Extraneuraxial Canine Meningioma

A Light and Electron Microscopic Study

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Abstract. A tumor mass removed from the subcutaneous tissue of the shoulder of a dog had the light and electron microscopic features of extraneuraxial meningioma. The neoplasm probably arose from arachnoid cap cells displaced during embryogenesis.

Although intracranial canine meningiomas are common [14] no primary meningioma, to our knowledge, has been reported outside the central nervous system in dogs or other animal species. Extraneuraxial meningiomas occur occasionally in man and are predominantly in the head and neck area [13]. We are aware of only one such neoplasm in man in which the meningiomatous nature of the lesion was confirmed by electron microscopy [13]. There is no similar ultrastructural study in the veterinary literature.

Case History

A 2×3×4-centimeter mass was removed from the subcutaneous tissue of the shoulder of a 7½-year-old German Shepherd crossbred male dog. The tumor had been enlarging for several months. Six months after surgery there was neither local recurrence nor metastases.

Materials and Methods

The tumor was fixed in 4% neutral buffered formalin. Representative samples were embedded in paraffin and 5-micrometer-thick sections were stained with hematoxylin and eosin (HE), periodic acid-Schiff (PAS), Masson's trichrome and Gomori's reticulin for light microscopy. Several 1-millimeter cubes from various areas of the tumor were taken for electron microscopy, fixed in buffered formalin (4%, pH 7.5), then in 2% osmium tetroxide, dehydrated in graded alcohols and propylene oxide and embedded in epon 812. Semi-thin sections were stained with toluidine blue. Diamond-cut thin sections were stained with uranyl acetate and lead citrate.

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Results

The neoplasm, 2×3×4 centimeters, was over the superficial fascia but not attached to it nor to the overlying skin (fig. 1). It was well demarcated but not encapsulated. On cut surface it was solid, had a coarsely lobulated appearance, and was firm and tan.

Light microscopy showed that the tumor had a uniform and moderately lobulated arrangement of solid masses of elongated tumor cells with ill-defined cell borders and delicate round to oval nuclei (fig. 2). Regular nuclear membranes, pale nucleoplasm and the frequent presence of one or two conspicuous nucleoli were noted. Mitotic figures were seen occasionally. Stains for connective tissue demonstrated a fibrous stroma confined to trabeculae that divided the tumor into distinct lobules. The tumor cells were sometimes arranged in concentric whorls in which they frequently were crescentic (fig. 3); these structures were often around capillary blood vessels. No significant degree of cell palisading or psammoma body formation was seen.

Ultrastructurally, cellular apposition was characterized by various degrees of interdigitating cell processes; in its most pronounced form this resembled a jigsaw puzzle (fig. 4). Cell membranes were separated only by about 20 nanometers and occasionally up to 80 nanometers. Adjacent cells sometimes were connected by intercellular junctions of the desmosomal and intermediate types. The cytoplasm of these cells contained a moderate number of round to ovoid mitochondria. There was a small amount of rough endoplasmic reticulum and only a few cytoplasmic vesicles. The Golgi apparatus was present in all cells and usually was paranuclear. Centrioles, glycogen, free ribosomes, lysosomes, lipid droplets and lipofuscin granules were inconspicuous. Delicate intracytoplasmic fibrils about 10 nanometers in diameter and arranged for the most part in parallel bundles with occasional criss-crossing were seen in all cells (fig. 5). Many had formed whorls. The nuclei
were round or slightly elongated, their outlines usually were regular but occasionally had deep cytoplasmic invaginations. Fine granular chromatin formed small condensations under the inner layer of the nuclear membrane. Nucleoli were prominent. In some areas of the neoplasm a greater degree of intercellular separation than stated above was noted. Bundles of collagen fibrils with normal periodicity were seen in these areas. No basal lamina, basal lamina-like substance or long-spacing collagen were noted in any area of the tumor.

