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MR of Vascular Encasement in Parasellar Masses: Comparison with Angiography and CT

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The relationship between tumor mass and vascular involvement as seen on MR imaging was examined in 11 patients with masses in the parasellar region, and the findings were correlated with CT and angiography. In six cases, MR was superior to CT and angiography in depicting the relationship of the tumor to adjacent blood vessels. In these cases, MR demonstrated tumor surrounding the blood vessel without changing the diameter of its lumen. Angiography did not reveal encasement in these cases. In four cases, both MR and angiography showed signs of vascular encasement with narrowing of the vessel's lumen. In two cases, MR was equivocal while angiography revealed vascular encasement in one case and was negative for encasement in the other. CT was less sensitive than MR in defining vascular encasement since there is usually little contrast between an enhancing tumor and the major blood vessels. Coronal scanning appeared to be the best plane of imaging and correlated well with the anteroposterior angiogram.

We propose that MR is the method of choice for evaluating arterial encasement by tumors and may obviate the need for angiography in those cases in which MR is positive for a basal lesion.

With a spin-echo technique, blood vessels with flowing blood appear on MR as curvilinear structures with a signal flow void [1-3]. The absence of signal adjacent to the relatively high intensity of brain parenchyma and/or tumor mass enables vasculature to be discerned on MR images because of the inherent contrast. In patients with intracranial neoplasms, angiography is often performed not only to assess the vascularity of the tumor but to evaluate whether there is vascular encasement; that is, whether the blood vessels are surrounded by tumor [4]. Demonstration of encasement would alter the management of the patient as far as surgical approach, and usually renders the lesion nonresectable. The purpose of this study is to assess the usefulness of MR, compared with angiography and CT, in evaluating vascular encasement.

Materials and Methods

A retrospective study of 11 patients with tumors or masses involving the parasellar region was conducted by evaluating MR, angiographic, and CT findings. The criteria for inclusion in this study were that the subjects had been imaged by all three techniques and that the studies on each technique were performed within 2 weeks of one another. Patients were included only if the MR was positive for a basal lesion and there was a suspicion of vascular encasement on MR, CT, or angiography.

All patients were scanned on a 1.5-T GE Signa unit using spin-echo techniques with the head coil. Short spin-echo pulse sequences with a repetition time (TR) of 600 msec and echo delay time (TE) of 20-25 msec were used to obtain images in the sagittal plane on all patients, in the axial plane on two patients, and in the coronal plane on six patients. The section thickness of the sagittal images was 5 mm with an intersection gap of 2.5 mm. The axial and coronal images were also acquired with the above parameters except in three patients in whom 3-mm contiguous sections were used. Long TR pulse sequence images with a TR of

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2000–2500 msec and TEs of 30–40 and 80 msec were obtained in the coronal plane on all patients and in the axial plane on four patients. All long TR sequences were imaged with a section thickness of 5 mm and intersection gap of 2.5 mm.

In addition to the short TR sagittal and long TR coronal images that were obtained in all patients, the short TR coronal pulse sequences were acquired when the monitoring radiologist wanted further delineation of the anatomy, and the long TR axial pulse sequences were obtained only if time allowed.

Cerebral angiograms were obtained with conventional biplane film technique whereby the intracranial circulation was studied bilaterally in all patients, with injections into the common or internal carotid arteries.

CT was performed on a GE 9800 scanner with 3- or 5-mm sections through the region of the sella with axial and/or direct coronal images. All patients received a rapid bolus of IV contrast with 28.2 g I over 30–60 sec. Regular CT scanning (nondynamic) proceeded immediately after the injection.

Results

Eleven patients (five men and six women) ranging in age from 26–66 years had the following pathologically verified lesions: meningioma (seven patients), chordoma (one patient), trigeminal neuroma (one patient), actinomycotic cavernous

sinus infection (one patient), and chondrochordoma (one patient). The results were grouped into three categories on the basis of MR and angiographic findings. In category 1 (six patients) MR showed lesions surrounding a vessel (vascular encasement) whereas angiography revealed no definite evidence of vascular encasement (Fig. 1). Category 2 (four patients) included cases in which angiography and MR both revealed vascular encasement (Fig. 2). Category 3 consisted of two patients in which MR was equivocal for vascular encasement. Angiography was positive in one (Fig. 3) and negative in one. One case belonged to both categories 1 and 2, since it involved both cavernous sinuses, with the left side showing category 1 findings and the right side category 2 findings. Independent readings of the angiograms corresponded with our observations in all cases except one in category 2. In this case, we detected luminal narrowing on the angiogram whereas the independent reader did not.

