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Diploic Meningioma Contiguous to a Contralateral Parasagittal Meningioma: CT and MR Features

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Abstract

A patient with a diploic meningioma is presented. Computed tomography (CT) scan revealed an intradiploic tumor which seemed contiguous at a point to a contralateral, recurrent parasagittal meningioma. On CT, density of the diploic meningioma was similar to that of the parasagittal meningioma, but the contrast study showed that the former enhanced much less than the latter. Magnetic resonance (MR) imaging demonstrated that the diploic tumor was heterogeneous and much less enhanced with Gadolinium-DTPA (Gd-DTPA) than the parasagittal meningioma on T_1-weighted image, although they were very similar in signal intensities on T_2-weighted and proton density-weighted MR images without Gd-DTPA. Reasons for such marked differences in enhancement patterns are discussed.

Introduction

Meningiomas may occasionally present signal characteristics similar to those of the surrounding brain on magnetic resonance (MR) imaging, providing an insufficient contrast for diagnosis (10). Gadolinium-DTPA (Gd-DTPA) reportedly increases the perceptibility of meningioma on MR imaging (11), and one might think that MR studies with contrast agent should increase the sensitivity and specificity in the evaluation of recurrent or multiple meningiomas.

We report computed tomography (CT) and MR findings of a patient with intradiploic meningioma, which presumably extended from a recurrent contralateral parasagittal meningioma. Appearances of contrast-enhanced CT and MR studies differed significantly between the intradiploic tumor and the parasagittal one, in spite of a similar histological subtype. We have found only few previous reports on CT or MR features of diploic meningioma (6, 8).

Case report

A 54-year-old woman was seen in July 1983 because of a weakness in her right extremities. CT scan revealed a round, enhancing tumor in the *left* posterior frontal region associated with a marked

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perifocal edema. The patient underwent intracranial pressure (ICP) monitoring for perioperative managements through a burr hole placed in the *right* parietal region, and a left frontal convexity meningioma was removed including the dural attachment. The patient did very well after surgery until May 1990, when she was readmitted because of a bulge in the *right* parietal region which had progressively enlarged.

On examination, the bulge was ca 4.5 cm in diameter and 1.5 cm in height. It was a very soft, unmovable, and nontender tumor, locating opposite to the previous bone window. The neurological examination was without note.

Plain skull roentgenograms showed heterogeneous erosion, or partial absorption, of the left frontoparietal bone flap, and an osteolytic lesion in the right parietal bone with thin, interrupted sheets of the remaining inner table expanding inwards.

Plain CT scan demonstrated a round, homogeneous, isodense mass in the left frontal parasagittal region associated with a massive perifocal edema (Fig. 1a). At a higher level, another isodense

