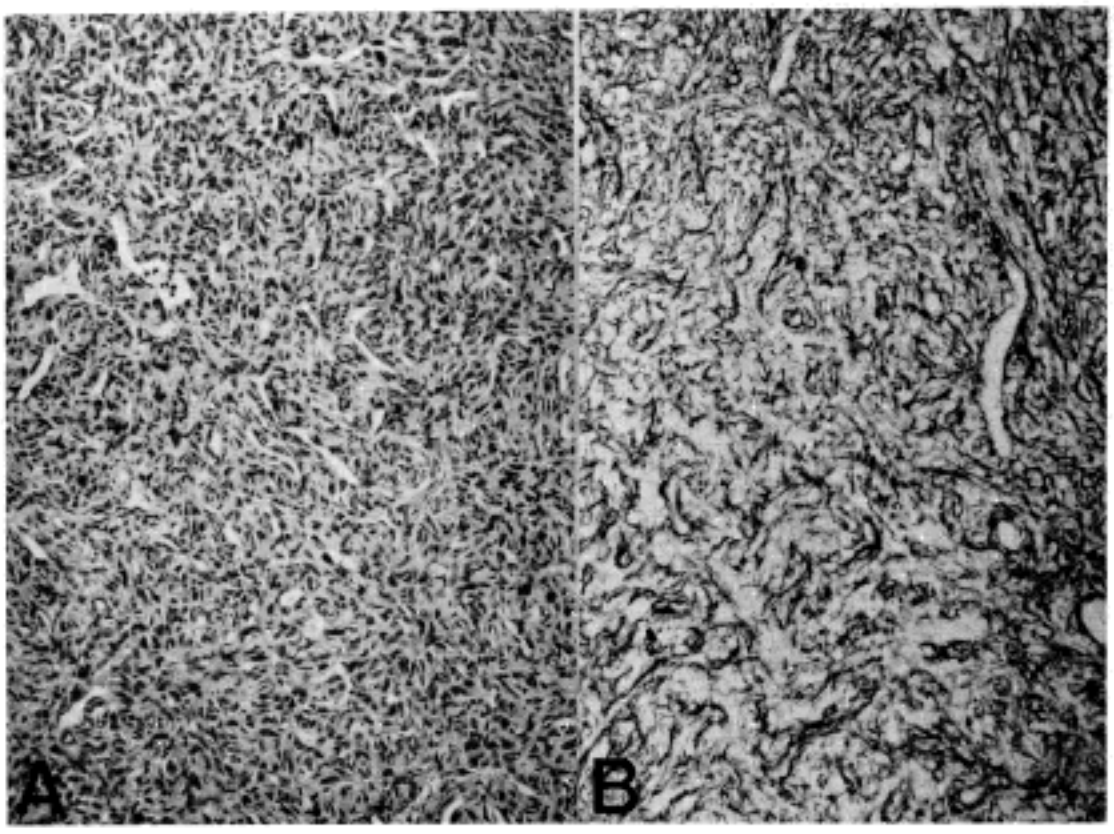

Fig. 4A. Section of case 1 reveals thin-walled, irregular blood vessels surrounded with plump, spindle-shaped cells (H & E, X100).

Fig. 4B. Section of case 1 shows abundant reticulin fibers around the tumor cells or blood vessels (Reticulin, X100).

