AUTONOMIC PATHWAYS IN THE SPINAL CORD

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Most of our knowledge about the autonomic pathways within the spinal cord in man stems from the findings of Foerster on patients following anterolateral chordotomy for intractable pain. Foerster, as well as Guttmann,§ found anhidrosis after anterolateral chordotomy and concluded that the pathways for sweating ran in the anterolateral column of the spinal cord. Foerster and Gage§ believed that the pathways for sweating in the spinal cord travel in the most dorsal part of the anterolateral columns, adjacent to the pyramidal tracts, because the 2 patients in whom they were able to demonstrate anhidrosis also had Babinski reflexes postoperatively. Because the anhidrosis was not permanent, they concluded that the pathways for sweating also ran in other quadrants of the spinal cord.

Later, in 1936, Foerster⁴ demonstrated changes in vasoconstrictor reflexes after bilateral chordotomy. He expressed the belief that the efferent arm of these reflexes also was situated in the anterolateral column of the spinal cord. Because he observed changes in vasoconstrictor reflexes, not after unilateral, but only after bilateral chordotomy, he concluded that vasoconstrictor pathways to both sides of the body are represented in each anterolateral quadrant of the cord. Therefore, he thought that the vasoconstrictor pathways were interrupted only when the chordotomy was bilateral and adjacent to the pyramidal tracts. During this same period, Babtchine¹ reported elevation of the cutaneous temperatures after unilateral chordotomy. He believed that the vasomotor and pyramidal tracts run closely together, because in each case there was also a Babinski reflex on the side of the chordotomy.

In Foerster’s opinion the somatotopic arrangement of the fibers in the spinal cord was the same for those fibers mediating impulses to the sweat glands as it was for those mediating impulses to the blood vessels. He concluded that the pathway to the arm was located medially in the cord and the pathway to the leg was located laterally. This concept of spinal cord anatomy is illustrated in Fig. 1.

Shortly afterward, in 1939, List and Peet¹⁰ could neither confirm nor deny Foerster’s conception of the somatotopic arrangement of the auto-

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nomic fibers in the spinal cord. They suggested that vasoconstrictor and sudomotor impulses might pursue different and distinct paths in the cord since in 1 case they found hyperthermia in the ipsilateral arm following chordotomy, without changes in the sweating function.

Falconer and Lindsay reported data on 2 cases in which chordotomy resulted in diminution of sweating, most marked above the level of the chordotomy. Hyndman and Wolkin also had 1 case in which sweating was abolished above the level of a bilateral chordotomy. In these cases the pyramidal tracts were simultaneously impaired, and the authors agreed that the autonomic fibers reside very close to or within the pyramidal tracts.

Because of the lack of agreement of previous investigators and the opportunity to study a group of patients after anterolateral chordotomy for intractable pain, the question arose as to whether further information could be gained by carrying out such physiologic tests as reflex sweating on exposure to a baker and skin temperature measurements after anterolateral chordotomy. Thus the present investigation was begun.

**PROCEDURE**

*Patients.* Anterolateral chordotomy was carried out on 5 patients because of intractable pain. Neurologic examination was performed before and after anterolateral chordotomy in each patient.

*Operation.* After removal of the spines and laminae of the 7th cervical and 1st and 2nd thoracic vertebrae the dura was opened and the dentate ligaments were divided. Anterolateral chordotomy was performed between the 1st and 2nd thoracic levels by rotating the spinal cord and dividing the anterolateral tracts at depths from 5 to 7 mm.

*Physiologic Tests.* Skin Temperatures. Basal metabolic rates and skin temperature measurements of the fingers and toes were determined after anterolateral chordotomy. Control studies before operation were attempted but, because of the severe pain, basal observations could not be determined.

Before the tests the subjects were fasted for 15 hours, and during the test they wore light-weight short pajamas and lay supine on comfortable beds. Data were obtained in a room in which the constant temperature was 25.5°C. (78°F.) and the relative humidity was 40 per cent. The temperatures of the plantar surface of the first and third toes of both feet and the volar side of the distal phalanges of the first and third fingers were determined by means of copper-constantan thermocouples. The observations were made at