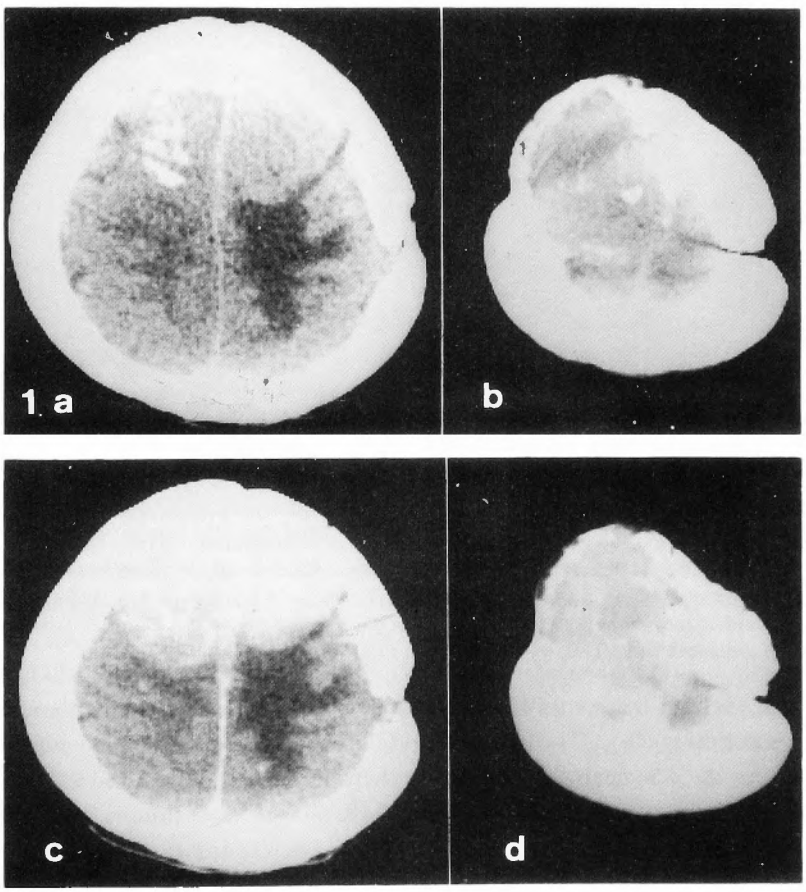

Fig. 1 Plain and contrast-enhanced axial CT scans. *a*: Plain CT reveals an isodense mass in the left frontal lobe with marked perifocal edema, and fragments of bone in the right frontal area. *b*: At a higher level, an osteolytic tumor in the right frontal region is demonstrated with bone fragments. *c* and *d*: Contrast-enhanced CT scan shows that the left frontal tumor enhanced homogeneously whereas the right tumor enhanced less and heterogeneously.