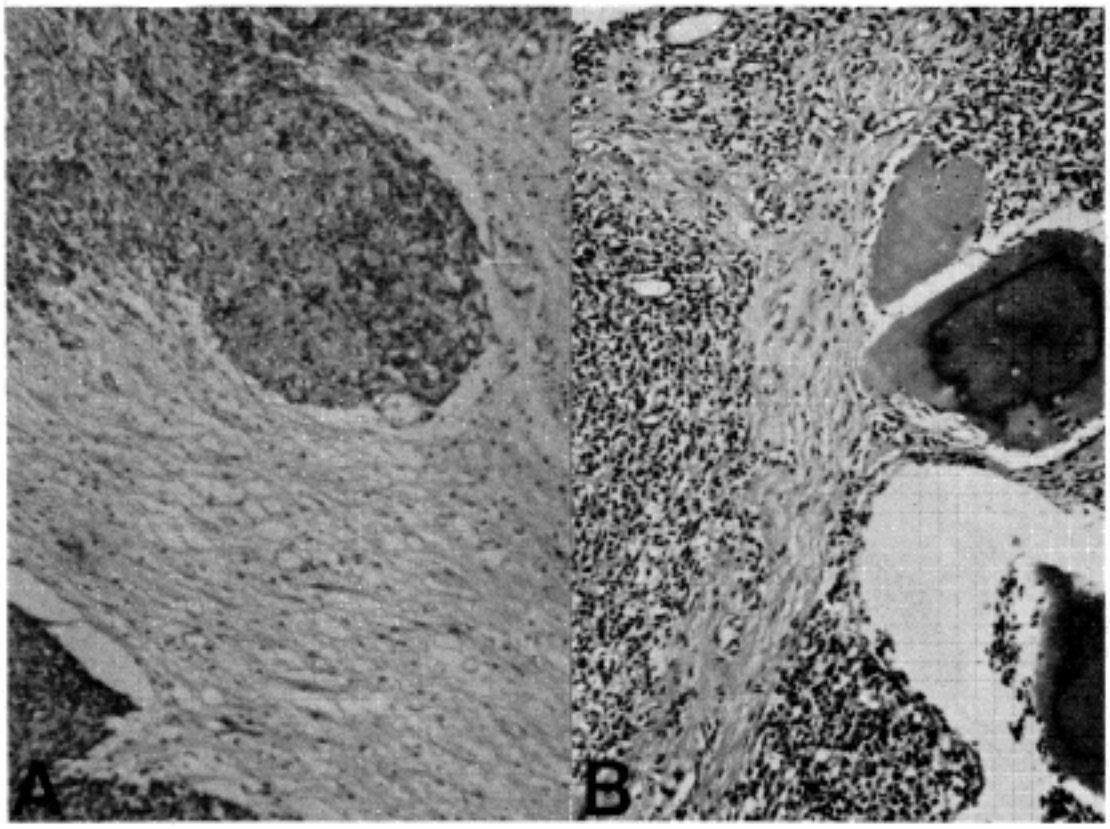

Fig. 5A. Section of case 4 reveals brain infiltration with finger-like projections (H & E, X100).

Fig. 5B. Section of case 4 shows skull bone invasion which is composed of destructed bony trabeculae and irregular tumor cell infiltration (H & E, X100).

The amount of blood vessels were variable and there was cystic degeneration or foci of yellow necrosis in two tumors.

Microscopic features

In all the hemangiopericytic type, the characteristic plump, spindle-shaped cells, the thin-walled irregular vascular channels, and the extraluminal position of the tumor cells, as described by Stout, were evident (Fig. 4A). Mitotic figures were frequent, ranging from 4 to 25 per 10 high-power fields (HPF). The reticulin stain showed atypical pattern of fine reticulin fibers around a single cell or small groups of tumor cells (Fig. 4B). Two cases (case 1 & 2) which had received two operations showed no significant change in histology.

