# Gd-DTPA in Clinical MR of the Brain: 2. Extraaxial Lesions and Normal Structures

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*AJNR Am J Neuroradiol* 1986, 7 (5) 789-793
http://www.ajnr.org/content/7/5/789

# Gd-DTPA in Clinical MR of the Brain: 2. Extraaxial Lesions and Normal Structures

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**Fifteen patients with suspected extraaxial tumors were evaluated with MR before and after intravenous injection of Gadolinium-DTPA (Gd-DTPA). Meningiomas (7), neurinomas (4), chordomas (2), a previously irradiated dural metastasis, and a giant aneurysm were studied. All the lesions except the dural metastasis enhanced. In two patients with asymptomatic meningiomas, the use of Gd-DTPA with MR allowed definitive diagnosis of the lesions when the routine MR did not. Gd-DTPA also provided improved definition of intracranial tumor margins, produced differential enhancement of dura and nasopharyngeal mucosa from tumor, and caused enhancement of the choroid plexus, some venous structures, the pituitary gland, and its stalk. The enhancement of the pituitary suggests a role for Gd-DTPA in the diagnosis of microadenomas. Routine T2-weighted images without Gd-DTPA were useful in differentiating neurinomas from meningiomas. Judicious use of Gd-DTPA should improve the ability of MR to detect extraaxial lesions, delineate their extent, and characterize their perfusion.**

Extraaxial lesions offer a different challenge for MR than do intraaxial ones. Their location on the periphery of the brain—and therefore the edges of an axial section—makes them less conspicuous and subject to partial volume averaging with CSF. These lesions may be calcified (e.g., meningioma) or they may possess tissue with signal characteristics similar to normal brain (e.g., neurinoma). Both factors can contribute to making their MR signal similar to normal brain parenchyma. Indeed, problems with the identification of extraaxial lesions on routine MR have been encountered [1–3]. Unlike the brain, however, these extraaxial lesions lack a blood-brain barrier (BBB). Therefore, most of them should be ideal candidates for enhancement with a paramagnetic contrast agent such as Gd-DTPA [4]. The evaluation of this agent for this purpose is the topic of our study. Because such tumors often abut the normal brain, meninges, and even the nasopharynx, the enhancement characteristics of these structures are also briefly considered.

## Subjects and Methods

A total of 15 patients form the basis of this study. Their lesions consisted of meningioma (7), neurinoma (4), chordoma (2), dural metastasis from prostate primary (1), and giant cavernous aneurysm (1). All the solid tumors were verified histologically; the aneurysm by angiography.

The patient selection criteria, MR sequences, and dose of Gd-DTPA delivered were the same as those described in the preceding article [5]. The same sequential acquisition of long (2000 msec) and short (500 msec) TR sequences was performed. It is notable that five of the seven patients with meningioma were specifically referred for the MR study by their clinicians because of the difficulty in delineating the lesion with CT based on location (e.g., foramen magnum).

Regions of interest were defined within the lesions, and the intensity values obtained were used for quantitative analysis of relaxation effects, the topic of a previous report [6]. Visible enhancement of the lesions was scored on a 0–2 basis by experienced observers (IB, MBZ):

**This article appears in the September/October 1986 issue of *AJNR* and the December 1986 issue of *AJR*.**

Received December 20, 1985; accepted after revision April 2, 1986.

Presented at the American Society of Neuroradiology, San Diego, CA, January 1986.

This work was supported in part by Berlex Laboratories, New Jersey.

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***AJNR* 7:789–793, September/October 1986**
0195–6108/86/0705–0789