CT was not helpful in evaluating for vascular encasement. In only one case could a tumor mass be clearly seen to surround a blood vessel (Fig. 1E). In one other case a blood vessel could be traced into the mass (Fig. 4). However, its course within the mass was not discernible, since both the vessel and the tumor enhanced to the same degree so that there was no contrast between them. In the other nine cases,

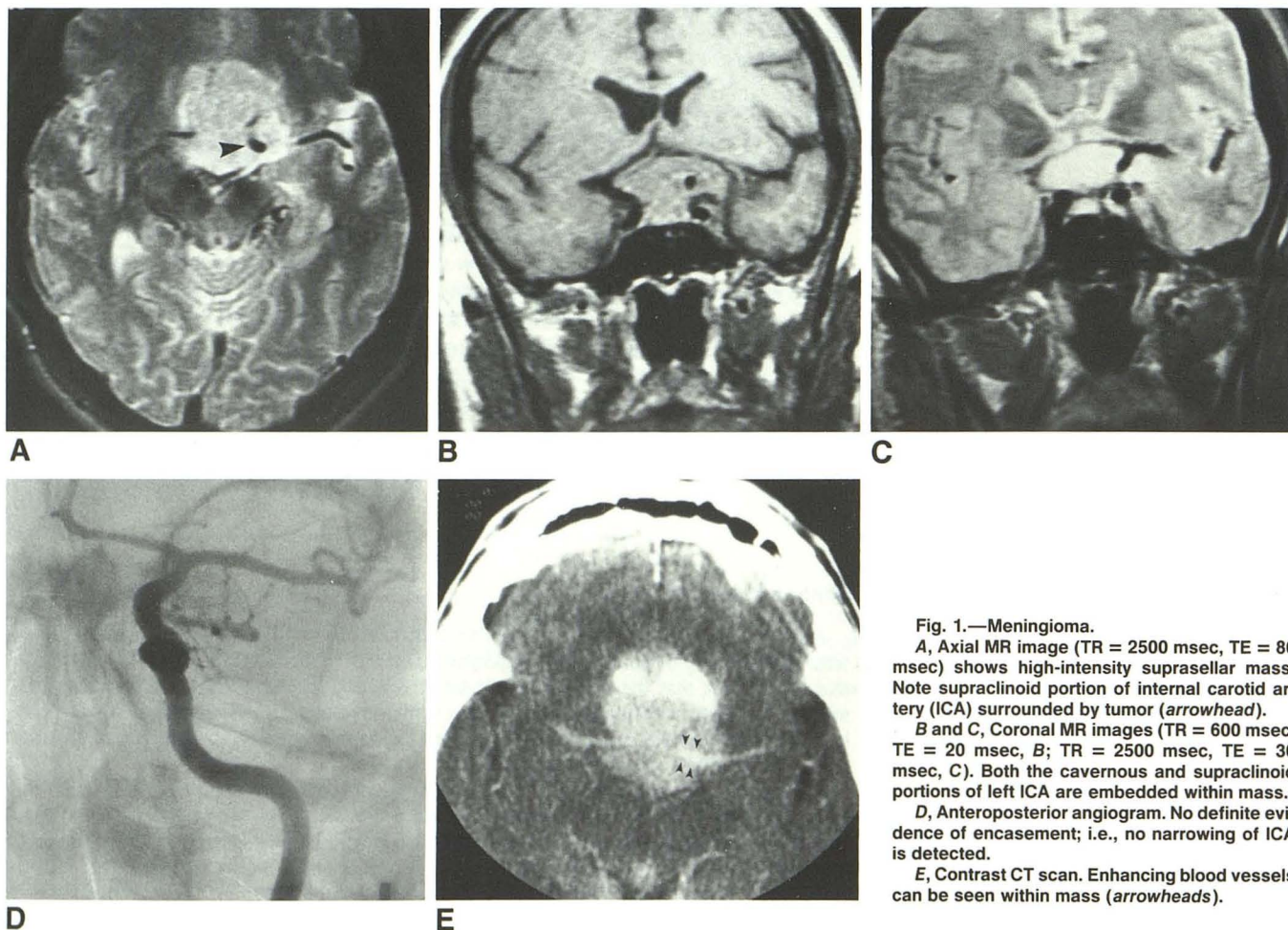


Fig. 1.—Meningioma.

