STUDIES ON THE SACRAL REFLEX ARC IN PARAPLEGIA

V. SURGICAL THERAPY OF AUTONOMIC HYPERREFLEXIA IN CERVICAL AND UPPER THORACIC MYELOPATHY*

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(Received for publication April 18, 1955)

Restoration of patients with spinal cord injury to a healthy active life is often deterred by pathologic reflex mechanisms peculiar to the isolated spinal cord. Not the least of these is autonomic hyperreflexia with its dangerous paroxysmal hypertension. It is the purpose of this paper to determine a rational approach to the too long neglected treatment of this phenomenon.

A clinically significant mass autonomic reflex may be seen in patients with myelopathy above the 6th thoracic neurotome. The symptoms in such cases are severe throbbing headache, sweating and cutis anserina, usually above the level of myelopathy, and occasional dyspnea, palpitation and nasal congestion. During the first World War, Head and Riddoch described excessive sweating in patients with spinal cord injuries. Autonomic reflexes in spinal man have been observed and described subsequently, but except for Bors and French who presented satisfactory experience in 7 cases of posterior rhizotomy of T9 through S5, no surgical attempt to relieve all manifestations of autonomic hyperreflexia and particularly the hypertension has been reported. List and Pimenta advocated sympathectomy or paravertebral alcohol injection for relief of reflex sweating while Thompson and Witham presented the use of tetraethyl ammonium chloride for paroxysmal hypertension.

In paraplegic patients with poorly functioning bladders, it was found that novocain injection of the sacral nerve usually relieved and spinal anesthesia always relieved the headache and hypertension that may be associated with a cystometrogram. Stimulation of areas supplied by the sacral nerves and particularly of the bladder is capable of causing a severe autonomic hyperreflexia although it may be elicited by any stimulus below the level of myelopathy. Therefore, filling of the bladder was selected as a stimulus for the pre- and postoperative studies. Only patients with extremely severe hypertension and persistent headache or sweating in response to bladder irrigation or catheterization, routine enemas and bathing of the perineum were considered for study and surgery.

* Presented at the Southern Neurosurgical Society meeting, Birmingham, Alabama, February 19, 1955.
For preoperative study the patient was taken in his bed to a constant temperature room. After at least one-half hour of rest the following measurements were made: plethysmographic tracings from thumb, little finger and large toe, blood pressure, pulse, and skin resistance and temperature recordings from the forehead, ear, arm, thumb, little finger, chest, abdomen, thigh, foot and toe. A cystometrogram by way of urethral or suprapubic catheter was then begun by introducing 200 drops of normal saline into the bladder per minute. The flow was temporarily stopped at each 50 cc. to allow determination of resting bladder pressure and the above recordings. The onset of headache, cutis anserina, perspiration, pupillary changes and nasal congestion were noted. The procedure was terminated by bladder drainage when bladder pressure exceeded 40 cm. of water or discomfort became severe. In the first cases of this series sacral or saddle block followed by the same course of study was employed to predict the postoperative result, but this is no longer felt necessary. Identical postoperative observations were also recorded.

The 13 patients operated upon had in common a myelopathy at or above T4 which was physiologically complete in all except 3. Bladder distention resulted in marked elevation of blood pressure, bradycardia, headache, decrease in skin temperature as much as 8°F. in fingers and toes, marked constriction of blood vessels, dilatation of pupils, varied cardiac arrhythmias with rates as low as 36 and the following changes usually above the level of myelopathy: cutis anserina, blotchy redness of skin and marked decrease in skin resistance with profuse perspiration. Reversion to normal was usually rapid with bladder drainage. Stimulation of the legs by pin prick or rubbing usually resulted in mild subclinical changes. Postoperative bladder distention revealed absence of the above manifestations of autonomic hyperreflexia with the various surgical procedures.

Two of the 13 patients had a milder pressor reflex, but are included although they had division of sacral nerves primarily for elimination of recurrent pyelonephritis caused by ureteral reflux. Seven patients underwent 1st or 2nd through the 5th sacral rhizotomy or neurotomy performed through upper sacral laminectomy. This is a modification of the previously described technique for sacral neurotomy.11 Four patients had total lumbosacral rhizotomy with excision of the conus medullaris for concomitant relief of spasticity of the lower extremities. Posterior rhizotomy below T9, as described by Bors and French,2 was done in 1 case with thoracic chordectomy in the remaining patient.

Electrical stimulation of the exposed sacral roots revealed that stimulation of intact anterior and posterior sacral roots resulted in immediate hypertension, etc. Stimulation of the proximal divided anterior root was without effect, while of the distal anterior root resulted in elevation of the blood pressure which was eliminated on division of the posterior roots. Stimulation of the distal posterior root yielded no response, but there was consistent hypertension with stimulation of the proximal end of the divided posterior sacral root. Surgical manipulation usually resulted in severe enough eleva-