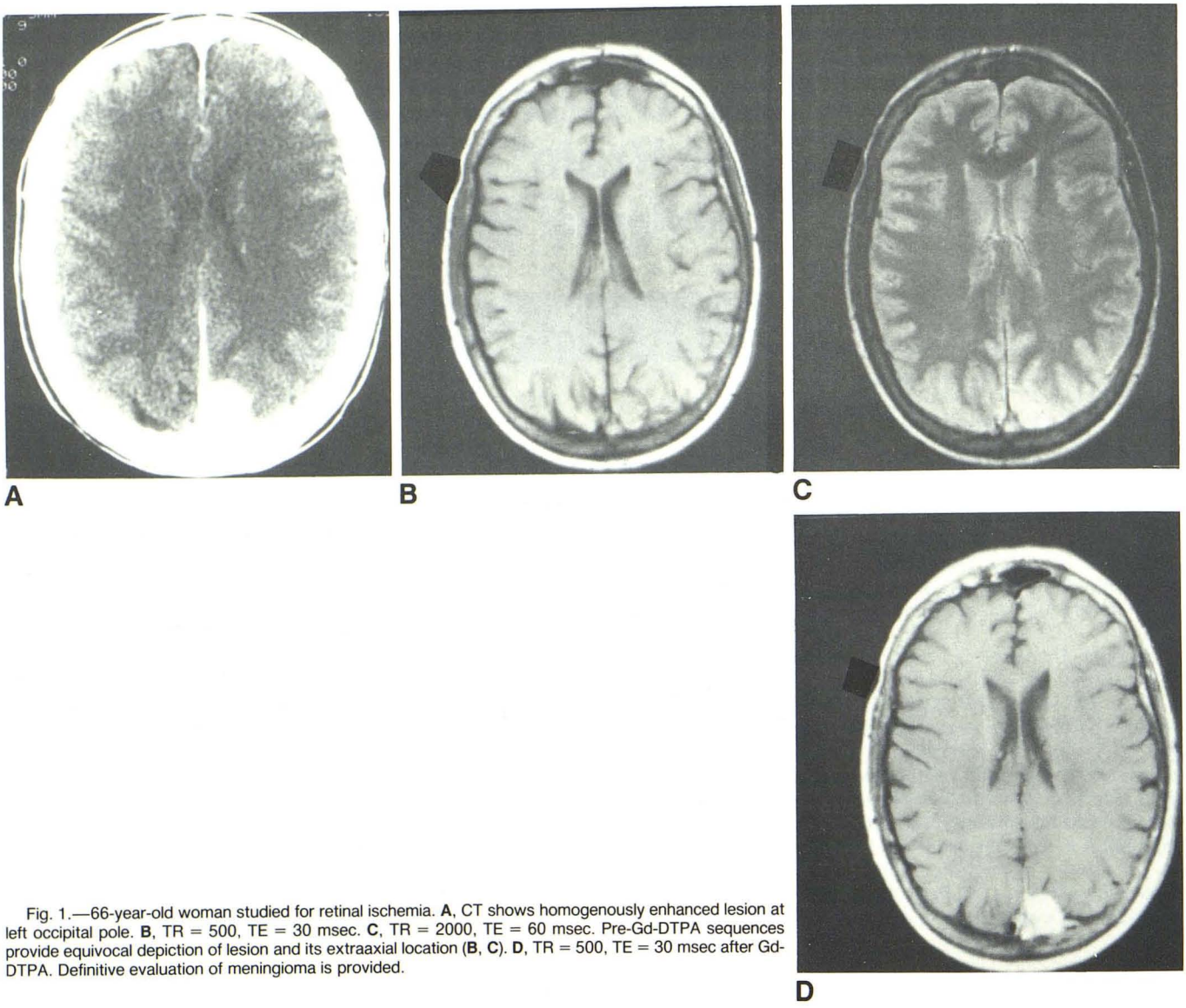


Fig. 1.—66-year-old woman studied for retinal ischemia. **A**, CT shows homogenously enhanced lesion at left occipital pole. **B**, TR = 500, TE = 30 msec. **C**, TR = 2000, TE = 60 msec. Pre-Gd-DTPA sequences provide equivocal depiction of lesion and its extraaxial location (**B**, **C**). **D**, TR = 500, TE = 30 msec after Gd-DTPA. Definitive evaluation of meningioma is provided.

0 = no enhancement, 1 = equivocal enhancement (detected only if the pre-Gd-DTPA image was available for side-by-side comparison), and 2 = definite enhancement. Normal structures that were included in the analysis included large arteries, veins, dura, gray and white matter, pituitary stalk and gland, choroid plexus, and nasopharyngeal mucosa.

## Results

Enhancement with Gd-DTPA was noticeable in all but one of these lesions and was best seen on the initial short TR (T1-weighted) sequence obtained after Gd-DTPA. The one exception was a nonenhancing dural metastasis in a patient who had undergone whole cranium radiation (3000 rad) for bone involvement by metastases from prostate carcinoma.

