

CT and MR Findings of Meningioangiomas¹

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Purpose : To characterize the CT and MR findings in patients with meningioangiomas(MA).

Materials and Methods : Four patients (18 to 53 years old, two females and two males) with MA were retrospectively reviewed. CT was used in four cases and MR in three. Pathologic specimens were obtained from all four.

Results : All lesions were located in the cortical and subcortical areas and showed spotty(n=1), popcornlike(n=2), or gyral(n=1) calcification. The masses were associated with surrounding edema and gliosis. In two patients, lesions were multiple and were accompanied by eccentric cysts.

Conclusion : MA is a surgically correctable benign disease. Its radiologic characteristics are cortical or subcortical mass with various calcifications, associated peripheral edema and gliosis.

Index words : Brain, CT
Brain, MR
Meninges, neoplasms

MA is a rare benign hamartomatous lesion of the cerebral cortex and leptomeninges(1). Grossly and microscopically it is characterized by cortical meningovascular proliferation and leptomeningeal calcification (2), though its pathogenesis is unknown. In almost 50 % of reported cases it was associated with neurofibromatosis(NF)(3). The reported CT findings of MA are various types of calcification with little or no contrast enhancement, or a hypodense round mass in the cortical or leptomeningeal area. In several cases, MR findings have been reported; abnormalities are confined to the cortex and consists of isointensity or hypointensity on T1 weighted images and T2 weighted images show a heterogeneous cortical mass surround by an area of increased intensity due to edema or gliosis(3-5). We describe the characteristic CT and MR findings of MA.

Materials & Methods

We retrospectively reviewed six lesions in four patients with MA. Two were men and two were women, and their ages ranged from 18 to 53 years. Two had a history of seizures, and two had suffered seizures and headaches, but none had a family history or stigmata of NF.

Using a Simens Somatom Plus 4B scanner (Erlangen, Germany), all patients underwent unenhanced and contrast CT; three underwent MR on a Simens 1.0T Magnetom Expert, and on a 0.5T scanner at an outside institution. In three cases, T1(420/14/2, repetition time/echo time/excitations), proton density(2600/22/2) and T2(2600/90/2) weighted spin-echo images were obtained, and in two, gadolinium enhanced T1 weighted images were acquired. All lesions were evaluated for pattern of calcifications, associated cysts with mass, edema, location and extent of enhancement. One patient underwent angiography at an outside institution and all underwent surgery for tumor removal.

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Results

The clinical data and radiologic findings of six lesions in four patients are summarized in Table 1.

On CT scans, all lesions showed calcifications which were pop-cornlike(n=2), spotty(n=1), or gyriform(n=1), and in all, there was edema. In two of the four, eccentric cysts were associated with the calcified mass(Figs 1 & 2). Lesions were located in the cortical and subcortical areas of the frontal(n=1), frontoparietal(n=1), parietal (n=2), temporal(n=1) and temporo-parietal(n=1)

lobes. In two of the three patients who underwent MRI, T2-weighted images showed that the lesions were predominantly high signal intensity with central areas of low signal intensity(Fig. 1D, Fig. 2C); the latter corresponded to the calcifications seen on CT. On T2 weighted images, eccentric cysts, which were of isosignal intensity, with cerebrospinal fluid(CSF), were not clearly identified. On T1 weighted images, the lesions showed heterogeneous signal intensity and cysts were slightly hyperintense relative to cerebrospinal fluid (Fig. 2B). In the third patient, the lesion was intermediate on T1 weighted images, and on T2-weighted image,