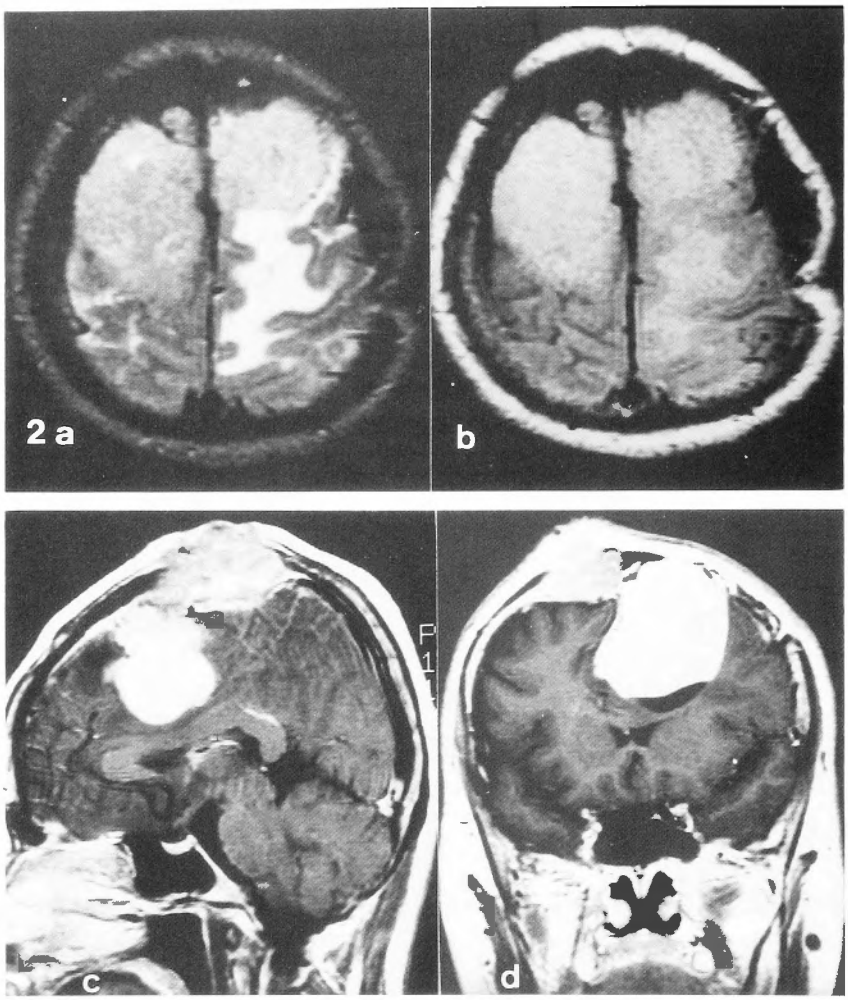

Fig. 2 Magnetic resonance images. *a*: Axial T_2-weighted image demonstrates two individual tumors with the same intensity in the bilateral frontal areas. *b*: Axial proton density-weighted image shows the couple of tumors with the almost equivalent intensities. *c*: Sagittal T_1-weighted image with Gd-DTPA enhancement. The right intradiploic mass enhanced less than the left parasagittal tumor. *d*: Coronal T_1-weighted image with Gd-DTPA enhancement. The two tumors seem to have connection on the midline.

mass with a cluster of bone fragments was present in the osteolytic skull defect without accompanying perifocal brain edema (Fig. 1b). The left parasagittal tumor showed marked, homogeneous enhancement (Fig. 1c), but the tumor on the right side enhanced much less than the left one (Fig. 1d).

On T_2-weighted and proton density-weighted MR images, both tumors were similarly high in signal intensities (Fig. 2a, b). Plain T_1-weighted MR image was unfortunately not available. Contrast-enhanced T_1-weighted image showed increase in signal intensities of both tumors compared to the surrounding structures. The left parasagittal tumor enhanced homogeneously and much more markedly than the contralateral extradural mass. Two tumors seemed contiguous at a point on the midline, but their different enhancement patterns were apparent on both CT and MR image (Fig. 2c, d).

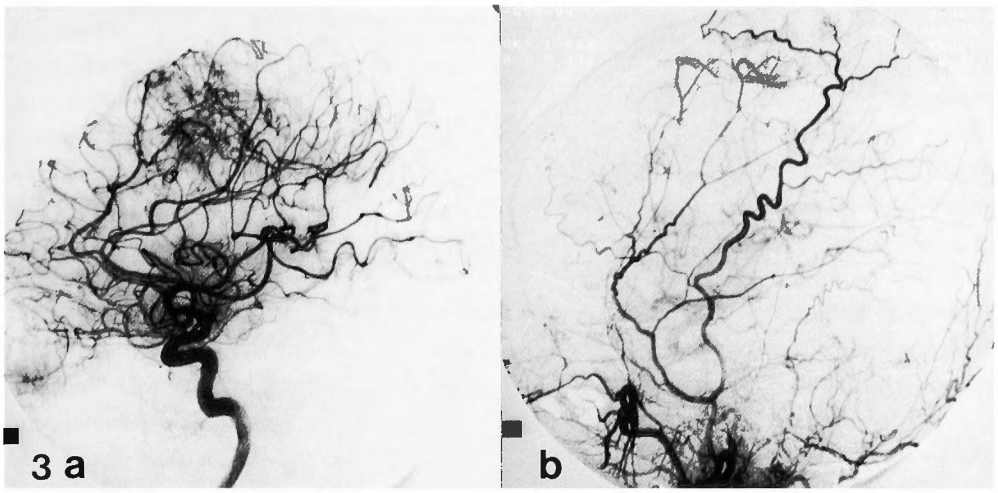

Fig. 3 *a*: Left internal carotid angiogram demonstrates a tumor stain mainly fed by the anterior cerebral arteries in the frontal lobe. *b*: Right external carotid angiogram shows another tumor stain in the frontoparietal diploic space fed by the middle meningeal and superficial temporal arteries.

