Physiologic Abnormalities Encountered after Removal of Brain Tumors from the Floor of the Fourth Ventricle*

GEORGE S. BAKER, M.D.
Section of Neurologic Surgery, Mayo Clinic and Mayo Foundation, Rochester, Minnesota

The most common tumor to arise from the floor of the fourth ventricle is a subependymal glioma. It is a relatively rare tumor and seems to grow from the layers of glia, just underneath the ependyma. The ependyma may be modified in some regions and absent in others, but it does not show any signs of proliferation. The tumor is avascular, rarely calcified, and is composed primarily of islands of the nuclei of tumor cells in a vast network of homogeneous glial fibers, which stain well with hematoxylin and eosin. Pathologically, it is considered a benign and unusual type of astrocytoma (Fig. 1).

From the neurosurgeon’s point of view, the floor of the fourth ventricle is considered “no man’s land,” and from an anatomical and physiological standpoint it is a very important region. This portion of the brain must not be traumatized, and the surgeon must use utmost care when removing a tumor in order to avoid serious complications. The data for this paper are gleaned from the experiences that have followed the surgical removal or attempts at removal of 11 tumors, all considered to be subependymal gliomas of the fourth ventricle.

Preoperative Signs and Symptoms

The preoperative signs and symptoms of these tumors may be misleading to both the neurologist and the neurosurgeon. The early findings may be indicative of migraine and may be treated unsuccessfully as such for several years. Transient headaches, associated with vertigo, nausea, and vomiting, may be the chief complaints long before signs of ventricular obstruction and intracranial pressure develop. However, as the growth enlarges and obstruction of the aqueduct of Sylvius occurs, the severe forms of intermittent headache, nausea, and vomiting are associated with disorders of equilibrium, nystagmus, diplopia, and frequently rigidity of the neck. Rarely is it possible to detect, prior to a surgical procedure, any involvement of the cranial nerves whose nuclei are in the floor of the fourth ventricle. In an untreated patient, however, respiratory paralysis or severe cardiac irregularities of central origin may develop suddenly. Generally, the central nervous system will tolerate a very slowly developing pressure from tumors remarkably well, but any sudden change is often disastrous.

Diagnosis and Treatment

Tumors of the posterior fossa are suspected by the neurological findings, such as ataxic gait, nystagmus, and papilledema,

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Fig. 1. Subependymal glioma. Note avascular, homogeneous network of glial fibers with islands of nuclei of tumor cells (hematoxylin and eosin; X80).
and the diagnosis is usually confirmed by ventriculography or by fractional pneumoencephalography. A few of these tumors reveal themselves as calcified masses in the midline of the posterior fossa. An interesting case was that of a patient with bitemporal hemianopsia from dilatation of the third ventricle and compression of the chiasm. A ventriculogram is obviously necessary to clarify the diagnosis in a situation of this kind.

The treatment involves suboccipital craniectomy as well as upper cervical laminectomy when the mass extends to the cervical region. The tumor is then removed completely, or a biopsy and ventriculocisternostomy are performed. The nature of the attachment of the growth and the ease of its mobility at the time of operation determines the proper attack. The clinical appraisal can be made at the time of exploration.

From observations in this series of 11 cases, it has been found that the mass may be handled in one of several ways: (1) It may be of a type that can be removed completely without any physiological changes. (2) Others cannot even be approached because of the respiratory paralysis or vasomotor instability that develops with manipulation. (3) In a third group, although the tumor can be removed completely, the operation leaves a residue of severe long-lasting physiological abnormalities.

These problems can be demonstrated better by the following 4 illustrative case reports.

Report of Cases

Case 1. The 1st case is an example of a tumor that was totally removed, without any resulting physiological abnormalities.

This 30-year-old white garage mechanic was examined in 1953 at the Mayo Clinic. He had complained of headache, transient vomiting, and occasional periods of diplopia for about a month. He mentioned that relief from the headaches was always obtained by lying down; this indicated a ball-valve type of obstruction.

Examination. The neurological examination demonstrated minimally increased reflexes bilaterally in both upper and lower extremities. Results of coordination tests were normal and Babinski's sign was not present. The patient was not ataxic. Eye examination showed 1 D. of papilledema but no weakness of the muscles of the eye to account for the transient diplopia. Roentgenograms of the skull demonstrated some erosion of the floor of the sella. Electroencephalographic findings were normal.

Because of the increasing degree of headache and papilledema, ventriculography was advised. Trephine openings were made over the posterior horn of each lateral ventricle. The ventriculogram showed moderate dilatation of both lateral ventricles and the third ventricle, but no air could be mobilized into the fourth (Fig. 2a and b). A tumor of the fourth ventricle was diagnosed, and the patient was prepared immediately for a suboccipital craniectomy and exploration of the posterior fossa.

Operation. The operation was undertaken through a midline incision with the patient in an upright cerebellar position. The fourth ventricle was exposed, and a tumor, which measured 2.5 by 1.5 by 1.5 cm., was found to arise within it. Cerebellar tonsils extended to a level of the second cervical vertebra. The mass was solid, avascular, and very lightly attached, and practically fell out of the ventricle on gentle traction. The lesion proved to be a typical subependymal glioma.

Postoperative course. No immediate changes were noted in the patient's condition, and he made an uneventful recovery, with no neurologic deficits. The choked disks and the headache subsided, and the man presently is working full time, 11 years after neurosurgery.

Case 2. The 2nd case is an example of a tumor arising from the floor of the fourth ventricle that could not be removed, as it was attached by a broad base, and attempts to mobilize the mass resulted in temporary periods of respiratory paralysis.

This 36-year-old white livestock dealer complained of headaches, nausea, and vomiting for about 6 months prior to his examination in 1955 at the Mayo Clinic.

Examination. The neurological examination demonstrated grade 1 to 2 ataxia on turns and tandem walking. The reflexes were moderately hyperactive in both upper and lower extremities. Coordination tests were performed satisfactorily. Ocular examination demonstrated coarse lateral nystagmus to both sides, bitemporal hemianopsia, and 1 D. of papilledema. Ventricular study was advised, and trephine openings were made over the posterior horn of each lateral ventricle. The ventriculogram (Fig. 3a and b) showed a symmetrical dilatation of the lateral ventricles, a dilated third ventricle, which was thought to be the source of the bitemporal hemianopsia, and the outline of a large tumor in the fourth ventricle.

Operation was undertaken immediately with the patient in the upright cerebellar position.