Pinealomas and Tumors of the Posterior Portion of the Third Ventricle

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This is a review of 45 patients with tumors in the region of the pineal body and posterior third ventricle treated in the Department of Neurosurgery of the Lahey Clinic Foundation from 1934 to 1965. The pinealomas referred to in this report cannot be considered separately from other tumors of the posterior portion of the third ventricle for most of the diagnoses were unverified and based mainly upon clinical and radiologic findings. Tumors of the surrounding regions are not considered.

Classification and Definition

The term “pinealoma” has been used since Krabbe* adopted it in 1923 and has been applied to any tumor of the pineal parenchymal cells. Because of the variations in maturity of the characteristic cells, del Rio-Hortega used the terms “pineocytoma” and “pineoblastoma.”

Several authors have continued to use this classification to emphasize the difference in cell maturity. Unfortunately, the term “pinealoma” has also been used widely for the growth that is regarded as an atypical teratoma and the term “ectopic pinealoma” has been used for growths of similar histology arising in other locations in the brain.

Many authors, working separately, have found previously unsuspected properties of the pineal body. It is no longer looked upon as a vestigial organ or merely as a useful landmark in neuroradiology. It is well known that radiiodine and radiophosphorus are taken up faster by the pineal body than by any other part of the brain. This indicates a high rate of metabolic activity. Large amounts of histamine, acetylcholine, epinephrine, melatonin, serotonin, 5-methoxyindoleacetic acid, and 5-hydroxyindoleacetic acid are found in the pineal body, even in partly calcified glands. These substances appear to be produced by the gland, not simply stored by it. Melatonin and hydroxyindole-o-methyating enzyme are practically unique products of the pineal body. Melatonin (N-acetyl-5-methoxytryptamine) is a neurohormone formed in the pineal body by N-acetylation and o-methylation of serotonin. Farrell* found that ablation of the pineal body decreased aldosterone secretion, and that the adrenal output of aldosterone increased when extracts from beef diencephalon were injected intravenously. The substance was named adrenoglomerulotropin and has been identified as a melatonin derivative (1-methyl-6-methoxy-1,2,3,4-tetrahydro-2-carboline).

The belief that tumors of the pineal body are frequently and specifically related to gonad malfunction is no longer accepted. Because of its strategic location, enlargement of the pineal body may compress the posterior hypothalamus or alter the cerebrospinal fluid dynamics. Cohen, et al.,2 emphasized that the influence of pineal tumors on the gonads is entirely secondary to pressure in other parts of the brain and called attention to the fact that pineal tumors have been associated with both precocious and delayed puberty. Furthermore, many nonpineal intracranial growths have also been associated with disturbances in puberty.

In 1954, Kitay,8 reviewing the literature on this subject, found some correlation between the histology of the tumor and the nature of the endocrine disturbance. Parenchymatous pinealomas have usually been associated with depressed gonad functions, while nonparenchymatous growths (for example, gliomas and teratomas) appeared to be related to precocious puberty associated with subsequent destruction of the gland. Thus, pineal hypofunction has been related to precocious puberty and pineal hyperfunction to delayed pubescence. These findings also have suggested that a hormone, probably

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inhibitory, is normally produced by the pineal body. No such hormone has been identified in patients having pinealomas, but evidence shows that it exists and probably is related to melatonin.

Clinical Signs and Symptoms

Our series of 45 patients included 29 males and 16 females. The average age was 23.8 years; 19 patients were less than 18 years of age. The pertinent clinical symptoms, pathological changes, treatment, and observations after treatment are summarized in Table 1.

Symptomatology. The duration of symptoms before treatment varied from 4 days to 4 years. In this series there were usually three clinical phases in the progression of these tumors (Table 2). Headaches characterize the first phase and may or may not be followed by nausea and vomiting. During this time the patient's general condition deteriorates. The second phase is usually characterized by blurred vision, diplopia, change in mental outlook, ataxia or dizziness, drowsiness, pupillary changes, and paralysis of the extraocular muscles, mainly those responsible for conjugate upward gaze. In the third phase papilledema, marked weakness, and varying degrees of spasticity appear. Air studies usually reveal a typical internal hydrocephalus associated with destruction of the walls of the third ventricle.

Eye signs may represent one of the main features in the clinical symptomatology of pineal tumors. Parinaud's syndrome is considered by many neurologists to be a pathognomonic sign for tumors arising in this region. Anatomical data indicate that the corticotectal tracts originating in areas 18 and 19 terminate in the midbrain; the fibers related to upward conjugate deviation of the eyes end in the rostromedial portion of the superior colliculus. The fibers responsible for downward conjugate deviation end in its caudolateral portion of the superior colliculus. Parinaud's syndrome is apparently caused by involvement of the rostral portions of the superior colliculi. Impairment of the caudolateral portion of the superior colliculi would cause loss of downward conjugate gaze. Loss of horizontal conjugate deviation is rarely observed because these fibers of the corticotectal tracts travel through the midbrain tegmentum. Studies (Szentagothai) have also shown that the direct coordinating center for movement of the eyes in the vertical plane is found in the periaqueductal gray substance near the site of takeoff of the aqueduct of Sylvius from the third ventricle.

Here the nucleus of Darkschewitsch and the interstitial nucleus of Cajal are directly connected with the oculomotor nuclei through fibers descending from the medial longitudinal fasciculus. These nuclei coordinate not only the ocular muscles for vertical movements but also the muscles for the superior eyelid. According to Szentagothai, the relationship between the superior colliculi and the oculomotor nuclei is only indirect and the link between these nuclei is more likely to be the nucleus of Darkschewitsch and the interstitial nucleus of Cajal. The explanation of the other eye signs is anatomically obvious and will not be considered in detail.

Laboratory Findings. Not all patients had a lumbar puncture, but one lumbar cerebrospinal fluid pressure of 400 mm of water was recorded. Tumor cells were present in the cerebrospinal fluid in Cases 4 and 44. No other important abnormalities were observed.

Not all of the patients had electroencephalograms. Of those who did, Cases 30 and 45 had abnormal tracings.

Roentgenography. Camp observed that calcification of the pineal in patients less than 10 years old is rare and when present should suggest a pinealoma. Twelve of our patients had calcification in the pineal region. Their ages ranged from 12 to 70 years. Calcification was found in nine patients under the age of 24 years.

Pineal shift was present in only five cases. Separation of sutures was observed in two cases, and increased convolutional markings were found in two.

Ventriculography. Although clinical signs may suggest the presence of a pineal tumor, the final diagnosis can only be made by ventriculography. Symmetrical hydrocephalus and filling defects in the pineal region were the main abnormal features present in these studies. Symmetrical hydrocephalus was observed in 36 of the 45 patients and a defect in the pineal region in 39 patients. Projection of the tumor shadow into the posterior portion of the third ventricle, associated with dilated ventricles as demonstrated by the ventriculograms and combined with the clinical and other roentgenographic findings,