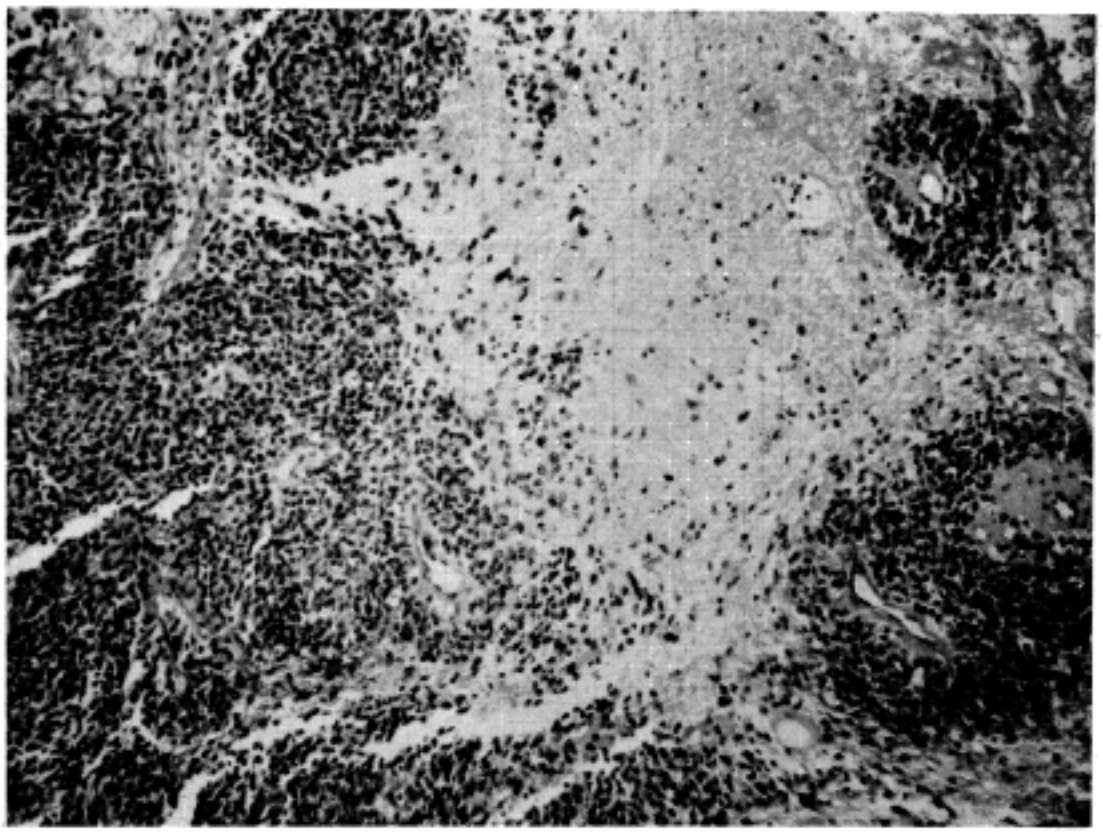

Fig. 6. Section of case 4 consists of hemorrhagic necrosis and remaining tumor cells around the blood vessels (H & E, X100).

