Pneumoencephalographic Findings Suggesting Aneurysm of the Vertebral-Basilar Junction*

Differentiation of Cases Simulating Mass Lesions

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Aneurysms of the vertebral-basilar system frequently appear as mass lesions in the posterior fossa with no history of bleeding.1,5-10,12 Pneumoencephalography is generally regarded as the diagnostic procedure of choice in posterior fossa tumor suspects. If a mass lesion of the brain stem is found and interpreted as a glioma, operation or radiation therapy may be undertaken without further radiologic studies.

The purpose of this paper is to present the pneumoencephalographic findings in aneurysms about the vertebral-basilar junction which clinically resembled mass lesions without a history of subarachnoid hemorrhage. These findings appear to be almost specific and, when seen, indicate the need for vertebral angiography. Successful treatment of a posterior fossa aneurysm was described by Schwartz in 1948,8 and there have been numerous subsequent reports.5,6 These cases and subsequent technical advances emphasize the need for more definitive diagnosis.

Case Reports

Case 1 (P. W.) A 23-year-old right-handed male was admitted to the UCLA Hospital on December 15, 1960, with a 1-year history of dull suboccipital headaches lasting up to 5 or 6 days at a time. Rapid movements of the head caused generalized headaches. For 9 months, he had had progressive weakness and clumsiness of the right extremities, and occasional slurring and stuttering.

Examination on admission showed a well-developed male in no acute distress. His retinal veins were full and without pulsation. There was a mild right spastic hemiparesis, more severe in the leg than in the arm. His right Babinski re-

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sponse was extensor. General laboratory and radiologic examination showed no abnormalities. Lumbar puncture showed an opening pressure of 230 mm. of water. The cerebrospinal fluid protein was 66 mg. per cent. The left carotid angiogram and pneumoencephalogram were normal. He was discharged, but readmitted on July 2, 1961, complaining of blurring of vision, intermittent diplopia, difficulty in chewing and swallowing with regurgitation through the nose, right facial numbness, progression of the right hemiparesis and intermittent hiccoughs.

Examination showed slight impairment of recent memory, a halting monotonous speech with marked dysarthria, horizontal nystagmus on lateral gaze, vertical nystagmus on upward gaze, paralysis of the left palate with absent gag reflex on the left, severe progression of the right spastic hemiparesis with slowed clumsy movements of the right side, a right extensor plantar response, right-sided astereognosis, and decrease of position sense in the right hand. Pneumoencephalogram was repeated and suggested an intrinsic tumor of the pons. Accordingly a 5025 r tumor dose of radiation therapy was given to the entire posterior fossa. Twelve days after completion of the therapy, on September 21, 1961, the patient died at home after a severe bout of coughing and dyspnea.

Postmortem examination showed a 2.0 X 2.5 X 4.0 cm. saccular bilobular aneurysm arising from the vertebral-basilar junction with severe compression of the medulla, pons, and cerebellum (Fig. 1 a and b).

Review of the pneumoencephalogram showed good filling of the ventricular system and no herniation of the cerebellar tonsils. There was elevation of the floor of the 4th ventricle with obliteration of the right lateral recess of the 4th ventricle by a well-circumscribed lesion with minimal lateral displacement of the aqueduct and 4th ventricle and preservation of the basal cisterns (Figs. 2 and 3).

Case 2 (L. S.) A 57-year-old right-handed white male entered the hospital on May 21, 1964, with a 4-month history of periodic and progressively severe episodes of staggering and falling to the right side. Seven weeks before admission he noted
that he could not close his right eye completely, that tearing in this eye was constant and that the area around the right eye was numb. Five weeks before admission, he noticed the onset of progressive clumsiness of the right lower extremity.

**Examination.** Physical examination showed a horizontal nystagmus on lateral gaze, more marked to the right. The right corneal reflex was markedly decreased and there was hypalgesia and hypesthesia in the right trigeminal nerve distribution. There was a severe right facial paraly-
sis, of the peripheral type. Hearing was markedly decreased on the right. There was slight weakness of the proximal muscles of the right lower extremity and some ataxia of both lower extremities, worse on the right. Sensory testing showed mild right-sided hypalgesia and hypesthesia with impaire
d position and vibratory sensation, especially in the lower extremity. The deep tendon reflexes were physiologic; the plantar responses flexor.

