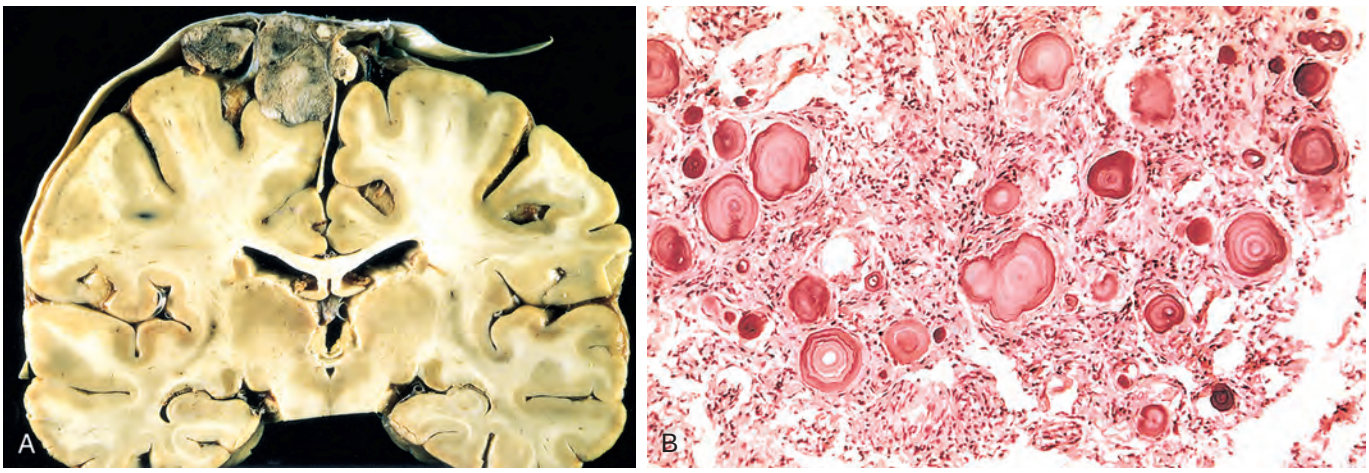

Figure 28-53 **A,** Parasagittal multilobular meningioma attached to the dura with compression of underlying brain. **B,** Meningioma with a whorled pattern of cell growth and psammoma bodies.

Most meningiomas have a relatively low risk of recurrence or aggressive growth, and so are considered WHO grade I/IV. Various histologic patterns are observed, with no prognostic significance. These include **syncytial** ("meningothelial"), appropriately named for the whorled clusters of cells that sit in tight groups without visible cell membranes; **fibroblastic**, with elongated cells and abundant collagen deposition between them; **transitional**, which share features of the syncytial and fibroblastic types; **psammomatous**, with psammoma bodies, apparently formed from calcification of the syncytial nests of meningothelial cells (Fig. 28-53*B*); **secretory**, with PAS-positive intracytoplasmic droplets and intracellular lumens by electron microscopy; and **microcystic**, with a loose, spongy appearance. Only the secretory subtype appears to be associated with a specific genotype; in initial reports all have had mutations of the *TRAF7* and *KLF4* genes. Xanthomatous degeneration, metaplasia (often osseous), and moderate nuclear pleomorphism are common in meningiomas. Among these lesions, proliferation index has been shown to be a predictor of biologic behavior.

Atypical meningiomas (WHO grade II/IV) are lesions with a higher rate of recurrence and more aggressive local growth, and may require radiation therapy in addition to surgery. They are distinguished from lower grade meningiomas by having four or more mitoses per 10 high power fields or at least three atypical features (increased cellularity, small cells with a high nuclear-to-cytoplasmic ratio, prominent nucleoli, patternless growth, or necrosis). Certain histologic patterns (**clear cell** and **chordoid**) are also considered to be grade II/IV because of their more aggressive behavior.

Anaplastic (malignant) meningioma (WHO grade III/IV) is a highly aggressive tumor with the appearance of a high-grade sarcoma, but retaining some histologic evidence of meningothelial origin. Mitotic rates are often high (>20 mitoses per 10 high power fields). **Papillary** meningioma (with pleomorphic cells arranged around fibrovascular cores) and **rhabdoid** meningioma (with sheets of tumor cells with hyaline eosinophilic cytoplasm containing intermediate filaments) both have such a high propensity to recur that they are also considered to be WHO grade III/IV tumors.

While most meningiomas are easily separable from the brain, some tumors invade the brain, either as broad, pushing edges or as single cells. The presence of brain invasion is associated with increased risk of recurrence but does not alter the histologic grade of the lesion. Meningiomas are commonly immunoreactive for epithelial membrane antigen, in contrast to other tumors arising in this region. Keratin is restricted to lesions with the secretory pattern, and these tumors are also positive for carcinoembryonic antigen.

Clinical Features. Meningiomas are usually slow-growing tumors. Patients present either with vague nonlocalizing symptoms or with focal findings referable to compression of underlying brain. Common sites of involvement include the parasagittal aspect of the brain convexity, dura over the lateral convexity, wing of the sphenoid, olfactory groove, sella turcica, and foramen magnum. They are uncommon in children and generally show a moderate (3:2) female predominance, although the ratio is 10:1 for spinal meningiomas, which are also commonly psammomatous. Lesions are usually solitary, but when present at multiple sites, especially in association with acoustic neuromas or glial tumors, the possibility of neurofibromatosis type 2 should be considered. Genetic studies indicate that multiple lesions are much more likely to represent dissemination from a single tumor than clonally distinct tumors. Meningiomas often express progesterone receptors and may grow more rapidly during pregnancy.

Metastatic Tumors

Metastatic lesions, mostly carcinomas, account for approximately a quarter to half of intra-cranial tumors in hospitalized patients. The five most common primary sites are lung, breast, skin (melanoma), kidney, and gastrointestinal tract, accounting for about 80% of all metastases. Some rare tumors (e.g., choriocarcinoma) have a high likelihood of metastasizing to the brain, whereas other more common tumors (e.g., prostatic adenocarcinoma) almost never do so. The meninges are also a frequent site of involvement by metastatic disease. Metastatic tumors present clinically as mass lesions and may occasionally be the first manifestation of the cancer. In general, localized treatment of solitary brain metastases improves the quality of the patient's