A, Axial MR image (TR = 2500 msec, TE = 80 msec) shows high-intensity suprasellar mass. Note supraclinoid portion of internal carotid artery (ICA) surrounded by tumor (arrowhead).

B and C, Coronal MR images (TR = 600 msec, TE = 20 msec, B; TR = 2500 msec, TE = 30 msec, C). Both the cavernous and supraclinoid portions of left ICA are embedded within mass.

D, Anteroposterior angiogram. No definite evidence of encasement; i.e., no narrowing of ICA is detected.

E, Contrast CT scan. Enhancing blood vessels can be seen within mass (arrowheads).

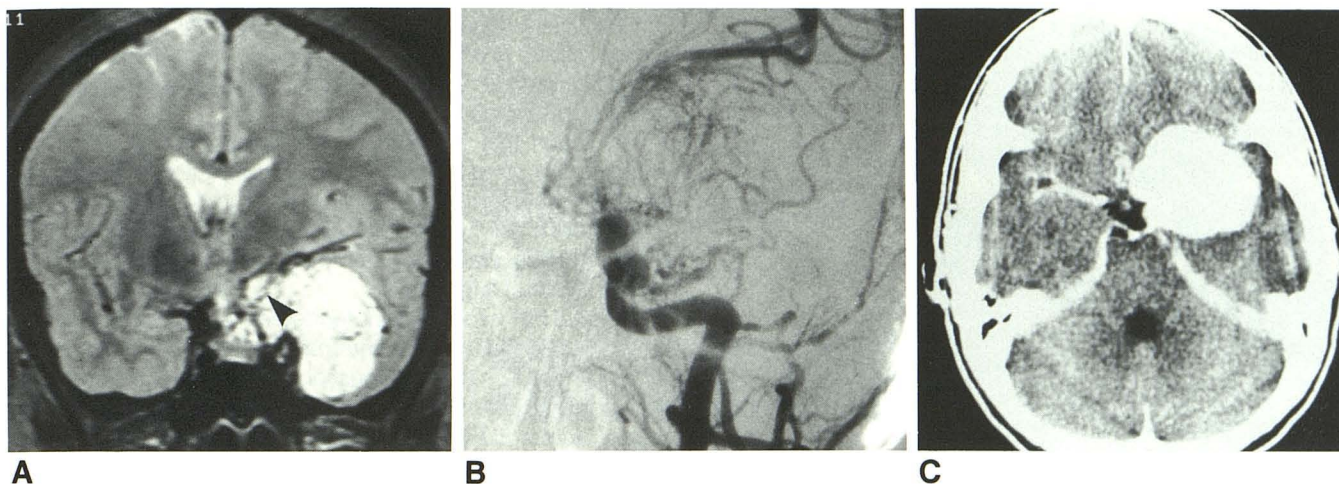


Fig. 2.—Meningioma.

A, Coronal MR image (TR = 2500 msec, TE = 80 msec). M1 segment of middle cerebral artery (MCA) (arrowhead) is surrounded and narrowed by tumor. Note enlargement of striate arteries, which is confirmed on arteriogram.

B, Anteroposterior angiogram. Supraclinoid internal carotid artery (ICA) and proximal MCA are markedly narrowed.

C, Contrast CT scan. Large mass enhances densely; vessels within it cannot be distinguished from mass.

