Pseudopsammomatus meningioma with elevated serum carcinoembryonic antigen: a true secretory meningioma

Case report

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A sphenoid-wing meningioma in a 60-year-old woman was accompanied by elevated serum carcinoembryonic antigen (CEA) levels, which returned to normal after removal of the tumor. Light microscopic examination revealed a secretory meningioma containing numerous pseudopsammoma bodies and a prominent vascular pattern. Immunohistochemical analysis showed the tumor cells and pseudopsammoma bodies to be CEA-positive. This case illustrates the possibility that secretory meningioma may be associated with clinically detectable secretion of CEA. The report also documents the rare occurrence of elevated serum CEA in a primary benign intracranial tumor.

KEY WORDS: meningioma • carcinoembryonic antigen • pseudopsammoma body • central nervous system tumor

CARCINOEMBRYONIC antigen (CEA) is an approximately 180,000-dalton glycoprotein, originally identified in 1965 by Gold and Freedman. Elevated serum levels of CEA are present in patients with a variety of epithelial malignancies, and may be found in patients with central nervous system (CNS) metastases from epithelial tumors. Elevated cerebrospinal fluid (CSF) levels of CEA have also been found in patients with metastatic carcinoma of the CNS. Serum and CSF CEA levels have therefore been clinically useful in distinguishing metastatic from primary brain tumors. We report the first case of a primary intracranial tumor with both immunohistochemical evidence of CEA positivity and elevated serum CEA levels.

Case Report

This 60-year-old right-handed woman was admitted to the Massachusetts General Hospital for removal of a right sphenoid-wing meningioma. She had undergone a laminectomy for cervical disc disease 14 years prior to this admission; 4 hours after that operation she had developed a left hemiparesis which cleared in 5 days. Ten years prior to her present admission, she had complained of menopausal headaches; a computerized tomography (CT) scan was normal, and her headaches eventually resolved. Three and one-half years prior to admission she noted decreased hearing in her left ear, along with tinnitus and episodes of vertigo. A diagnosis of Ménière's disease was made, and a CT scan revealed findings consistent with a right sphenoid-wing meningioma. The vertigo subsided and the patient was followed clinically and with CT scans. She remained asymptomatic from the meningioma until 18 months prior to admission, when she complained of increasing right-sided retro-orbital headaches and pain radiating into her right cheek. She did not wish to consider surgery because of recent breast surgery. Over the next year, her right-sided headaches worsened; CT scans documented an increase in the size of the mass and more edema in the temporal lobe. Magnetic resonance imaging (MR) imaging showed the middle cerebral artery branches adjacent to, but not within, the tumor.

The patient's medical history was significant in that she had undergone subtotal mastectomy for breast carcinoma 2½ years prior to admission. Axillary node dissection was negative and there was no evidence of
metastatic disease. Postoperative serum CEA levels were found to be elevated to 23.2 ng/ml (normal 0 to 3.0 ng/ml) and remained elevated during the year prior to admission, ranging from 13 to 17.8 ng/ml. No recurrent or metastatic breast carcinoma or second primary carcinoma was found on colonoscopy, bone or liver-spleen scanning, abdominal ultrasonography, CT, or MR imaging. There was no history of cigarette smoking.

Examination. On admission, there was a well-healed mastectomy scar and no lymphadenopathy was noted. Neurological examination was normal except for left-sided hearing loss and mild left-sided hyperreflexia with left Babinski and Hoffmann signs (which had been present since the laminectomy was carried out 14 years earlier).

Operation. A right frontotemporal craniotomy was performed with microsurgical removal of a meningioma arising from the posterior sphenoid wing and dura over the superior orbital fossa. A gross total resection was achieved. The patient’s postoperative course was uncomplicated and she made a full recovery. The serum CEA level fell to 2.7 ng/ml. One year after her surgery, the CEA level has remained within normal limits (2.1 ng/ml). She remains without evidence of recurrence of either meningioma or the breast carcinoma.

Pathological Findings. The tumor appeared reddish gray and rubbery on gross examination. Light microscopic examination revealed clusters of typical meningothelial cells with focal whorl formation. The cells contained round-to-oval nuclei with delicate stippled chromatin and occasional intranuclear pseudoinclusions. Nucleoli were not prominent. The cells had homogeneous eosinophilic cytoplasm without well-defined cell borders. Innumerable eosinophilic noncalcified round deposits (psammoma bodies) were scattered throughout the tumor (Fig. 1 left). These varied greatly in size and in degree of eosinophilia. The smaller psammoma bodies appeared intracellular. No calcified psammoma bodies were seen. In many areas the tumor had a prominent vascular pattern characterized by closely opposed large patulous vessels (Fig. 1 right). Pseudopsammoma bodies were frequently located adjacent to these large vessels. Pericytic proliferation was not marked.7 No hemangio-pericytic or “angioblastic” areas or cellular atypia were present.

