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## New CT Finding in Aggressive Meningioma

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The computed tomographic (CT) findings in aggressive or invasive meningiomas have been described by several authors [1–3]. These signs include heterogeneous contrast enhancement with or without cystic components, irregular tumor margins, and marked surrounding edema. Recently, "mushrooming" has been added as an additional CT finding [4]. According to Taveras and Wood [5], the angiographic demonstration of deep draining veins in meningiomas implies underlying invasion of brain tissue and indicates tumor aggressiveness. We describe two cases of proven aggressive meningioma in which these deep draining veins were seen on contrast-enhanced CT. To our knowledge, the significance of this CT finding has not been reported before. We also reviewed 100 cases of nonaggressive meningiomas and found no instances of deep draining veins on contrast-enhanced CT scans.

### Case Reports

#### Case 1

A 60-year-old woman had a 2 year history of a soft-tissue protrusion on the right side of her forehead. She also had intermittent headaches, unstable gait, and paresthesias in her arms and legs. On physical examination, a 2 × 2 cm solid, nontender lump was found protruding from her right frontal region. She had weakness in her left arm and leg and bilateral chronic papilledema. CT showed a nonhomogeneously enhancing lesion adjacent to the right frontal bone with central nonenhancing regions consistent with cystic or necrotic changes. There was invasion of the adjacent skull and scalp, marked surrounding edema, and significant shift of the midline structures; mushrooming was evident. An unusual serpiginous density arose from the tumor. It seemed to be directed toward the internal cerebral vein (fig. 1A). On angiography the tumor showed an inhomogeneous blush. There was early venous drainage into an abnormally large and tortuous medullary vein that drained into the thalamostriate vein (fig. 1B). This vein explained the tortuous density noted on CT. Pathologic diagnosis of the tumor was angioblastic meningioma, hemangiopericytic subtype. Evidence of aggressive behavior was shown by marked cerebral invasion, many mitotic figures, and various degrees of cellular pleomorphism.

#### Case 2

A 75-year-old right-handed woman had frontal signs consisting of psychomotor restlessness, urinary incontinence, gait ataxia, and a mild left hemiparesis. CT showed a large tumor that enhanced nonhomogeneously at different window settings. It arose from the right frontal region and extended to the left across the midline. There was marked surrounding edema, and mushrooming was apparent. A serpiginous density arose posteriorly from the tumor and was directed toward a deep cerebral vein (fig. 2A). Angiography demonstrated the typical findings of a large frontal meningioma. Early filling veins drained into deep medullary veins and these into the deep cerebral veins (fig. 2B). Craniotomy and tumor excision were performed. Pathology showed this to be a syncytial meningioma with extensive cerebral invasion.

### Discussion

Several CT features of meningioma have been found to be predictive of, and related to, those histologic features suggesting aggressivity: (1) marked perifocal edema, (2) absence of or minimal calcification, (3) cystic components on either plain or infusion CT scans, (4) moderate and nonhomogeneous contrast enhancement, and (5) irregular tumor outline [1, 2, 4]. Histologically, the cystic component and nonhomogeneous enhancement represent tumoral necrosis, while the irregular outline is indicative of brain invasion. Recently, New et al. [4] described an additional sign, "mushrooming," which they believe to be a most useful correlate of both clinical and histologic malignancy. It represents a prominent tumor pannus that is seen to extend away from the central globoid mass.

Taveras and Wood [5] stated that drainage of meningiomas into deep veins is a sign of brain invasion. This cerebral invasion is one of the histologic indications of aggressivity of meningiomas [6].

In our two cases in which these deep draining veins were seen on CT and confirmed by angiography, the meningiomas were aggressive. In case 1, the pathologic diagnosis was angioblastic meningioma, hemangiopericytic subtype. Angio-