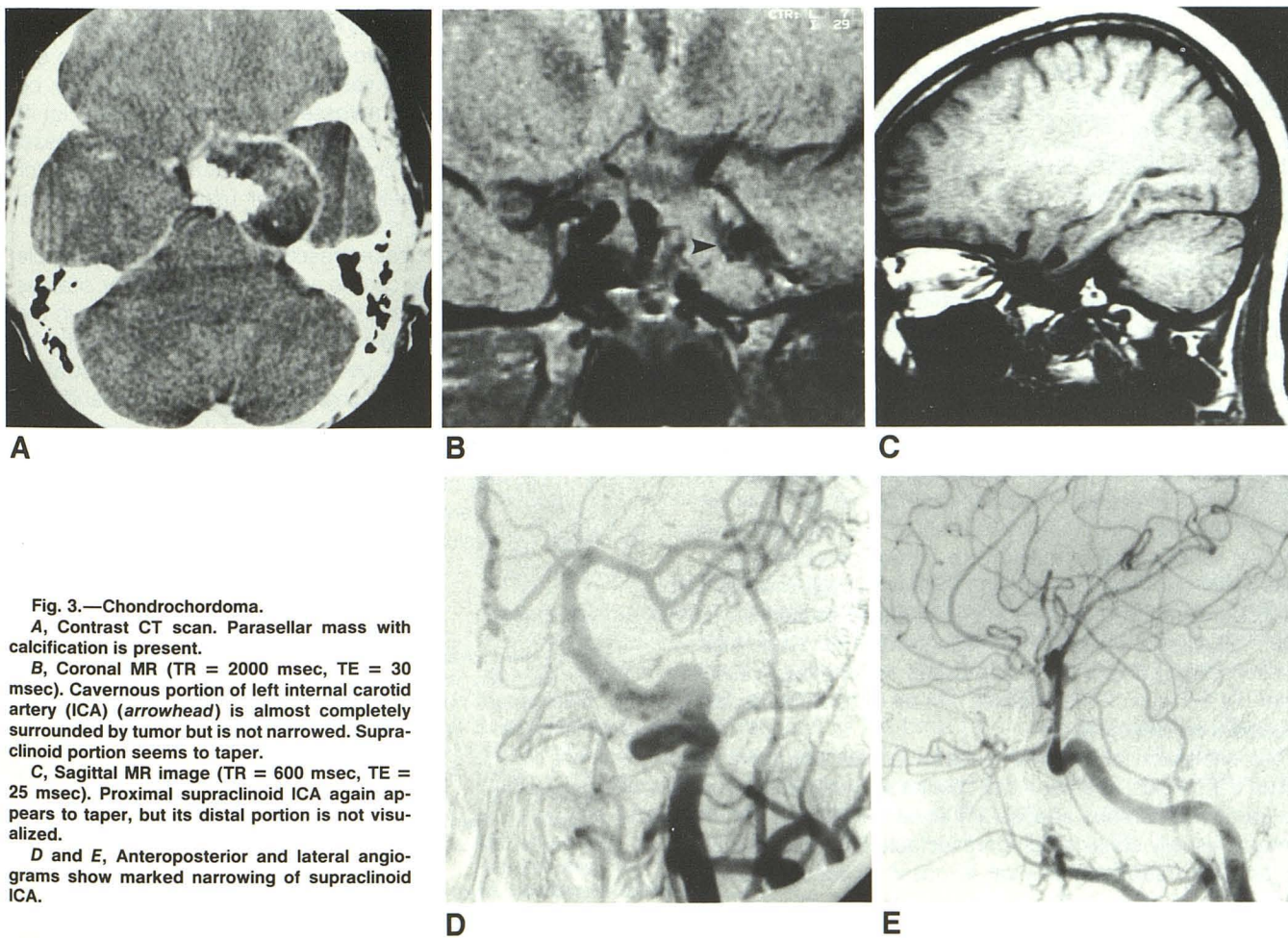


Fig. 3.—Chondrochordoma.

A, Contrast CT scan. Parasellar mass with calcification is present.

B, Coronal MR (TR = 2000 msec, TE = 30 msec). Cavernous portion of left internal carotid artery (ICA) (arrowhead) is almost completely surrounded by tumor but is not narrowed. Supraclinoid portion seems to taper.

C, Sagittal MR image (TR = 600 msec, TE = 25 msec). Proximal supraclinoid ICA again appears to taper, but its distal portion is not visualized.

D and E, Anteroposterior and lateral angiograms show marked narrowing of supraclinoid ICA.

