Medulloblastoma with striated muscle fibers

Case report

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A case is reported in which a medulloblastoma showed evidence of striated muscle fibers. Fifteen additional cases of primary central nervous system (CNS) tumor containing muscle fibers (excluding teratomas) are reviewed. These tumors appear to be of mesenchymal, rather than teratoid, origin, and to be related to embryonal sarcomas (mesenchymomas) in other parts of the body. It is postulated that the presence of such fibers in malignant gliomas may be due to rhabdomyoblast-inducing action of mesenchyme, analogous to the fibroblastic stimulation observed in desmoplastic medulloblastomas, and the massive stimulation of perivascular tissue often associated with undifferentiated astrocytomas.

KEY WORDS • medulloblastoma • rhabdomyosarcoma • mesenchyme

THE first instance of an intracranial tumor containing muscle fibers was apparently reported by Marinesco and Goldstein\(^{11}\) in 1933; it appeared to be a mixture of typical medulloblastoma, with immature and mature striated muscle fibers, and was termed a "medullomyoblastoma." Since that time there have been a number of comparable reports; some of these were embryonal sarcomas, with rhabdomyoblastic differentiation originating in the nasopharynx or pharynx.\(^{6,7,13,16,17}\) A tumor reported by O'Connell\(^{12}\) apparently originated as a lumbosacral teratoma, and other teratomas have been reported, as by Ingham and Bailey.\(^{8}\) There are 15 reported cases\(^{2-4,5,8-11,13-15,18}\) of primary intracranial tumors containing muscle fibers but devoid of ectodermal or endodermal derivatives. A further such case is presented.

Case Report

A 3-year-old boy had a 3-month history of vomiting, headache, and ataxia. Occipital craniotomy disclosed a large midline mass occupying the posterior vermis and measuring about 3.5 cm in its largest diameter. It was shelled out in large, firm, white fragments, the largest piece being 3 × 3 × 2 cm. Histological preparations showed areas containing clusters and sheets of small dark cells with hyperchromatic nuclei and scanty cytoplasm that resembled those of a medulloblastoma with no neurofibrillary differentiation (Fig. 1 left). The stroma was delicate, and contained a number of elongat-
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**Fig. 1.** Photomicrograph of tumor. *Left:* Medulloblastomatous area. H & E, X 125. *Center:* Area of rhabdomyoblasts showing striated fibers. PTAH, X 500. *Right:* Mixed area showing both medulloblastoma cells and rhabdomyoblasts, PTAH, X 125.

ed, narrow fibers with chains of oval nuclei, prominent nucleoli, and well-defined cross-striations (Fig. 1 *center*). Many areas showed an intimate mixture of medulloblastoma cells with stroma containing rhabdomyoblasts (Fig. 1 *right*). No bizarre or giant cells were noted.

Following radiotherapy the boy made fairly good progress for the next 3 years, and then began to vomit, lost 10 pounds in less than a month, and complained of weakness, tiredness, and headache. Examination revealed nystagmus on lateral and upward gaze, incoordination of the limbs, positive Romberg's sign, right facial weakness, and an extensor plantar response on the left. Intracranial pressure did not appear to be raised. Ventriculography showed a suspicious appearance of the floor of the fourth ventricle with possible dilatation, but filling was not technically adequate. Pneumoencephalography gave fairly good visualization, with no evidence of recurrent tumor. Cytological examination of cerebrospinal fluid showed some atypical cells. A 3-week course of radiation was given to the base of the skull and posterior fossa. He was discharged in fairly satisfactory condition 2 months later (at the age of 7 years), and has since been lost to follow-up.

**Discussion**

There now appear to be several types of tumors within the craniospinal cavity that may contain immature muscle fibers. Some of those reported originated in the nasopharynx, tonsillar bed, or palate; these were embryonal sarcomas with predominant rhabdomyoblastic differentiation. They are in no essential way different from those occurring in the genitalia in both sexes, and occasionally in the region of the biliary tract. They may invade the cranial cavity, usually the posterior fossa, and may also undergo general metastasis. One case appears to be unique in that invasion of the posterior fossa by rhabdomyoblastic tissue was associated with a moderately well-differentiated ganglioneuroma in the cerebellopontine angle; the tumor had metastasized to the lung, and these metastases were pure embryonal sarcoma (rhabdomyoblastic), without any neur ectodermal component.

O'Connell reported a paraplegic girl who had an apparently primary intraspinal tumor extending over the entire lumbosa-
cral cord with extensive seeding in the subarachnoid space as high as the posterior fossa. At the time of autopsy this tumor appeared to consist entirely of rhabdomyosarcoma, but in view of its association with posterior spina bifida and its sacral origin, the author considered this to be rhabdomyosarcomatous overgrowth in a teratoma.

If we exclude secondary tumors and frank teratomas, there remains a group of 16 cases (including the present report) which may represent entities specific to the craniospinal cavity. These are summarized in Table 1. The first group includes two cases of a type mentioned by Rubinstein that resembled embryonal sarcoma but occurred in adults. One was firmly attached to the parietal dura and had the gross appearance of a meningioma but microscopically showed undifferentiated malignant mesenchymal tissue with focal rhabdomyoblastic and chondroblastic differentiation. The other tumor arose from the leptomeninges of the right cerebellopontine angle, and had seeded extensively in the spinal and cerebral subarachnoid space; the seeded tumors showed rhabdomyoblastic and chondroblastic differentiation.

The second type of tumor is represented by a right occipital subcortical neoplasm with normal overlying meninges. The tumor, at first considered a typical gliosarcoma, was seen at later examination to have nests of rhabdomyoblasts, some showing cross striations.