Enhancement with Gd-DTPA improved the conspicuousness of all the meningiomas and, in two patients, allowed the definitive diagnosis to be made (Fig. 1). In both patients, the lesions were asymptomatic and discovered incidentially on CT done for other reasons. The routine MR images before contrast did not provide reliable identification of the lesion in one patient, and were not definitive of an extraaxial lesion in the other. Following Gd-DTPA, the homogenous enhancement of the lesions, their extraaxial location, and broad dural base were easily seen.

Unlike CT, MR allowed enhancement of the meningiomas, while arteries coursing through the lesions or adjacent to them did not enhance. Therefore, MR provided better anatomic information for the surgeon (Fig. 2). The normal dura enhanced and washed out quickly, but meningiomas retained their enhancement longer. This allowed differentiation of a small meningioma of the planum sphenoidal from the surrounding dura in a patient with visual loss (Fig. 3). Finally, after Gd-DTPA, the margins of several of the meningiomas

(corresponding to the capsule seen at surgery) exhibited a hyperintense appearance when compared with the body of the tumor.

All the neurinomas were easy to identify as high-intensity foci on the routine T2-weighted images before Gd-DTPA. In all cases their enhancement with the agent contributed little to the diagnosis. In the cases of chordoma, their high intensity on T2-weighted images before Gd-DTPA and their prominent early enhancement made differentiation of their margins from adjacent nasopharyngeal mucosa difficult. The mucosa faded on subsequent images, however, while the chordoma's enhanced intensity persisted (Fig. 4). Also of interest was the

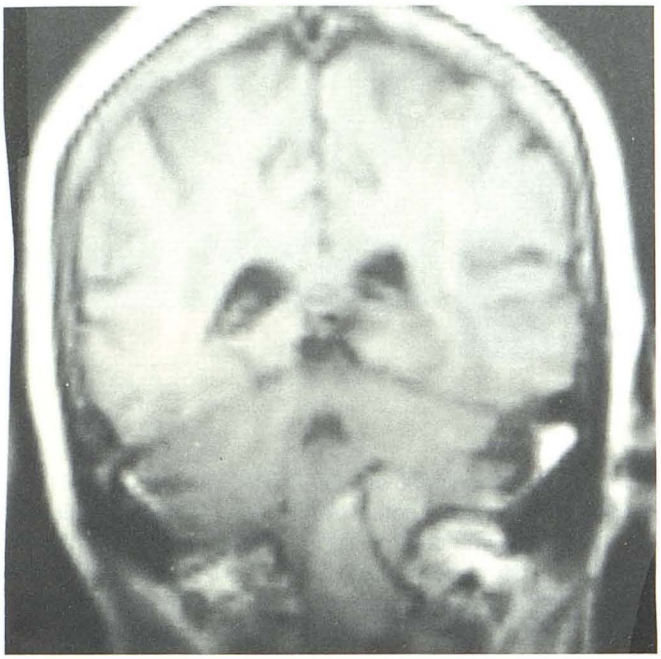

Fig. 2.—67-year-old woman with meningioma of foramen magnum. MR image (TR = 500, TE = 30 msec) after Gd-DTPA shows enhancing lesion, with vertebral artery within it seen because of signal void from rapid flow.

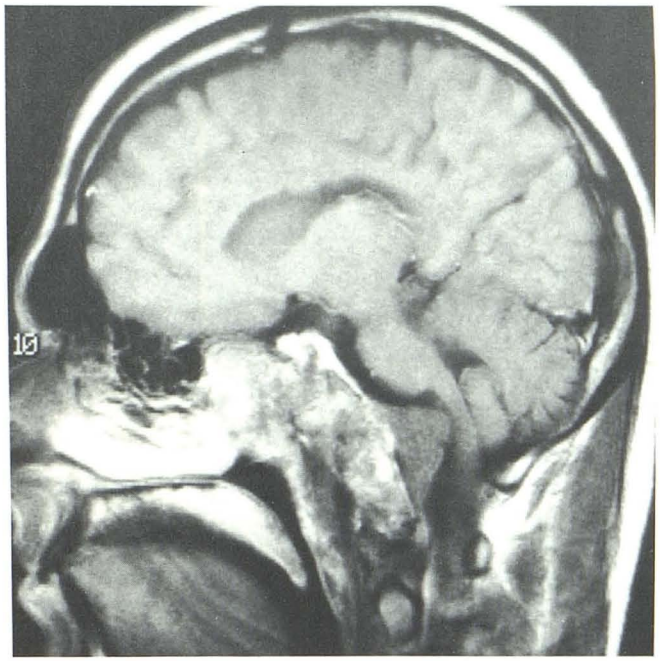


Fig. 4.—20-year-old man with chordoma of clivus. MR (TR = 500, TE = 30 msec) immediately after Gd-DTPA delineates tumor within nasopharynx. Note lesser intensity of intracranial component. Pituitary gland and basilar venous plexus enhance markedly on this early sequence, as does nasopharyngeal mucosa.