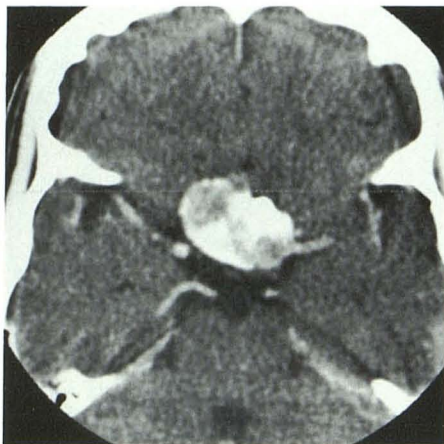


Fig. 4.—Meningioma. Contrast CT scan shows that blood vessel can be traced to mass but its course within mass cannot be seen.

one could not see the blood vessel at all either within or adjacent to the mass (Fig. 2C). Vascular encasement in these cases could only be inferred on the basis of the location of the mass, the region through which a vessel ought to pass.

Discussion

Intracranial neoplasms or masses may completely encircle contiguous vascular structures, especially in the perisellar region. This situation is defined as vascular encasement [4, 5]. On angiography, this can be inferred only if the mass narrows the diameter of the vessel's lumen. If the lumen is not compromised, angiography may indicate the presence of a mass but will fail to detect encasement. Thus, angiography is an indirect way of looking at the relationship of tumor masses to blood vessels.

On MR, rapidly flowing blood within arteries gives a signal void. This is because protons do not remain within the selected slice long enough to experience the initial 90° pulse and a subsequent 180° pulse to produce a spin echo [1–3]. Vasculature is usually seen well on MR by virtue of the inherent contrast in intensity between it and the adjacent tissues that have higher signal intensity. Unlike angiography, MR provides direct visualization of tumor masses or inflammatory lesions, and their relationship to the adjacent blood vessels, which possess a flow void, can be depicted well.

In six of our cases (category 1), vessels were seen to be encircled by tumor mass on MR in all pulse sequences but not in all planes, whereas the angiograms showed no signs of encasement (Fig. 1). In these cases the encased vessels were not narrowed. These cases can be considered as false negatives on angiography.

Demonstration of vascular encasement is important because the surgical approach can be altered. When the carotid and/or middle cerebral arteries are embedded in a tumor, the tumor is usually considered nonresectable and only palliative surgery with subtotal removal is possible because of the growth of the tumor around these vessels and into the base of the skull [4–6]. Thus, in the patients in category 1, management might have been different if only angiography and

CT had been done. Presurgical evaluation with MR in these cases greatly enhanced the surgeons' understanding of the relationship of the tumor to adjacent blood vessels and helped them plan their surgical approach.

We found that the coronal plane was the best plane for imaging the parasellar region on MR, and it correlated well with the anteroposterior angiogram. The sagittal and axial planes were helpful in some cases depending on the configuration of the mass. Sagittal images sometimes correlated with the lateral angiogram.

Coronal MR was excellent for detecting encasement of the cavernous portion of the internal carotid artery because it was seen end-on in the coronal plane. However, the proximal anterior and middle cerebral arteries and sometimes the supraclinoid carotid were not always well seen (Fig. 3). Failure to visualize a particular segment of a vessel may be due to either absence of lumen from vascular encasement or the natural course of the vessel going out of the plane of section. In these cases, scanning with thinner sections and more inclusive scanning may be useful. Most of our studies were performed with 5-mm thick sections, with 2.5-mm intervals between slices. In a few studies, 3-mm contiguous sections seemed to give better definition of the anatomy.

CT was not very helpful in defining the vasculature. The amount of enhancement depended on the quality of the bolus injection, and the adjacent tumors were usually densely enhancing such that there was little or no contrast between the tumor and the adjacent blood vessels, which were also enhanced (Fig. 2C). Thus, vascular encasement can only be inferred if one can trace a vessel into a tumor mass (Fig. 4) or if the tumor seems to occupy the region in which a vessel ought to be situated. Dynamic CT scanning is useful for delineating blood vessels but is not usually considered a primary technique and is somewhat more cumbersome.

Since tumors can encase vessels in any organ, the principle illustrated in this study can be applied to other body sites as well. Therefore, in evaluating tumors on MR anywhere in the body, one should try to visualize the vessels in relationship to the mass. MR appears to be more sensitive in demonstrating vascular encasement than angiography and CT. Its ability to image in multiple planes and the fact that it is noninvasive are also advantageous. The demonstration of vascular encasement on MR may obviate angiography in those cases in which it is positive. Therefore, we recommend MR as the method of choice for evaluating lesions with a potential for vascular encasement.

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