An angiogram of the left internal carotid artery demonstrated a left frontoparietal vascular tumor fed by the anterior cerebral arteries (Fig. 3a). A right external carotid angiogram revealed a right extradural vascular mass fed by the middle meningeal and superficial temporal arteries (Fig. 3b). Both of the tumor stains appeared in the arterial phase and persisted throughout the venous phase.

Preoperatively, a diagnosis of recurrent left parasagittal meningioma extending into the contralateral diploic space seemed most probable, but a marked difference in enhancement patterns between two mass lesions raised a possibility of a recurrent left parasagittal meningioma accompanied by an inflammatory mass on the right side related to the previous burr hole for ICP monitoring.

The patient underwent bilateral frontoparietal craniotomy, total removal of the left parasagittal tumor with involved segment of the superior sagittal sinus, and subtotal removal of the right diploic tumor. Both tumors were soft and moderately hemorrhagic. They had a very narrow connection to each other in the extradural space. The diploic meningioma was covered by interrupted, thin shells of the bone. Over the right precentral gyrus, the tumor firmly attached to the dura mater, and further to the arachnoid membrane penetrating the dura mater.

Histological diagnosis of fibroblastic meningioma was confirmed for both tumors. Cellularities and vascularities were comparable between the two tumors (Fig. 4a, b). Microscopic examination with Toluidine blue stain following glutaraldehyde fixation, however, revealed that the diploic meningioma had much wider extracellular space than the parasagittal one (Fig. 4c, d).

Discussion

Recurrence rate of meningioma after seemingly total removal (Simpson's Grade 1) is still rather high, ranging from 7 to 14% at five years' follow-up (1, 7). Besides the radicality of the operation, histological aggressiveness and sites of the tumor, gender and endocrinological factors of patients, and several other factors may well influence the probability of recurrence (2). On the other hand,

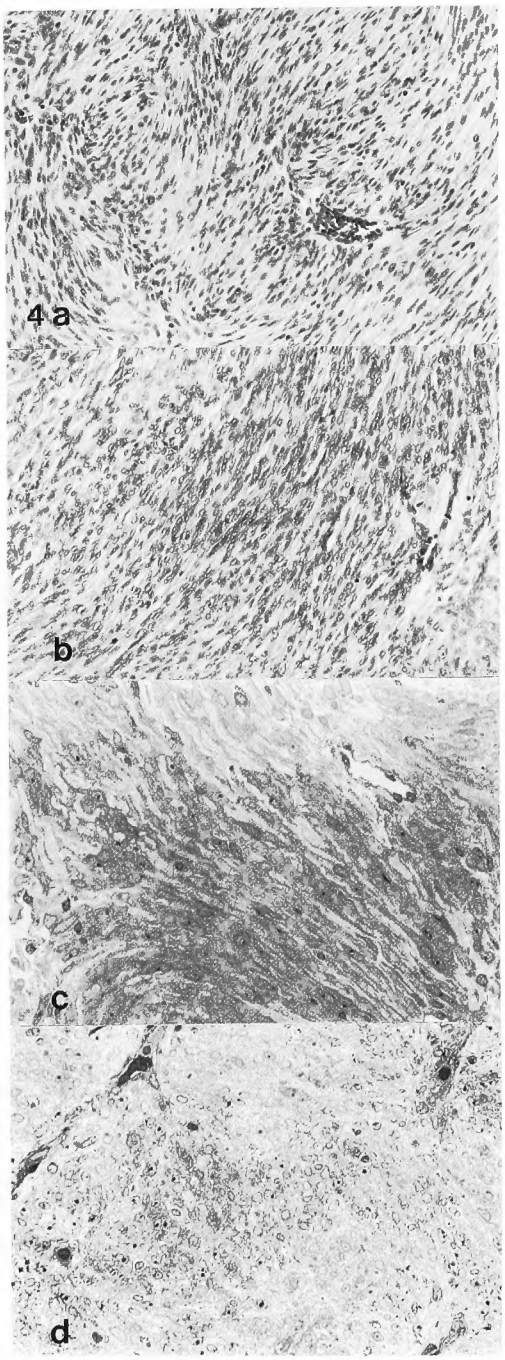

Fig. 4 Histological findings. *a, b*: Fibroblastic meningiomas from the left parasagittal region (*a*) and from the right intradiploic spae (*b*). Cellularities and vascularities are similar to each other. (Hematoxylin & Eosin, ×100). *c, d*: The parasagittal meningioma (*c*) shows wider extracellular space than the diploic meningioma (*d*). (Toluidine blue after glutaraldehyde fixation, ×100).