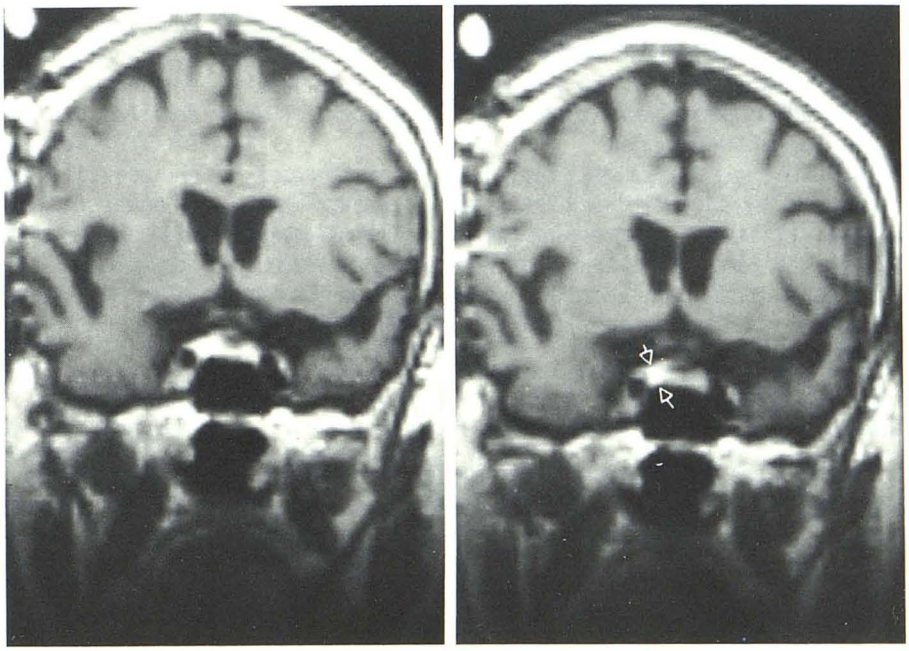


Fig. 3.—70-year-old woman with visual loss in right eye due to meningioma of planum sphenoidal. **A, B,** TR = 500, TE = 30 msec. Sequences obtained 5 and 45 min after Gd-DTPA. Small meningioma (*arrows*) retains contrast agent longer than dura of cavernous sinus.