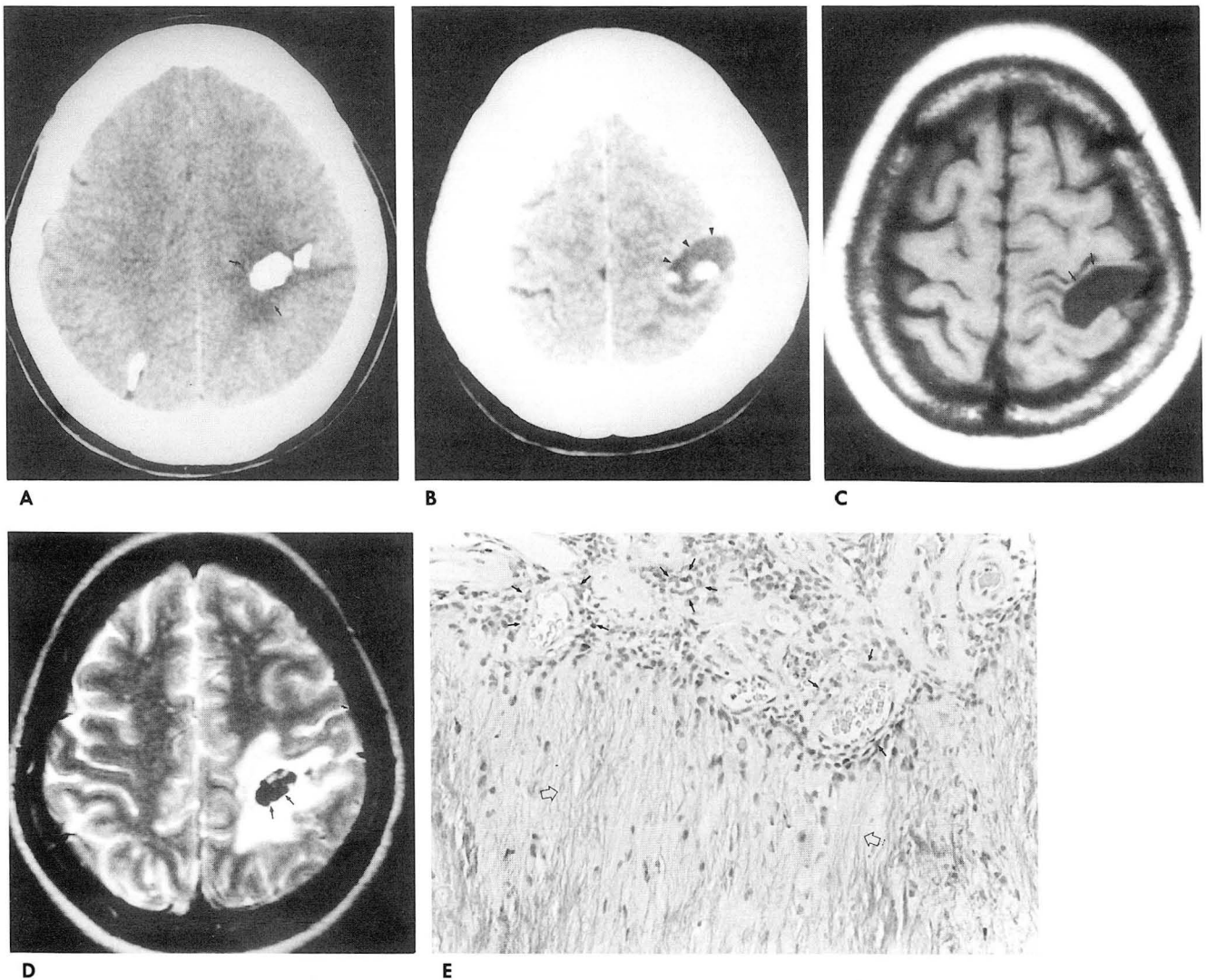


Fig. 1. patient 1

A & B. Precontrast CT scans show multiple popcornlike calcifications and eccentric cyst (arrowheads) with moderate edema (arrows) in left frontoparietal & right parietal lobes.

C. On axial T1 weighted image(420/14/2, repetition time/echo time/excitations), cyst(arrows) shows slightly high signal intensity relative to cerebrospinal fluid.