BOROVICH et al. emphasized importance of regional multicentricity in the so-called 'recurrence' of meningioma (8).

In our case, two meningiomas were contiguous to each other on the midline on MR image. Operative findings seemed to indicate that the diploic tumor was a direct extension of the parasagittal tumor, either directly through a part of the diploe facing to the previous craniotomy edge, or through the foveolae granulares of arachnoid villi into the diploic space. We should, however, reserve the possibility of incidental multicentricity; the parasagittal meningioma arose from another focus in the vicinity of the convexity meningioma previously operated on and the diploic meningioma from a separate rare intraosseous focus.

CT and MR studies without enhancement demonstrated that two tumors were quite similar as for the CT densities and MR signal intensities except for the presence of bone fragments in the right diploic mass. Contrast studies, however, showed that the diploic tumor enhanced much less than the contralateral parasagittal tumor both on CT and on MR image.

MR image without Gd-DTPA enhancement is not always reliable in the diagnosis of meningiomas, because meningiomas may show a variety of intensities on T_1-weighted and T_2-weighted images, and they are often iso-intense with minimal contrast to the surrounding brain tissue (10). ELSTER on one hand proposed that the intensity on T_2-weighted image corresponded well to meningioma subtypes (4).

Gd-DTPA enhancement significantly increases the sensitivity of MR images in the diagnosis of intracranial tumors. WATANABE and AZUMA suggested that tissue characterization might be possible by Gd-DTPA enhancement altering the relaxation process of water protons (11). The degree of contrast enhancement on MR image is known to be influenced by many factors; extent of vascularity of the pathological lesions, vascular permeability, velocity of washout of the contrast agent, and others. The capillary endothelium of tumor vessels usually is highly abnormal, with high degree of fenestrations, vesicles, open junctions and fragmented basal laminae, and leads to a considerable increase in permeability. When considering the permeability of tumor vascular beds, it seems important to realize a high degree of heterogeneity between different tumors and also a difference in the extent of vascular leakage within the different regions of a single tumor, in addition (5). In our case, the wider extracellular space might account for the increased accumulation and reduced washout of the extravascular contrast agents and thus contributed to the more intense enhancement of the diploic mass.

We have reported that findings of dynamic CT scan did not correlate to subtypes of meningiomas (9). Contrast study may not be reliable to determine the meningioma subtypes on MR image, either. However, it is of interest to know whether multicentric meningiomas have a variety of subtypes and/or many different MR features in a single case.

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和文抄録

傍矢状洞髄膜腫から進展した板間層の髄膜腫：CT と MRI 所見

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肉眼的全摘出術後約7年目に，頭頂部の皮下腫瘤を主訴として再発した髄膜腫を経験した．CT 検査で，反対側の傍矢状洞髄膜腫とごく狭い部分で連続しているように見える板間層の腫瘍を認めた．単純 CT では，板間層の腫瘍と対側の髄膜腫とはほぼ同じ density であったが，造影 CT では，前者の増強効果は後者に比べて弱かった．MRI T1 強調画像では板間層の腫瘍は不均一で，Gd-DTPA による増強効果は対側髄膜腫よりも著明に弱かった．一方，T2 強調画像，プロトン密度強調画像では二者は同じ信号強度の腫瘍であった．このような画像上の差異，特に増強効果の違いに注目して考察を行った．