The third group includes primary rhabdomyosarcomas of the posterior fossa. Four cases have been reported, three of the four were in young children, the other in a woman of 52. The childhood tumors showed only striated muscle fibers, but the tumor in woman of 52. The childhood tumors showed fibers. Two papers mention the presence of a fibrosarcomatous matrix within which myoblastic differentiation appears to be occurring.

The largest group of cases consisted of the "medullomyoblastomas" or "malignant teratoid tumors." Our case also falls into this group. Eight of the nine patients were under 10 years old; the other patient was a 26-year-old woman. Three cases were in females and six in males. In seven instances the differentiation was toward striated muscle, but in two only smooth muscle fibers were present. All these tumors contained areas interpreted as medulloblastoma, usually with recognizable neuronal differentiation, as well as rhabdomyoblasts. An interesting feature is that four of the cases showed an apparent gross separation between the medulloblastomatous and the myoblastic areas.

The origin of the muscle fibers in these cases has been a subject for debate. Some writers, such as Bailey and Russell and Rubinstein, have preferred to regard these as teratoid tumors, differing from the classical teratomas by showing no ectodermal or endodermal derivatives. A variation of this theory regards the tumors as derived

<table>
<thead>
<tr>
<th>Type of Tumor</th>
<th>No. of Cases</th>
<th>Posterior Fossa</th>
<th>Hemispheres</th>
<th>Patient's Age (yrs)</th>
<th>Sex</th>
<th>Comments</th>
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<tbody>
<tr>
<td>mesenchymoma (ref. 13)</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>41, 45</td>
<td>1 F, 1 M</td>
<td>include chondroid foci</td>
</tr>
<tr>
<td>gliomyosarcoma (ref. 5)</td>
<td>1</td>
<td>nil</td>
<td>1</td>
<td>72</td>
<td>M</td>
<td>glioblastoma</td>
</tr>
<tr>
<td>primary rhabdomyosarcoma (refs. 9,10,15)</td>
<td>4</td>
<td>4</td>
<td>nil</td>
<td>3 to 52*</td>
<td>3 F, 1 M</td>
<td>3 striated, 1 mixed</td>
</tr>
<tr>
<td>medullomyoblastoma (refs. 2,3,4,8,11,14,18, present case)</td>
<td>9</td>
<td>9</td>
<td>nil</td>
<td>1 to 26†</td>
<td>3 F, 6 M</td>
<td>7 striated, 2 smooth</td>
</tr>
<tr>
<td>total</td>
<td>16</td>
<td>14</td>
<td>2</td>
<td>1 to 72</td>
<td>7 F, 9 M</td>
<td></td>
</tr>
</tbody>
</table>

*Three of the four patients were 3 to 9 years old.
†Eight of the nine patients were 1 to 10 years old.
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from neur ecto derm (neural plate) and neur ectomesenchyme (neural crest).  

Willis, in his discussion of rhabdomyosarcomas and embryonal sarcomas, notes that these tumors commonly arise in areas where muscle is not a normal tissue component, and considers that they may be a product of differentiation of primitive mesenchymal cells characterizedly found around vessels. These differ from the rare malignant tumors of skeletal muscle since they appear at an earlier age, have an undifferentiated mesenchymal type of stroma, and contain relatively few bizarre or multinucleated cells. The possibility that the myoblastic components of cerebral rhabdomyosarcomas and medul lomyoblastomas may be of similar origin has been considered. The distinction between origin from neur ectomesenchyme and mesodermal mesenchyme may not be meaningful until the origin of the leptomeninges themselves is further clarified. It is quite possible that both types of tissue contain undifferentiated cells of similar broad potential, and the distinction is in the embryological derivation rather than in developmental potentials.

The more recent reports of central nervous system tumors containing muscle become less and less stereotyped. The first three reports were all of the medullomyoblastoma variety, but now it is seen that muscle fibers may develop on both sides of the tentorium and in association with a medulloblastoma or glioblastoma, or as a completely isolated lesion. The cases appear to be distinct from frank malignant teratomas. There is little reason to regard them as malignant teratoid tumors since none has included ectodermal (other than neur ectodermal) or endodermal derivatives. As already noted, it is not practical to distinguish between mesenchyme derived from the neural crest and that from the mesoderm. Although most tumors reported have been in close association with leptomeninges, one of the embryonal sarcomas reported by Rubinstein was firmly attached to the dura, and the case reported by Goldman lay within the brain, with apparently normal overlying meninges.

It seems to us that the most reasonable hypothesis is that the muscle component of these tumors arises from perivascular mesenchyme, as suggested by Willis and supported by several others. In the majority of cases reported the morphology of the muscle component has approximated closely that seen in embryonal sarcomas, rather than having the bizarre appearance of tumors originating in muscle. Pending the elucidation of the origin of the leptomeninges, there is no clear reason to implicate the neur ectomesenchyme. The predilection for the posterior fossa, even without an associated glioma, is not as yet explained. The association with medulloblastoma may be due to a direct stimulating effect of medulloblastoma cells on the leptomeningeal and perivascular connective tissue, as appears fairly well documented in the formation of desmoplastic medulloblastomas. It is also well recognized that undifferentiated astrocytomas may provoke a marked hyperplastic, or even neoplastic, reaction in the adventitial tissue of included vessels, and the presence of muscle fibers in Goldman's case may, therefore, also result from a mesenchyme-stimulating action of the undifferentiated astrocytoma analogous to, but rarer than, that observed with medulloblastomas. Some support for the secondary, or induced, nature of muscle fiber proliferation is offered by the fact that, in four of the nine cases of medul lomyoblastoma reviewed, the muscle tissue component was said to be grossly distinct and separate from the neur ectodermal tumor.

References


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