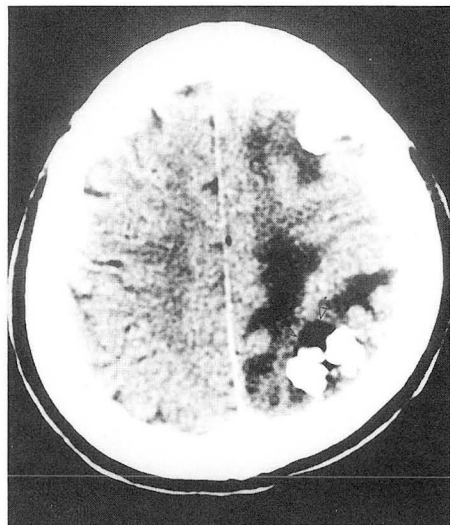
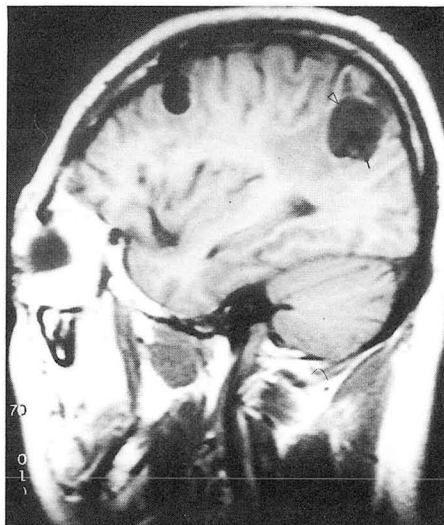
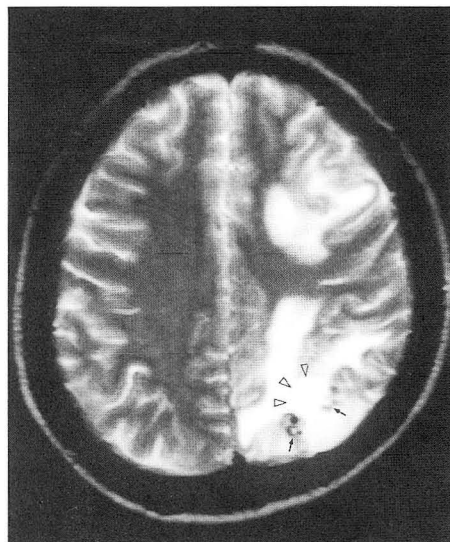
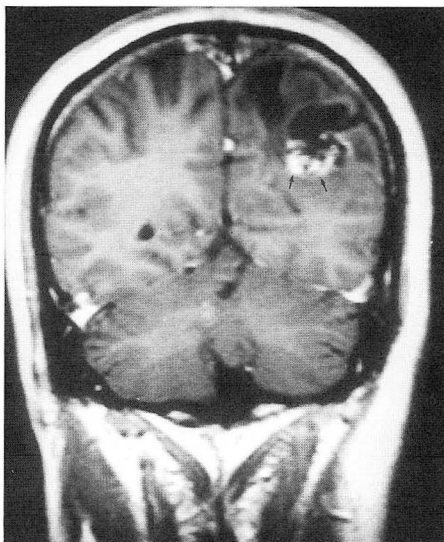
D. On axial T2 weighted image(2600/22/2), the lesions show high signal intensity with central low signal intensity(arrows).

E. Histopathologic specimen shows proliferated blood vessels surrounded by meningiothelial cells (arrows) and fibrillary calcification (open arrows)(Haematoxylin and eosin $\times 100$). The specimen was obtained from the cortex of the left parietal lobe.

Table 1. Clinical Features & Image Findings of Meningiogliomatosis Cases.

Patient No.	Age/sex	Clinical Presentation	Location	CT findings	MR findings
1	47/F	Seizure headache	Lt. fronto-parietal Rt parietal	calcification(+)--multiple, popcornlike cyst(+)--eccentric edema(+), [†] CE(-)	high [‡] SI with central low SI (* T2WI) CE(-)
2	53/M	Seizure headache	Lt frontal Lt parietal	calcification(+)--multiple, popcornlike cyst(+)--eccentric edema(+), CE(-)	high SI with central low SI (T2WI) CE(+)--amorphous
3	21/F	Seizure	Lt. temporal	calcification(+)--spotty cyst(-), edema(+) CE(+)--nodular	high SI(T2WI) CE(+)--nodular & leptomeningeal
4	18/M	Seizure	Rt. temporo -parietal	calcification(+)--cortical gyral syst(-), edema(+), CE--not performed	Not performed

* T2WI—T2 weighted image, [†] CE—contrast enhancement, [‡] SI—signal intensity, [§] Lt=left, Rt=right
In post-operative follow-up 15(case 1), seven(case 2), 24(case 3), six(case 4) months, seizures were free in all patients.

**A****B****C****D****Fig. 2.** patient 2

A. Precontrast CT scan reveals multiple popcornlike calcifications with eccentric cyst (open arrowheads) and moderate edema.

B. On sagittal T1 weighted image (420/14/2), lesions show inhomogeneous hypo-(arrow) and intermediate signal (open arrowhead) intensities in left frontal & left parietal lobes.

C. On axial T2 weighted image(2600/90/2), heterogenous signal intensities were noted in left frontal & parietal lobes due to calcifications(arrows), cyst (open arrowheads) and edema.