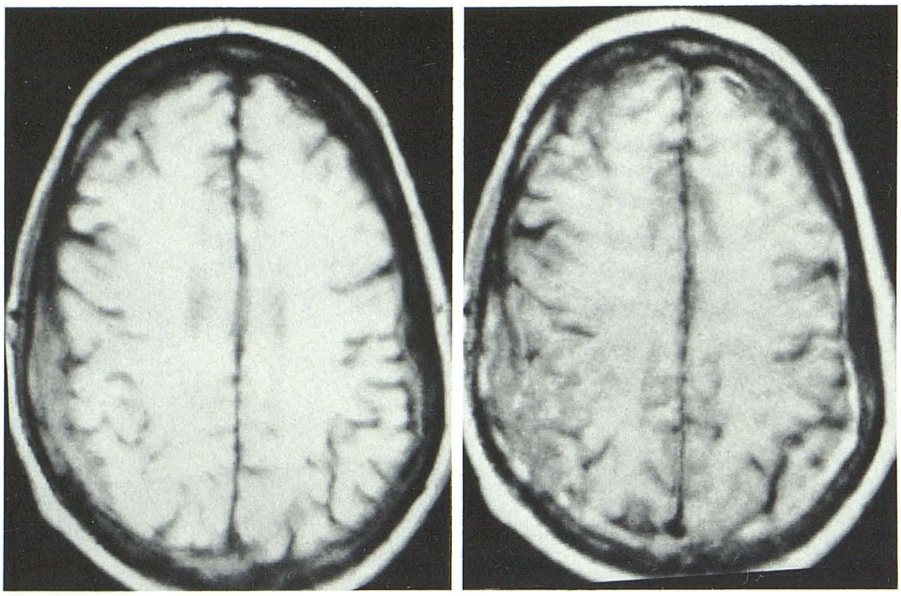

Fig. 5.—58-year-old man previously treated (3000 rad) for metastases to cranial vault from prostatic carcinoma. **A**, TR = 500, TE = 30 msec. **B**, TR = 500, TE = 30 msec after Gd-DTPA. Extraaxial mass is seen in high, right parietal convexity with no definite enhancement of mass itself; note dural and leptomeningeal enhancement.

one chordoma's intracranial component that was less enhanced than its extracranial portion.

The lack of definite enhancement of the dural metastasis (Fig. 5). was probably due to the patient's previous radiation therapy, which may have affected the vascularity of the dura. The lesion was hyperdense on CT before iodinated contrast, showed no obvious enhancement after contrast, and appeared relatively low in intensity on pre-Gd-DTPA MR sequences. A densely fibrotic, thickened region of dura infiltrated with prostatic carcinoma was found at autopsy 1 month later.

Finally, MR helped define a partially thrombosed, giant, cavernous aneurysm (Fig. 6), thought possibly to represent a parasellar meningioma on CT. Gd-DTPA added no diagnostic information, but did enhance slow component of flow in the lumen as well as the thrombus (presumably due to recanalized channels with slow flow). The slowed flow could be defined on the basis of second-echo rephasing [7] prior to Gd-DTPA on the T2-weighted images.

Of interest was the lack of visible enhancement of the gray or white matter, although the pituitary stalk and gland showed a prominent increase in signal after Gd-DTPA. Slowly flowing blood in veins and dural sinuses exhibited varying degrees of enhancement, as did the choroid plexus; all these structures enhanced early and washed out on the subsequent sequences.

## Discussion

The difficulties encountered in identifying meningiomas with MR relate to several factors: small size, plaquelike configuration, and relatively isointense characteristics on routine sequences. These may all contribute to the nondiagnostic appearance of these lesions. On the other hand, their usually typical vascularity and lack of a BBB make meningiomas ideal lesions for enhancement with Gd-DTPA. The role of Gd-DTPA in this context needs some clarification. Most meningiomas that produce symptoms or signs of mass effect on adjacent brain will readily be recognized on routine MR images because of the anatomic distortion produced, if not by altered signal characteristics. However, when characteristic symptoms of visual loss, cavernous sinus involvement, or lower cranial nerve dysfunction suggest a planum sphenoidal, parasellar, or foramen magnum lesion, Gd-DTPA should be used routinely. Appropriate timing of the study may be necessary to separate small lesions from adjacent dura.

Neurinomas did not require Gd-DTPA for definitive evaluation in our series. However, no solely intracanalicular lesion was included. Whether Gd-DTPA will aid the identification of such small tumors remains to be seen. The similar degree of enhancement of meningiomas and neurinomas with Gd-DTPA abolishes their distinctly different intensity features on pre-Gd-DTPA T2-weighted sequences. Neurinomas routinely showed high intensity on such sequences, whereas meningiomas do so rarely in our experience, and none of the ones in this series exhibited such intensity. Finally, the limited experience described suggests other important aspects of Gd-DTPA. The potential value of Gd-DTPA in differentiating nasopharyngeal neoplasms is suggested by the rapid enhancement and washout of normal tissue in this region and the temporally differential enhancement of the chordoma invading it.

The enhancement of the normal pituitary suggests a role for Gd-DTPA similar to that of iodinated agents with CT in diagnosing microadenomas. The lack of enhancement of normal gray matter and normal arterial structures is a relative, albeit minor, shortcoming. Further experience with Gd-DTPA is needed before its complementary role to routine MR can be fully defined.