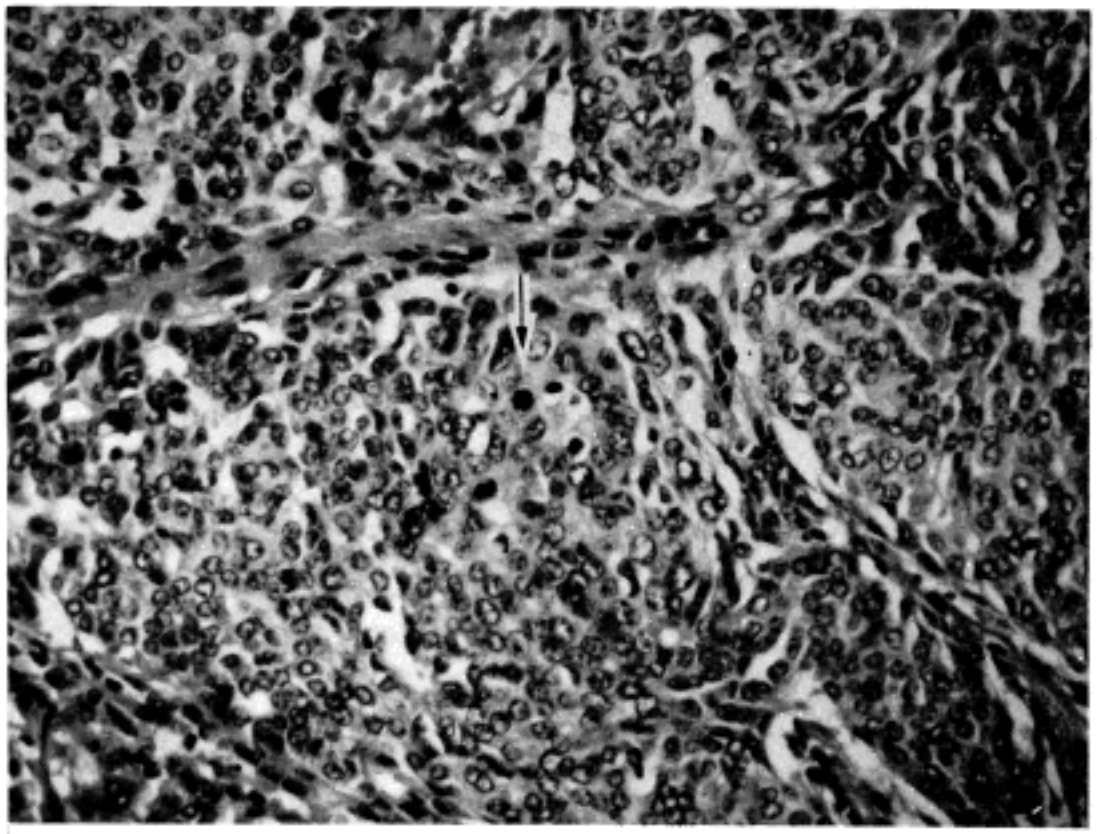

Fig. 7. Section of 6 discloses increased cellularity, frequent mitoses, nuclear pleomorphism of the tumor cells arranged in diffuse sheet pattern (H & E, X160).

In one of the anaplastic types which were progressed from the benign type, the first histological diagnosis was meningotheliomatous type. In review there were variablity in the nuclear size and a small number of mitosis (1/10 HPF). Malignant changes at the second operation were obvious: a large number of mitosis (25/10 HPF), marked pleomorphism of nuclei, anaplasia, the adjacent brain and bone infiltration (Fig. 5), focal necrosis (Fig. 6), and high cell-larity. The typical arrangement and organoid structures that seen in the first specimen were lost. In two cases (cases 5 & 6) of anaplastic meningiomas, organoid pattern such as whorls was not observed, and instead cells arranged in broad sheets. Mitoses ranged from 1 to 30 per 10 HPF and atypical mitoses were identified in one case(Fig. 7). There were ne-

crosis in two patients. In one patient, the meningioma infiltrated the brain, showing finger-like projections.

Follow-up results

Of the three hemangiopericytic meningioma cases one case had recurred a year later and received second operation. The two cases received the postoperative radiation therapy. Of the three anaplastic meningioma cases, one case recurred a year later which required the second operation. The two patients received postoperative radiation.

DISCUSSION

Meningiomas are well known benign brain tumors and its incidence is about 14 to 19% of intracranial and reached 25% of intraspinal neoplasms[5,6]. In Korea University Hospital, the incidence of meningioms among total CNS neoplasms was 23/100 during 3 year period. They are generally benign, well-circumscribed, and slow growing.

The recurrence rate is between 2.3 and 30% in the literatures[3,5,7,8]. The probability of recurrence is significantly influenced by the extent of the first operation; the more radical the excision, the smaller chance of recurrence[6]. In this series, the recurrence rate was 2/6 even in the cases of total removal.

In the extensive survey of literatures on meningiomas, few articles deal specifically with the problem of malignancy. The clinical features including symptoms, duration and location of the malignant tumors were similar to those of benign type but the incidence was higher in males, as reported, and also the age distribution declined somewhat in the young[2,3].

The angiographic findings common to hemangiopericytomas include a myriad of tiny irregular feeding vessels arborizing from a main trunk, an intense fluffy type of stain, lack of early veins, and prolonged tumor circulation time. In this study, irregular vascular shadows were seen in 4 of 6 tumors. Recently, CT findings of malignant meningiomas had been reported with relation to the microscopic appearance by Dietemann et al[8]: tumoral necrosis determines heterogeneous enhancement; brain invasion explains the irregular outline of the tumor and sometimes the absence of surrounding low attenuation area. In this series, all cases were examined and heterogeneous enhancement and irregular outline of the tumor were shown in four tumors.

Microscopic features are the most important and unusual findings such as brain infiltration, dural and bone invasion and necrosis should be carefully checked. In our series, brain infiltration and/or bone invasion was found in three cases and all of these were anaplastic meningiomas. Microscopically, malignant meningiomas are devided into three types according to the WHO classification[4]; hemangiopericytic, papillary and anaplastic. But the papillary type was not found in our series. Also, as described above, anaplastic change from the benign type was observed. The ratio of malignant to benign cases in Korea Univ. Hospital for 3 years was 6/23.

