Meningiomas mimicking cerebral schwannoma

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A brain tumor with histological features reminiscent of schwannoma with underlying meningioangiomatosis was subjected to electron microscopic and immunohistochemical analysis, which confirmed the neoplasm as a meningioma. This prompted reexamination of a similar tumor, described in a previous publication as a cerebral schwannoma, with identical immunohistochemical techniques. The results obtained favored alteration of this diagnosis to that of meningioma. This experience has led the authors to recommend the use of immunohistochemistry techniques when evaluating unusual intracranial neoplasms.

KEYWORDS • schwannoma • meningioma • immunohistochemistry

It has been proposed by various authors that cerebral schwannoma exists as a rare, but genuine pathological entity. This concept has been suggested by the appearance of some 20 such cases in the literature. A variety of mechanisms are postulated to explain the ectopic location of this tumor.

These cases demonstrate histological features typical of schwannoma, such as the presence of palisading and Antoni type A and B histological patterns. Microscopic differentiation between meningioma and schwannoma is usually straightforward; however, meningiomas are known to mimic other tumors and may be confused with schwannoma. Certain ultrastructural features in the cases reported as meningioma were considered compatible with those of schwannoma. Confirmatory immunohistochemistry has been performed in only three previous cases.

The advent of recent technological advances has allowed us to examine immunohistochemically two cerebral tumors with identical histological characteristics suggestive of cerebral schwannoma. These studies support the alternative diagnosis of meningioma. It is therefore concluded that immunohistochemical techniques should be used as an adjunct to conventional methodology in the evaluation of neoplasms thought to be cerebral schwannomas.

Clinical Material and Methods

Case Reports

Case 1. This 33-year-old man presented with a 2-year history of intermittent right-sided supraorbital headache, accompanied by intermittent visual obscurations. He also noted episodic periorbital swelling of the right eye, accentuated when he was in the supine position. Physical examination revealed mild edema of the right upper eyelid and funduscopic evidence of early papilledema. Computerized tomography (CT) demonstrated an intracranial extra-axial nonhomogeneously enhancing neoplasm in the right frontotemporal region (Fig. 1). Surgical excision of the neoplasm was performed through a right frontotemporal craniotomy. The tumor had eroded the orbital roof, thereby accounting for the fluctuant periorbital swelling.

Case 2. This 15-year-old boy was the subject of an earlier publication. Briefly, he presented with signs, symptoms, and a CT scan suggestive of subarachnoid hemorrhage. Re-evaluation 1 year later revealed a right frontotemporal/subfrontal mass. He subsequently underwent surgical and pathological examination of this lesion, which was described as a schwannoma.

Tissue Preparation

Formalin-fixed tissue samples were processed for light microscopy in the usual manner. Five-micron sections were used for routine staining (hematoxylin and eosin) and immunohistochemistry. Immunohistochemistry utilized commercially available antibodies against S-100 protein, Leu-7, and vimentin, and the presence of a reaction was detected with the avidin-biotin-peroxidase complex technique.

Tissue specimens for electron microscopy were fixed in 2.5% glutaraldehyde and postfixed in 1% osmium
FIG. 1. Case 1. Computerized tomography scan showing a lobulated nonhomogeneously enhancing right frontal extra-axial neoplasm.

tetroxide. Tissue was embedded in Araldite (Epon-Ardite mixture) and sections were stained using a triple-staining technique of lead citrate-uranyl acetate-lead citrate.

Results

Case 1

Light microscopy revealed a neoplasm in the subarachnoid space, extending down the sulci and Virchow-Robin spaces. The tumor was uniformly composed of fibroblastic cells, exhibiting a remarkable palisading pattern (Fig. 2 left). In areas where the tumor infiltrated Virchow-Robin spaces, the microvasculature was accentuated, exhibiting in cross-section an onion-skin appearance (Fig. 2 right). Foci of calcification were common and intervening cortex displayed neuronal loss and gliosis. The appearance was that of a fibroblastic meningioma with an unusual degree of nuclear palisading and underlying meningioangiomatosis. Electron microscopy indicated the presence of desmosomes, interdigitation of plasma membranes, and the presence of cytoplasmic filaments (Fig. 3 left), the ultrastructural features of meningioma. A basement membrane was only found related to cell processes in perivascular locations (Fig. 3 right). Immunohistochemical stains for S-100 (Fig. 4) and Leu-7 were negative, and those for vimentin were positive.