Laboratory and roentgenologic examinations

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**FIG. 1.** Aneurysm arising from the vertebral-basilar junction; postmortem specimen. a. Bilobular aneurysm in situ. b. Specimen with aneurysm and vessels removed, demonstrating severe compression of medulla, pons, and cerebellum. (Courtesy of Armand L. Dollinger, M.D. and the Riverside (California) County Medical Examiner's Office).

**FIG. 2.** (Case P.W.) Lateral view of pneumoencephalogram demonstrating elevation of the floor of the fourth ventricle by a well-circumscribed mass with preservation of the basal cisterns. There is good filling of the ventricular system and no herniation of the cerebellar tonsils.

**FIG. 3.** (Case P.W.) PA view of pneumoencephalogram demonstrating obliteration of right lateral recess of fourth ventricle by a well-circumscribed lesion. There is minimal lateral displacement of the fourth ventricle. The pontocerebellar cisterns are well preserved.
were all within normal limits except for pneumoencephalogram performed on June 7, 1964, which showed good filling of the ventricular system and no herniation of the cerebellar tonsils. There was elevation of the floor of the 4th ventricle with obliteration of the right lateral recess of the 4th ventricle by a well-circumscribed lesion with slight widening of the vallecula but minimal lateral displacement of the 4th ventricle and no encroachment on the basal cisterns. (Figs. 4 and 5).

**Fig. 4.** (Case L.S.) Lateral view of pneumoencephalogram demonstrating elevation of the floor of the fourth ventricle by a well-circumscribed mass with preservation of the basal cisterns. There is good filling of the ventricular system and no herniation of the cerebellar tonsils.

**Fig. 5.** (Case L.S.) PA view of pneumoencephalogram demonstrating obliteration of right lateral recess of fourth ventricle by a well-circumscribed lesion. The vallecula is slightly widened. There is minimal lateral displacement of the fourth ventricle. The pontocerebellar cisterns are well preserved.

**Fig. 6.** (Case L.S.) Lateral and AP vertebral angiograms demonstrating aneurysm of right distal vertebral artery at junction of posterior inferior cerebellar artery.
The patient left the hospital on June 10, 1964, to attend to some important personal business. He returned on June 24, 1964, complaining of increased clumsiness of the right leg and dragging of the right foot. Examination now showed a right trigeminal nerve motor weakness, progression of right facial weakness and progression of the right hemiparesis with slowing of movements and ataxia of the right extremities. Because of the pneumoencephalographic findings, a right vertebral angiogram by selective retrograde catheter technique was performed on July 10, 1964. An aneurysm of the right vertebral artery at the junction of the posterior inferior cerebellar artery was demonstrated (Fig. 6a and b).

At operation, the aneurysm was found to be partially filled with clot, and much larger than was apparent by angiography. It was ligated and decompressed through a right suboccipital craniectomy on August 11, 1964, by Drs. R. Balch and R. W. Rand, using a Zeiss dissecting microscope (Fig. 7).

Postoperatively, the patient has done well and when last seen on December 29, 1964, showed continuing improvement in his neurological status.

Discussion

With a more widespread use of vertebral angiography, considerable attention has been given to posterior inferior cerebellar artery aneurysms as a source of subarachnoid hemorrhage. Aneurysms of this artery have been responsible for 3 to 5 per cent of the sub-
arachnoid hemorrhages. A significant percentage of these aneurysms have been discovered accidentally or have presented the symptoms of a mass lesion. Yaskin and Alpers reported such a case and reviewed the clinical histories of 72 aneurysms of the intracranial portion of the vertebral artery from the literature. Thirty-five were reported in sufficient detail to recognize a group of 21 patients who had the symptoms of a mass lesion rather than those of subarachnoid hemorrhage. The histories of the illnesses of these patients could not be differentiated from the histories of patients with gliomas of thepons.