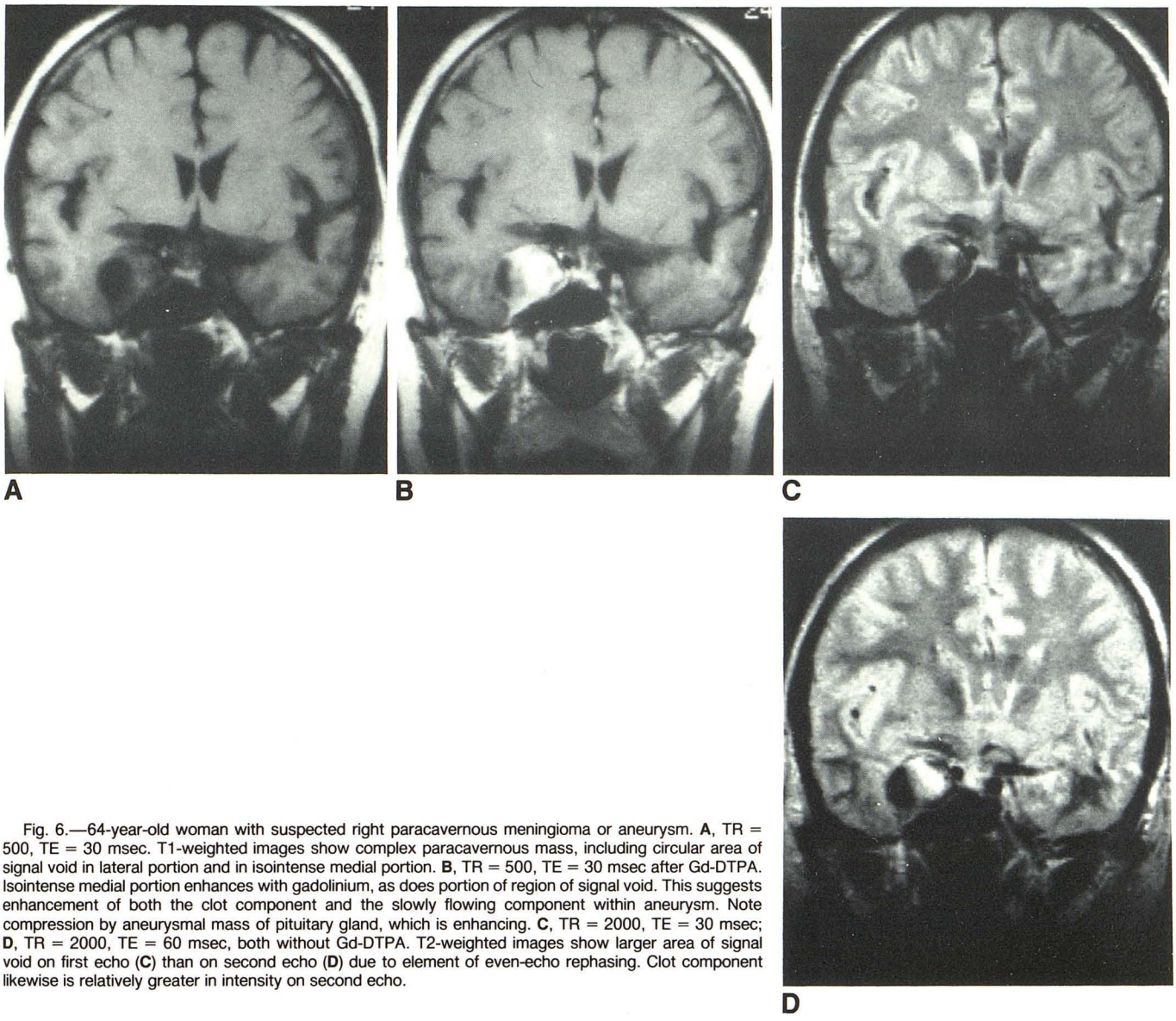


Fig. 6.—64-year-old woman with suspected right paracavernous meningioma or aneurysm. **A**, TR = 500, TE = 30 msec. T1-weighted images show complex paracavernous mass, including circular area of signal void in lateral portion and in isointense medial portion. **B**, TR = 500, TE = 30 msec after Gd-DTPA. Isointense medial portion enhances with gadolinium, as does portion of region of signal void. This suggests enhancement of both the clot component and the slowly flowing component within aneurysm. Note compression by aneurysmal mass of pituitary gland, which is enhancing. **C**, TR = 2000, TE = 30 msec; **D**, TR = 2000, TE = 60 msec, both without Gd-DTPA. T2-weighted images show larger area of signal void on first echo (**C**) than on second echo (**D**) due to element of even-echo rephasing. Clot component likewise is relatively greater in intensity on second echo.

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