D. On coronal Gd-enhanced T1 weighted image(420/14/2), lesion (posterior mass) shows amorphous enhancement(arrows).

homogeneous high signal intensity. On Gd-DTPA-enhanced T1-weighted images, enhancement was observed in two of three cases. One lesion showed amorphous enhancement(Fig. 2D), and in the other, enhancement was cortical and leptomeningeal(Fig. 3D). In one patient, angiography was performed and the finding was normal.

Histopathologically the lesions showed extensive fibrillary calcification and a proliferation of vessels surrounded by meningotheial cells(Fig. 1E).

Discussion

MA is a rare benign disorder characterized by hallmarks of meningioma and angioma(6). The tumor grows very slowly(7) and has rarely been reported in the literature in English(1 — 18). It mostly affects children and young adults and was first described by

Bassae and Nuzum in 1915 as an incidental autopsy finding in a 15-year boy; it was first named by Worster-Drought et al in 1937(1, 6). Seizures and headaches are the most common symptoms(2), and in nearly 50% of reported cases it is associated with NF; a review of the literature suggests that its association with NF2 is stronger than with NF1(9, 10).

Though its pathogenesis is unknown, three possible theories have been suggested(11). The lesions could be hamartoma, they could be secondary to direct invasion of brain tissue from a leptomeningeal meningioma, or could represent a vascular malformation.

The characteristics of MA are leptomenigeal calcification and meningovascular proliferation interwoven with fibrous connective tissue bands(12). Its pathologic criteria may be summarized as follows: leptomeningeal proliferation of nodules, whorls or bands of meningotheial (i.e. arachnoidal cap) cells exhibiting