Immunohistochemical analysis of the tumor was performed using monoclonal antibodies with an avidin-biotin complex method. On frozen sections and formalin-fixed paraffin-embedded tissue, both tumor cells and pseudopsammoma bodies were positive for CEA (Fig. 2). In formalin-fixed paraffin-embedded tissue, pseudopsammoma bodies were often positive for epithelial membrane antigen and alpha-1-antitrypsin. The cytoplasmic margins bordering the pseudopsammoma bodies were positive for cytokeratins AE1,3 and Cam 5.2. Tumor cells were positive for vimentin in all areas of the tumor, and blood vessels were positive for Factor VIII-related antigen. The tumor was negative for S-100 protein and desmin.*

Discussion

The secreteory meningioma has been defined as a meningioma which displays pseudopsammoma bodies on light microscopic examination. Pseudopsammoma bodies are eosinophilic round deposits of various sizes, positive to periodic acid-Schiff, scattered throughout otherwise classic meningiomas.1,8,9 Immunohistochemical studies have shown positive of the pseudopsammoma bodies for CEA, as well as secretory component, immunoglobulin (Ig)A, IgG, and alpha-1-antitrypsin (products characteristic of secretory cells).1,2,8,11 On ultrastructural examination, pseudopsammoma bodies are intra- or extracellular luminal collections of amorphous material surrounded by meningothelial cells with prominent microvilli and tonofilaments.1,2 On the basis of these histochemical and ultrastructural data, the pseudopsammoma bodies have been interpreted as secretory products of the tumor cells.

Elevated serum and CSF CEA levels are frequently associated with epithelial malignancies and CNS metastases, but have rarely been noted to be elevated in primary CNS tumors.4,6,10,12-14 In the present case, the elevated CEA levels were initially considered to be due to recurrent breast carcinoma; however, workup failed to demonstrate recurrent carcinoma, and further follow-up monitoring for 1 year has also not revealed any recurrent breast tumor or metastasis. In addition, the striking postoperative decline of serum CEA to normal levels strongly argues for the meningioma as the source of the elevated CEA.

The present case demonstrates that secretory activity in a meningioma may be sufficient to elevate serum levels of CEA; however, previous reports of secretory meningiomas have not documented elevated serum CEA levels. In one previously reported case of meningioma with elevated serum CEA,10 the authors did not histologically subclassify the meningioma. In addition, the CEA levels were only mildly elevated (2.5 to 5.0 ng/ml), and could have been within normal limits if the patient were a cigarette-smoker.7 The prior lack of documented CEA elevation in secretory meningiomas is most likely because CEA levels have not been measured in patients suspected of having benign meningiomas. Perhaps retrospective analysis of preoperative blood samples in patients with secretory-type meningiomas might reveal elevated serum CEA in more of these patients. In addition, in our case, the proximity

* CEA, epithelial membrane antigen, alpha-1-antitrypsin, vimentin Factor VIII-related antigen, S-100 protein, and desmin obtained from DAKO Corp., Santa Barbara, California; cytokeratin AE1,3 obtained from Boehringer Mannheim, Indianapolis, Indiana; cytokeratin Cam 5.2 obtained from Becton Dickinson, Mountain View, California.

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**Fig. 1.** Photomicrographs of the excised tumor specimen. *Left:* Meningothelial meningioma with numerous pseudopsammoma bodies. H & E, ×313. *Inset:* Higher-power view of the tumor cells and pseudopsammoma bodies. H & E, ×500. *Right:* Patulous vascular channels separating small islands of meningioma (straight arrows). Note pseudopsammoma bodies adjacent to the vascular channel (curved arrow). H & E, ×125.

**Fig. 2.** Immunohistochemical preparations of the tumor. Immunoperoxidase for carcinoembryonic antigen (CEA) with hematoxylin, ×200 (left) and ×500 (right). *Left:* Pseudopsammoma bodies and background tumor stain strongly positive for CEA on formalin-fixed paraffin-embedded tissue. *Right:* Pseudopsammoma bodies stain strongly positive for CEA on frozen tissue.
of pseudopsammoma bodies to the vessels and the prominent vascularity of the tumor may have enhanced absorption of CEA and contributed to high serum levels.

This case illustrates the rare occurrence of elevated serum CEA in a patient with a benign primary intracranial tumor. It does not diminish the importance of serum and CSF CEA levels in distinguishing primary from metastatic CNS tumors, but adds a small caveat. It also adds one further piece of evidence that meningothelial tumor cells may undergo a striking degree of secretory and epithelial differentiation.

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References


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