Case 2

The pathology report for Case 2, as originally published stated “Light microscopy revealed a tumor in the subarachnoid space, intimately related to brain, with heavy calcification near the pia and along the Virchow-Robin spaces of the subjacent cortex. The tumor extended down the Virchow-Robin spaces of the numerous blood vessels of all sizes, and showed the unmistakable palisades of a schwannoma around the cortical vessels. The cells were elongated and spindle-shaped, forming the distinct Verocay bodies of Antoni A tissue in the perivascular tumor. Loose, reticulated Antoni B tissue was present chiefly in the subarachnoid portion of the tumor. Electron microscopy revealed abundant, finely fibrillar basement membrane material surrounding the tumor cells.”

This case report was published prior to the widespread application of immunohistochemical techniques to diagnostic neuropathology. Recent re-evaluation of the tumor sample revealed weak positivity for vimentin, and negative staining for S-100 and Leu-7. This suggests a diagnosis of meningioma, as schwannomas characteristically stain for S-100 and frequently for Leu-7.

Discussion

The microscopic appearance of schwannoma has been well defined. It has long been recognized that this appearance may be mimicked by meningiomas. The precursor to meningioma, the pluripotential arachnoidal cap cell, exhibits diverse differentiation and variability of histological expression. Thus, these lesions may simulate oligodendroglioma, astrocytoma, or schwannoma.

Electron microscopy has demonstrated basement membrane encompassing tumor cells in several cases. This was presented as compelling evidence in favor of a diagnosis of schwannoma, as meningioma cells are not usually surrounded by basement membrane. However, it has been reported that amorphous basement membrane-like material may be demonstrated between meningothelial cells. Furthermore, it is recognized that cell processes in perivascular regions can be intimately associated with basement membrane material, and failure to recognize this on electron microscopy could lead to a mistaken impression of schwannoma.

Vimentin has been identified as the main intermediate filament in meningioma. It is, however, also present in schwannomas and does not help to differentiate between meningiomas and schwannomas. The S-100 protein is of unknown function, and is largely localized in the cytoplasm and nuclei of schwann and glial cells. Although ubiquitous and reported in a variety of brain tumors, S-100 is characteristically present in schwannomas. As up to 15% of meningiomas can stain for S-100 protein, a tumor staining for this protein and not staining for Leu-7 should be studied by electron microscopy to establish the diagnosis. Anti-Leu-7 monoclonal antibody is directed against a carbohydrate epitope on myelin-associated glycoprotein. Leu-7 has been detected in 80% of schwannomas, while it was notably absent in all other tumor types tested.
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Fig. 2. Photomicrographs in Case 1. Left: Nuclear palisading was found throughout this tumor. H & E, × 180. Right: An area of meningioangiomatosis illustrates the intimate association of tumor cells with vessels in Virchow-Robin spaces (arrow) and adjacent gliotic cortex. H & E, × 90.

Fig. 3. Electron micrographs in Case 1. Left: Collagen (C) is seen between interdigitating tumor cell processes that are occasionally connected by desmosomes (arrows). × 11,100. Right: A red blood cell (R) is seen within a vascular channel lined by endothelial cells. Cell processes (asterisks) in the immediate vicinity of this vessel are associated with basement membrane material (arrows). × 14,480.
An issue quite separate from the identity of cerebral schwannoma is the speculation regarding its histogenesis. It has been suggested that cerebral schwannoma may arise from preexisting foci or migration of cells from the olfactory nerve. Russell and Rubinstein have indicated that pial cells may undergo Schwann cell transformation. Little evidence has emerged, however, in substantiation of these theories and they should thus be contemplated only tentatively.

Interestingly, most cases of cerebral schwannoma have presented in a remarkably young age group, possibly reflecting a congenital origin. Although schwannoma and meningioma display histological heterogeneity, they are both benign tumors and likely share similar molecular mechanisms of tumorigenesis. Both of these tumors have been associated with loss of regions of the long arm of chromosome 22. These regions may subtend a tumor-suppressor gene, inactivation of which results in stimulation of cell growth.

It is evident that judicious application of immunohistochemical techniques and electron microscopy affords greater diagnostic specificity. We would particularly recommend that unusual and rare pathology, such as cerebral schwannoma, undergo such scrutiny.

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References

2. Cushing HW, Eisenhardt L: Meningiomas: Their Classification, Regional Behavior, Life History and Surgical End Results. Springfield, Ill: Charles C Thomas, 1938
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