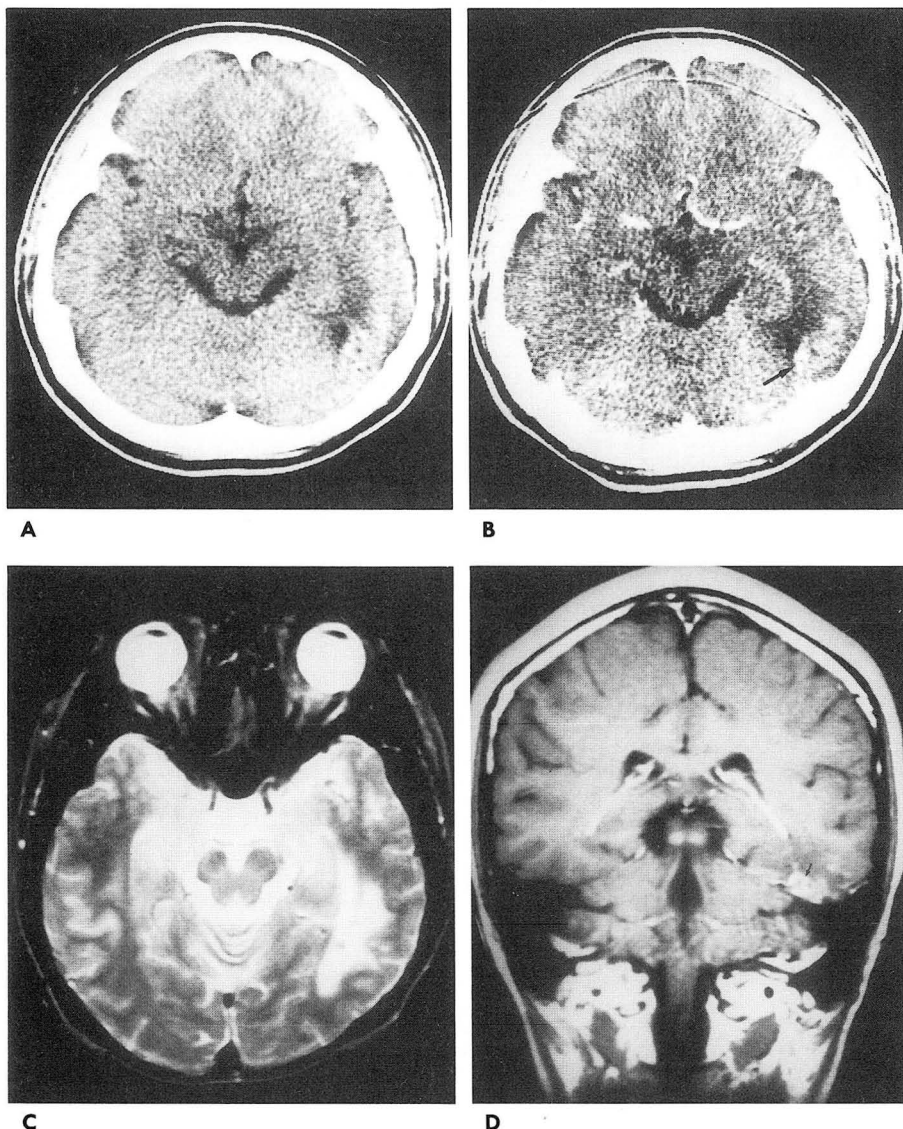


Fig. 3. patient 3

A. On precontrast CT scan, mottled high densities with edema are noted in left posterior temporal lobe

B. Postcontrast enhanced CT scans show nodular enhancement of the lesion(large arrow).

C. On axial T2 weighted image(2600/90/2), homogenous high signal is noted in left temporal lobe.

D. On coronal Gd-DTPA T1 weighted image(420/14/2), lesions show nodular & leptomeningeal enhancement (arrow) in left temporal lobe.

marked degenerative reactions such as calcification, fibrocartilage or bone formation in association with sharply demarcated intracortical plaques of proliferating small vessels and perivascular cuffs of spindle shaped fibroblast-like cells(6). Calcification patterns vary from faint psammomatous to dense osteoid(7). MA affects the cerebral cortex in 90% of cases and usually occurs in the frontal or temporal lobes; in the third ventricle, thalamus, cerebral peduncles(2), and brain stem(13) it is rare. In our cases, lesions were present in all lobes of the brain, and frequency did not vary according to location. An association with meningioma or oligodendroglioma has occasionally been reported(14, 15).

Although multifocal lesions have been described, MA usually involves well-demarcated solitary lesions (2, 14). Multiple lesions and associated cysts have not, though, been described on CT scan and/or MR images. We experienced six lesions in four patients with MA. In two of the four, the lesions were multifocal and associated with an eccentric cyst. At craniotomies, all lesions were well demarcated and superficially located. The masses were composed of popcorn-like, spotty, gyrated calcification, and in two cases, eccentric cysts were noted in the subarachnoid space. We think that the mechanism of extratumoral cyst formation is same as that of cystic meningioma. Wasenko JJ et al(17) suggest the cyst may form as the result of a ball valve mechanism with the gradual accumulation of cerebrospinal fluid in several sulci between the tumor and brain parenchyma. Our patients were older than most reported cases, and had no stigmata or family history of NF. We thought that our MA may be sporadic rather than associated with NF-2.

MA is always benign(5), and because total surgical removal is the treatment of choice and the prognosis after surgery is most cases excellent, accurate diagnosis is important. Differential diagnosis of radiologic images include meningioma, oligodendroglioma, granularomatous meningitis and parasitic diseases. However, radiologic characteristics are non-specific and differential diagnosis is not easy(10, 18).

In conclusion, MA is a benign cerebral lesion and may be seen in patients with or without NF. Its CT and MR characteristics are a cortical or subcortical mass with various calcifications and peripheral edema or gliosis, and it is usually a solitary lesion. Multifocal lesions and associated cyst formation may, however, be seen.

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수막혈관종증의 CT 및 MR소견¹

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목 적 : 수막혈관종(meningioangiomatosis 이하 MA로 약함)의 CT 및 MR소견을 알아보고자 하였다.

대상 및 방법 : 4명(18-53세, 남자 1명, 여자 3명)의 MA환자를 대상으로 후향적으로 CT(n=4), MR(n=3)소견을 분석 하였고, 모든 환자에서 병리조직 소견을 얻었다.

결 과 : 모든 병변은, 피질 및 피질하부에 위치하였고, 다양한 석회화[spotty(n=1), popcornlike(n=2), gyr-al(n=1)]와 병변과 동반되어 부종과 신경교증을 보여 주었다. 두명의 환자에서 병변은 다발성으로 나타났고 편심낭종(eccentric cyst)이 동반 되었다.

결 론 : MA는 수술로서 치료가 가능한 양성질환으로 방사선학적 소견은 병변이 피질과 피질하부위에 위치하며 다양한 석회화와 동반된 부종과 신경교증이 특징이었다.