A MECHANISM TO ACCOUNT FOR FRONTAL HEADACHE IN CASES OF POSTERIOR-FOSSA TUMORS

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HEADACHE in the frontal area is a symptom frequently associated with intracranial tumors. It occurs with many supratentorial masses and almost all tumors of the posterior fossa.

The mechanism of headache associated with intracranial mass lesions has been the subject of much study; in particular, the investigations of Wolff, Ray, Schuchmacher, and Kunkle have clarified many of the problems of pain posed by this type of pathology. Despite these and many other contributions, there remain perplexing features still hard to explain and reconcile with the known facts.

It is well known that headache may be misleading as a localizing sign of intracranial tumor, since, as pointed out by Wolff and others, it overlies the tumor in only about one-third of cases. Thus in many instances there is no correspondence between the mass and the headache. Of this, posterior-fossa tumors constitute a conspicuous example; for while the tumor is suboccipital, the headache commonly is frontal. Cushing, in reviewing his large series of cerebellar astrocytomas, stated that the headaches often were frontal rather than suboccipital and that in a few instances the frontal sinuses had been explored because of unexplained frontal headaches. He continued: "Indeed, by the time the headaches come to be localized in the suboccipital region the patient no longer refers to them as such but rather as [suboccipital] discomfort or a painful stiffness in the neck which is aggravated by any sort of effort likely to produce intracranial venous congestion."

Bailey et al. stated that 70 per cent of headaches were frontal in their series of tumors of the cerebellar fossa; and recently Bodechtel noted that when headaches are present with cerebellar tumor they are in the posterior region, the neck, and the forehead. Dandy also indicated the likelihood that headache with these tumors will be frontal.

Numerous other authorities have noted this referral of headache to the frontal area with expanding lesions of the posterior fossa, though occasionally it is stated that the headache in a given series of posterior-fossa tumors was in the back of the head.

PREVIOUS EXPLANATIONS

The mechanisms of headache in cases of brain tumor still are under study. It has been well established that increased intracranial pressure is not the basic mechanism involved. Northfield showed that the level of intracranial pressure as determined by spinal manometry has little to do with the presence of headache, and Wolff confirmed and extended these observations.

It was their opinion that the headache with mass lesions is related to shift of the intracranial contents with traction on pain-sensitive structures—an interpretation that generally is accepted. The identification of these pain-sensitive structures we owe particularly to Ray and Wolff who studied this point exhaustively in patients undergoing craniotomy with local anesthesia.

Although these observations and the known distribution of pain evoked by stimulation of the recognized pain-sensitive structures account for many of the peculiarities of headache of intracranial origin, in some instances one still cannot explain the discrepancy between the sites of tumor and of headache.
In the case of posterior-fossa tumors with bifrontal headache, for example, the most commonly cited explanation\textsuperscript{1-3} is that pressure on the tentorium from below irritates the tentorial nerves. These nerves have been known to anatomists for over a century and have been the subject of careful study by Feindel and co-workers\textsuperscript{5} more recently. According to their descriptions, the tentorial nerves arise from the ophthalmic branch of the trigeminal nerve and run in a recurrent direction along the tentorial edge to distribute over the superior surface of the tentorium, the falx, and the region of the torcular. Stimulation in these regions gives rise to referred pain in the frontal and orbital regions—which is to be expected, since the tentorial nerve arises from the ophthalmic nerve.

Activation of this mechanism in the case of a posterior-fossa tumor must require a considerable degree of pressure from below to stimulate nerves that lie on the superior surface of the fairly rigid and thick tentorium. A possibility would be that branches of these nerves penetrate the tentorium to the undersurface and thus become accessible to stimulation. However, Ray and Wolff\textsuperscript{12} in their study of patients under local anesthesia stated:

“Slight or even moderate pressure upward [on the tentorium] usually failed to cause pain unless the margins of the venous sinuses were approached, in which case pain was usually experienced behind the homolateral ear. When pressure on the center of the tentorium was increased, pain occurred behind the ear, in the region of the forehead and eye on that side or in both regions. . . . Faradic stimulation of sufficient intensity to induce pain in the structures with well established sensitivity to pain . . . failed to cause pain when applied to points on the undersurface of the tentorium more than 5 mm. from the venous sinuses. It was found further, however, that if the intensity of the stimulus was increased sufficiently pain was experienced in the forehead and in the region of the eye on that side, suggesting that the stimulus was transmitted through the tentorium to its superior surface.”

It seems clear from these observations of Ray and Wolff that a stimulus of considerable intensity is required to evoke frontal and orbital pain from the under surface of the tentorium, and furthermore, that pain behind the ear is often associated with such stimulation. Only when stimuli are applied to the upper surface of the tentorium is isolated frontal and orbital pain elicited at low-stimulus parameters.

Although in the late stages of a posterior-fossa tumor considerable distortion of the tentorium sometimes occurs, it would appear most unlikely that this mechanism is responsible for frontal pain. First, the bifrontal headaches in these cases often appear at an early stage, before there is any evidence of increase in intracranial pressure. Second, as noted previously, headache frequently is experienced without increase of pressure; and as shown by others, intracranial pressure has no relation to headache. Third, by the time there is a significant degree of pressure the headaches are no longer exclusively frontal but are replaced or accompanied by suboccipital discomfort (Cushing\textsuperscript{6}).

Thus, the current knowledge of pain mechanisms in headache does not appear to account for referral of headache to the forehead from posterior-fossa mass lesions.

A PROPOSED MECHANISM

Observation of response to stimulation in 4 patients undergoing upper cervical dorsal rhizotomy because of hemianal-pain syndromes led to consideration of a hitherto undescribed mechanism as a possible explanation for the pain.

These patients were operated on under local anesthesia and all were cooperative. Cervical laminectomy was performed and the upper three cervical roots were exposed; during the procedure each individual rootlet composing each dorsal root was stimulated separately. Initially a Grass stimulator was used, but subsequently gentle pressure or traction with bayonet forceps was found to be equally effective.

It was noted that when the dorsal rootlets of C2 were stimulated extension of pain to the frontal and orbital regions did not occur, though on one occasion a fine filament associated with this root did produce pain in the