The biologic behavior of meningiomas is not always predictable from the histologic appearance of the tumors[7,10]. Crompton et al[11] studied the recurrence of meningiomas histologically and suggested that mitotic figures, focal necrosis and cerebral infiltration are indicative of likely recurrence. Monte et al[10] described seven histopathologic features that predict recurrence of meningiomas following subtotal resection, which are hypervascularity of tumors, hemosiderin deposition, growth of tumor cells in sheets, prominent nucleoli, mitotic figures, single-cell and small-group necrosis, nuclear pleomorphism, and overall atypicality or malignant tumor grade.

In a study Jaaskelainen et al[12], hypercellularity, loss of architectural pattern, nuclear pleomorphism, mitotic index, focal necrosis, and brain infiltration were used to grade meningiomas as follows: I-

benign; II-atypical; III-anaplastic; and IV-sarcomatous. It was found that tumors with higher grades had shorter doubling times. Necrosis was a common feature in these series, but it occasionally also occurs in benign meningiomas[2,7]. Although rare mitoses can be found in benign meningiomas, numerous mitoses predict active growth and recurrence[2,11]. Greater than three mitoses/10 HPF seems to be the most reliable indicator of malignant behavior, but that measure is also imperfect[13]. Atypical mitoses are always proof of malignancy[2]. There is controversy whether invasion of the brain indicate malignancy[2].

Begg and Garret were the first to describe a tumor in the meninges in 1954 which they referred to as hemangiopericytoma[14]. Histological, ultrastructural, and behavioral characteristics indicated that it is a distinct entity[9,15,16]. Rorke et al proposed the revision of WHO classification of childhood brain tumors and then, he considered the hemangiopericytoma as belonging to the tumors of blood vessel origin[17]. A stain for reticulum, which in the hemangiopericytoma encloses individual cells, is helpful in diagnosis[2]. These neoplasms are always at least potentially malignant. In our series, three of 6 patients had hemangiopericytomas.

Metastasis is incontrovertible proof of malignancy[18~20]. The most common sites to which meningiomas metastasize, in oder of frequency, are lungs, liver, lymph nodes, and bones[13,21]. Metastasis was not noted in this series. The role of radiation therapy remains controversial[6]. Most authors suggest postoperative radiotherapy in cases where the excision is incomplete, where the tumor is malignant, or in cases of recurrent tumors[6]. In consideration of the biology of malignant meningiomas, we believe that the therapeutic approach for these tumors is a total removal and postoperative irradiation[3].

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＝국문초록＝

악성 수막종

—임상 및 병리학적 특성을 중심으로—

고려대학교 부속병원 병리과

박혜림 · 채양석 · 이갑노 · 백승룡

수막종은 비교적 흔한 중추신경계 종양이지만 그 악성기준에 대해서는 논란이 많다. 저자들은 1985년 3월부터 1988년 2월까지 만 3년간 고려대학교 부속 구로병원 병리과에 의뢰되었던 검체중에서 WHO 분류에 의거하여 악성 수막종의 범위에 속하는 여섯 예를 모아 그 임상적 및 병리학적인 특색을 보고하는 바이다. 증례는 혈관외피세포종성 3예와 퇴행성 3예로 이중 2예에서 재발이 발견되어 재수술을 시행받았다. 혈관외피세포종성 수막종은 혈관 조영술 혹은 육안적 소견상 혈관이 풍부한 특징을 보이고 현미경 검색상 특징적인 방추형의 세포가 얇은 벽을 갖는 불규칙한 혈관 주위로 배열되는 소견을 보였고 비교적 증가된 유사분열상이 관찰되었다. 퇴행성 수막종은 전형적인 세포 배열 형태의 소실, 증가된 유사분열상, 세포충실성증가, 국소괴사, 뇌실질침윤, 다형성과 퇴행성의 특징을 보이며 한 예는 양성 수막세포성 수막종에서 전환된 경우였다.

본 연구에서 전이는 증명되지 않았다.