DIABETES INSIPIDUS FOLLOWING SECTION OF HYPOPHYSEAL STALK

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(Received for publication September 27, 1960)

Although considerable progress in the understanding of the anatomy, physiology, and pathology of diabetes insipidus has been made, there still remain aspects of this process that are in a state of controversy or are unknown.

The significance of Cajal's observation in 1894 of a nerve tract joining the hypothalamus with the hypophysis, was originally not fully appreciated, for in the early part of the 20th century diabetes insipidus was thought to be the result of deficiency of secretion from the posterior lobe of the pituitary body. Camus and Roussy showed that this condition could occur following damage to the hypothalamus alone. The appreciation of the importance of the fiber tract joining the posterior lobe of the pituitary body to the hypothalamus by Pines and Greving gave further impetus to the idea that these structures functioned as a unit rather than separately.

Using the Horsley-Clarke stereotaxic instrument, Fisher et al. found that when hypothalamic lesions in cats interrupted the supraopticohypophyseal tract bilaterally, the daily volume of urine was greatly increased. It was also observed that administration of posterior pituitary extract decreased the polyuria. Microscopic examination of the hypothalamus in the animals showing polyuria revealed that both supraopticohypophyseal tracts had been sectioned. The marked loss of supraopticohypophyseal fibers was associated with loss of nerve cells in the supraoptic nuclei. The essential features observed in cats were also found by Magoun et al. to apply to monkeys, with the additional observation that section of the infundibulum resulted in a mild to moderate polyuria, whereas section of the median eminence resulted in severe polyuria.

Using a method of remote stimulation, Harris furthered the concept of functional unity of the hypothalamohypophyseal system. When the tip of an electrode was in contact with the hypothalamic portion of the supraopticohypophyseal tract, median eminence or infundibulum, stimulation caused inhibition of water diuresis which varied from 15 minutes to several hours, depending upon the strength of the stimulus. This inhibition of water diuresis was the result of release of the antidiuretic hormone.

Although Popp had suggested that the hypothalamus was a secretory center, it remained for Scharrer and Gaupp to show evidence of neurosecretion in man. Investigations of Hild and Zetler and others suggested that the antidiuretic hormone is produced by cells of the hypothalamus and then transported down the hypophyseal stalk to be stored in the posterior lobe of the pituitary gland.

Although general acceptance of an interrelated hypothalamohypophyseal system has been largely achieved, some disagreement has persisted as to the relationship of section of the pituitary stalk to diabetes insipidus. Paulesco, in 1908, mentioned briefly the results of section of the pituitary stalk in 6 dogs with survival periods ranging from 1 to 24 days, but made no mention of water balance other than to comment on the lack of glycosuria in 1 dog.

In their experiments on hypophysectomy, Crowe et al. included 5 dogs in which division of the pituitary stalk was done. No mention was made of diabetes insipidus. In later studies on dogs, Cushing and Goetsch
crushed the pituitary stalk with a silver clip, with resulting severe polyuria in 1 animal.

Section of the pituitary stalk first was done in monkeys by Karplus and Kreidl, and in the 2 animals that survived, no obvious disturbance was noted. Later Morawski sectioned the pituitary stalk in 6 monkeys and reported that no abnormal symptoms developed in these animals.

Bell occluded the stalk in 1 dog, and divided it in 2 other dogs, but made no mention of polyuria in the postoperative period.

The first section of human pituitary stalk was performed on a patient of Dr. Cushing's, and was reported by Dandy and Goetsch in 1911. In this case the stalk was avulsed accidentally during pituitary biopsy. The patient died in the early postoperative period, and no mention was made of polyuria.

In 1928, Dott, in an effort to assure permanent separation of the blood supply to the pars distalis, placed a small platinum plate between the sectioned stalk and the pituitary gland. Postoperatively, Dott noted a marked polyuria which was maximal in the first 24 to 48 hours.

Mahoney and Sheehan crushed the pituitary stalk with silver clips in dogs and monkeys. These investigators believed that the presence of diabetes insipidus in the dog was associated with inadvertent damage to the hypothalamus while placing the clip on the stalk. In the monkey the anatomical features were such as to permit clipping the stalk without hypothalamic trauma, and no polyuria occurred.

In 1940, Dandy reported 1 case in which section of the human stalk was done. The patient, who gave birth to two children after the procedure, had immediate polyuria and polydipsia which continued until death 11 years later. During the periods of observation, the 24-hour volume of urine averaged approximately 3,000 cc. with maximum 24-hour volume reaching about 4,500 cc., indicating, at most, only a moderate degree of diabetes insipidus.

The present study consists of 23 patients who have undergone section of the hypophyseal stalk in an effort to further palliate advanced stages of carcinoma of the breast or prostate. Information regarding the clinical course and endocrinologic investigation of some of these patients has been reported elsewhere. The objective of this study is to determine the relationship of diabetes insipidus to section of the hypophyseal stalk in man.

MATERIALS AND METHODS

This report is based on all the cases of section of the pituitary stalk performed upon patients at The University of Texas M. D. Anderson Hospital and Tumor Institute, Houston, Texas, during the period from December, 1955 through June, 1958. All patients showed evidence of far advanced cancer with extensive metastatic spread.

Of the 24 patients operated upon, 18 were female (all with a known primary carcinoma of the breast) and 6 were male (5 with adenocarcinoma of the prostate and 1 with choriocarcinoma arising in the right testicle). One patient (Case 17) died during the surgical procedure.

None of the patients in this series is still alive. Necropsy was obtained in 19 of the 24 patients (79 per cent). Counts of cells in the supraoptic nuclei were made in 3 cases (2, 18 and 19).

Surgery was performed under general endotracheal anesthesia (N₂O, O₂, Pentothal). The pituitary stalk generally was approached through a right four-hole fronto-temporal craniotomy extradurally to the sphenoid ridge, where the dura mater was opened. A silver clip was placed low on the pituitary stalk, which was then transected below the clip in the first 10 cases. The placement of the silver clip was omitted in the remaining cases. After cutting the stalk, a polyethylene disc approximately 1.5 cm. in diameter was placed over the diaphragma sellae to maintain separation of the infundibulum from the hypophysis as well as to prevent re-establishment of the hypophyseal-portal vessels. In most cases, a small Penrose drain was used, and then removed within 24 hours.

In general, injection of cortisone was be-