**Discussion**

Light microscopic diagnoses considered were: benign skin adnexal tumor (with or without a myoepithelial component), benign nerve sheath tumor, extra neuraxial meningioma, fibrous histiocyteoma and hemangiopericytoma. The lesion did not lend itself to a facile light microscopic interpretation. Ultrastructurally, however, many features of the neoplasm were those of a meningioma [2, 3, 7, 12, 15, 16, 19, 23]: cells with complex interdigitating cytoplasmic processes and devoid of a surrounding basal lamina, narrow intercellular spaces sometimes bridged by
intercellular junctions (desmosomes and intermediate junctions), abundant intracytoplasmic filaments and few other cytoplasmic organelles.

The literature on occurrence and growth of extraneuraxial meningiomas indicates that they are exceedingly rare in man [11, 13] and hitherto unreported in animals. In man they may be found in the cutis or subcutis of the face, scalp, neck or paravertebral areas. The possible mechanisms of formation of extraneuraxial meningiomas have been classified [11] as follows: 1) primary intracranial meningiomas with direct extension outside the skull; 2) meningiomas originating from arachnoid cells and accompanying nerve sheaths (such as orbital meningiomas arising from optic nerve sheaths); 3) meningiomas without any demonstrable connection with a cranial nerve; and 4) metastases from intracranial meningiomas. Based on clinical evidence we do not believe that the dog had a primary intracranial meningioma. Moreover, the neoplasm was histologically benign. Thus, on clinical and morphological grounds we can exclude groups 1 and 4. The neoplasm was not related anatomically to a cranial or major spinal nerve and this would place our case into group 3 and thus arising from arachnoid cap cells displaced during embryogenesis. Furthermore, we agree with others [18, 22] that
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Fig. 5: Tumor cell. Abundant and predominantly perinuclear cytoplasmic filaments (arrowheads). Bar = 2 µm.

it is most unlikely for a lesion such as this to arise from Schwann cells and that “metaplasia into meningothelial cells on the part of any other tissue would be unprecedented” [22].

The diagnosis of benign nerve sheath tumor was ruled out ultrastructurally by the absence of a surrounding basal lamina, the lack of abundant cytoplasmic pinocytic vesicles and the absence of extracellular long-spacing collagen [1, 21]. A diagnosis of cutaneous adnexal tumor was excluded because of the absence of any of the epithelial features usually associated with such neoplasms [8–10]. The lack of abundant cytoplasmic filaments associated with dense bodies and attachment plaques and desmosomes and hemidesmosomes excluded a diagnosis of myoepithelial tumor [17]. Hemangiopericytomomas may also have cells (as in our case) with abundant interdigitating cytoplasmic cell processes [4]. In those tumors, however, at least some of the neoplastic cells are partially or less often completely enveloped by a basement lamina and show other cytoplasmic features characteristic of pericytes (cytoplasmic filaments in association with dense bodies and attachment plaques and abundant pinocytic vesicles). In addition the tumor cells frequently are arranged in such a manner so that they retain their association or contact with adjacent capillaries and sometimes form pseudolumina in the intercellular space. Because all the previously mentioned features were absent we rejected the
diagnosis of hemangiopericytoma. The possibility of a fibrous histiocytoma of soft tissues was dismissed because of the absence of the characteristic mix of fibroblasts and histiocytes with occasional undifferentiated mesenchymal, xanthomatous and multinucleated giant cells that characterizes the lesion ultrastructurally [5, 20]. Furthermore, histiocytomas do not generally have such complex cytoplasmic interdigitations and frequent intercellular junctions as did our neoplasm. Although our lesion had some superficial ultrastructural similarity with a synovial sarcoma [6] several important differential points were noted: lack of formation of lumina with peripheral microvilli and closed by intercellular junctions, lack of a basement membrane around cell clusters and the presence in our tumor of abundant cytoplasmic filaments that usually are scanty in synovial sarcoma.

References


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