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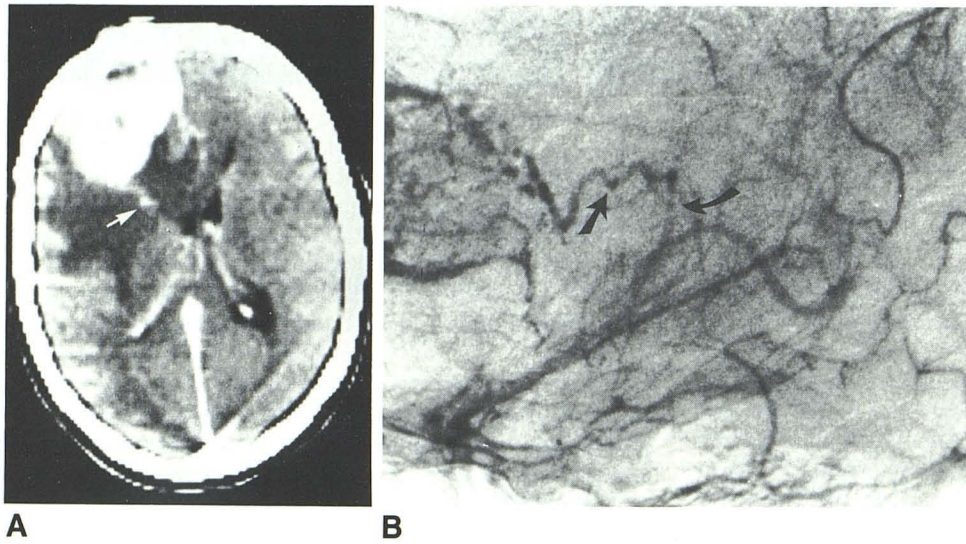


Fig. 1.—Case 1. Right frontal angio-blastic meningioma, hemangiopericytic subtype. **A**, Enhanced CT scan. Serpiginous density arises from tumor and seems to be directed toward internal cerebral vein (arrow). **B**, Angiogram. Early venous drainage into enlarged tortuous medullary vein (straight arrow), which drains into thalamostriate vein (curved arrow). This vein accounts for tortuous density on CT.

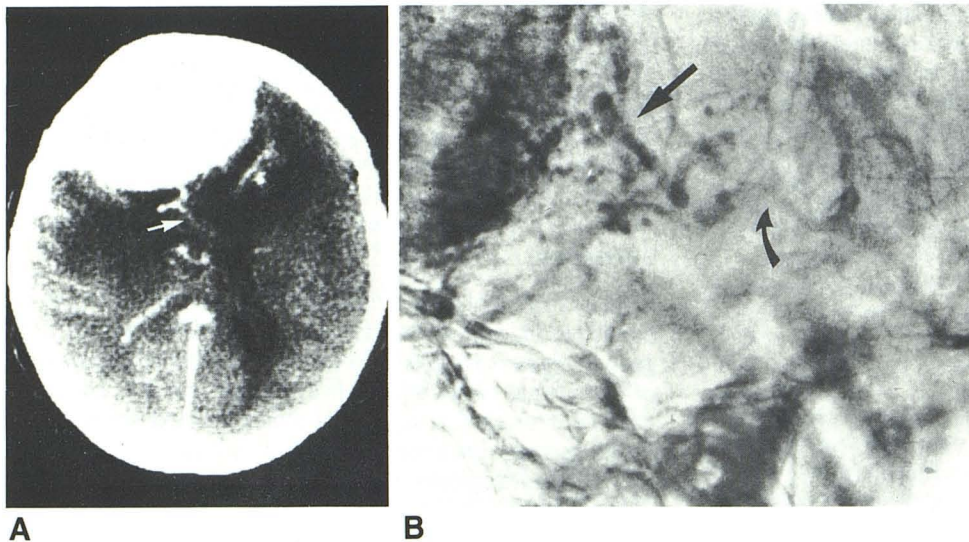


Fig. 2.—Case 2. Right frontal syncytial meningioma. **A**, Enhanced CT scan. Serpiginous density arising posterior to tumor corresponds to deep draining vein (arrow). **B**, Angiogram confirms CT finding of deep draining vein. Deep medullary vein (arrow) drains into deep cerebral vein (curved arrow).

blastic meningiomas are the most aggressive type of meningiomas, and the hemangiopericytic type is the type most likely to become malignant and metastasize [3, 7, 8]. In our case, it had invaded the underlying cerebrum. In case 2, a syncytial meningioma, aggressivity was evident pathologically, again by its extensive cerebral invasion.

To confirm the significance of demonstrating deep draining veins on CT, we undertook a retrospective review of our institute's nonaggressive meningiomas from the last 5 years. There were 100 cases for which both histology and contrast-enhanced CT scans were available. In no case were these deep draining veins observed on CT. Therefore, we believe that deep draining veins should be sought on contrast-enhanced CT scans of meningiomas. If present, they suggest that the meningioma is an aggressive one and that underlying brain invasion is likely.

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