Spindle and Abbott found that 3 out of 12 vertebral artery aneurysms from the autopsy files of the Los Angeles County General Hospital simulated mass lesions. They reviewed 110 reported vertebral artery aneurysms from the literature and added 12 of their own. From this group, 3 classifications were recognizable.

1. Individuals with signs and symptoms of a posterior fossa mass lesion but no history of bleeding.
2. Patients with subarachnoidal hemorrhage or acute rupture of the aneurysm.
3. Aneurysms found incidentally at postmortem.

More recently, Jamieson found that 2 of 19 aneurysms of the vertebral-basilar system appeared to be mass lesions. Posterior cerebral aneurysms were included in this study. Only 2 cases were at the vertebral-basilar junction.

Following our first case, it became clear that vertebral angiography was necessary for definitive diagnosis when certain pneumoencephalographic findings were present. Our patients both showed precisely the same pneumoencephalographic findings:

1. The lesions were sharply delineated and rounded in outline.
2. The lateral recess of the 4th ventricle on the side of the lesion was obliterated.
3. There was only slight shift of the 4th ventricle and vallecula to the opposite side.
4. There was no compression of the basilar cisterns; this included the cisterna magna and pontocerebellar recesses.
5. The cerebellar tonsils were not herniated.

6. Filling of the ventricular system occurred normally.

The origin of this type of aneurysm is not as important as the direction in which it expands. The 2 lesions here presented expanded inwardly, compressing and distorting the 4th ventricle. Aneurysms arising from distal vertebral, proximal cerebellar, and proximal basilar arteries could all conceivably do this. Duvoisin and Yahl have described 2 cases of aneurysm of the basilar artery which appeared to be mass lesions; these occurred in a series of 27 saccular posterior fossa aneurysms. Two other cases which simulated tumors were briefly mentioned. Their first case was diagnosed as a glioma of the pons. Postmortem review of the pneumoencephalogram upon which the diagnosis was based showed a rounded pre-pontine mass. The second case was correctly diagnosed by angiography after the pneumoencephalogram also showed a circumscribed pontine lesion.

One of us (with Wickbom) reviewed the pneumoencephalograms of 131 patients with posterior fossa neoplasms. Many of the tumor patients showed 1 or 2 of the pneumoencephalographic findings of aneurysms but not the entire radiological complex. Some of the cerebellopontine angle tumors caused obliteration of a lateral recess of the 4th ventricle but the ipsilateral pontocerebellar cisterns were also partly or completely obliterated. Gliomas of the pons usually grow in a symmetrical fashion with posterior displacement and splaying of the floor of the 4th ventricle. Fourth ventricular tumors may occlude one lateral recess and produce little distortion of the ventricular system. However, they tend to grow in a lobulated fashion and may protrude through the foramen of Magendie to present as a soft tissue mass at the foramen magnum. Frequently, they grow cephalad into the region of the aqueduct and produce partial obstructions. The age distribution and clinical picture of tumors of the 4th ventricle are quite different from those in the posterior fossa aneurysm.

Even though the surgeon explores the posterior fossa to establish a doubtful diagnosis, prior knowledge that the lesion is an aneurysm will allow more specifically planned surgery. The use of the surgical microscope in our second patient is an example. A mass
lesion in this region which is not typical of cerebellopontine angle tumor or intrinsic tumor of the pons may be an operable aneurysm. Operation upon aneurysms of the posterior fossa appears justified as demonstrated in our 2nd case and by other cases in the literature.

Summary

1. We have reported 2 patients with aneurysms in the region of the vertebral-basilar junction. Their clinical symptoms were due to the pressure effect of the aneurysm.

2. The pneumoencephalogram showed a well-rounded, fairly sharply outlined mass obliterating the lateral recess of the 4th ventricle and causing very little distortion of the ventricular system and little or no distortion of the basal subarachnoid cisterns. The cerebellar tonsils were not herniated and filling of the ventricular system occurred uneventfully.

3. Pneumoencephalographic findings of an atypical mass lesion, may be due to an operable aneurysm arising from the region of the vertebral-basilar junction.

4. Vertebral angiography is necessary for definitive diagnosis and proper surgical management.

References