An Anterior Approach to Percutaneous Lower Cervical Cordotomy*

PAUL M. LIN, M.D., PHILIP L. GILDENBERG, M.D., AND PEDRO P. POLAKOFF, M.D.
Department of Neurosurgery, Temple University School of Medicine, Philadelphia, Pennsylvania

The technique of anterolateral cordotomy has been used successfully in the treatment of intractable pain since 1912. However, this operation has not been available to many patients suffering from pain that is not relieved by the usual nonsurgical methods. The reason is that, until recently, cordotomy involved a major operation with possible mortality and morbidity, significantly greater in those debilitated patients who needed pain relief most. The procedure often caused weakness of an extremity or loss of sphincter control. If it were unsuccessful, or if pain recurred later, each successive attempt to incise the cord became more difficult.

In 1963, Mullan et al. devised an approach to the cervical spinal cord by inserting a needle through the neck under roentgenologic control. They introduced a radioactive needle (strontium) to produce a lesion interrupting the lateral spinothalamic tract. Mullan and Rosomoff et al. later simplified the procedure by using an electrical current to produce the lesion. The percutaneous methods required the insertion of a needle through the lateral aspect of the neck, between the arch of the atlas and the lamina of the second cervical vertebrae, and thus to the anterolateral surface of the cord.

Respiratory impairment associated with high surgical cervical cordotomy has been well documented. It has been shown that the fibers descending to the respiratory musculature lie exceedingly close to the lateral spinothalamic tract at the higher cervical level. Belmusto et al. reported a peculiar type of paralysis of involuntary respiration with preservation of voluntary respiratory activity occurring in patients who had undergone bilateral high cervical antero-
lateral surgical cordotomy. In patients who had marked limitation of pulmonary function of one lung, a unilateral cordotomy on the side of normal pulmonary function might produce a similar impairment of reflex respiration. These patients have preservation of voluntary respiration. They breathe adequately while awake but, "during a period of natural sleep, respiratory efforts become ineffective and require assistance." In his series of percutaneous high cervical cordotomies, Mullan reported a similar respiratory complication, but Rosomoff et al. did not.

We have done percutaneous radiofrequency high cervical cordotomy by a modification of the Rosomoff technique and had 4 deaths due to paralysis of involuntary reflex mediated respiration. In an attempt to avoid the respiratory complications associated with high cervical percutaneous cordotomy, we devised an anterior approach to the lower cervical cord. The needle electrode is inserted through an intervertebral disc in the lower cervical area, below the emergence of the phrenic nerve fibers that control diaphragmatic respiratory movement (Fig. 1). With this approach we are not only able to protect involuntary respiratory function but also to reduce the risk of postoperative motor and sphincter paralysis. Moreover, by this method we can do a selective segmental cordotomy.

Method

The electrode is a modified version of that used by Rosomoff et al. It consists of a standard uninsulated three inch, 18 gauge, thin walled, lumbar puncture needle through which is inserted a steel wire stylet .016 inch in diameter. The stylet protrudes 4 mm. beyond the point of the needle and is insulated with Teflon, except for the last 2 mm. Two different types of stylets can be used interchangeably. One is straight, and the other has a curve at the end so that the lesion can be made at a point 1 to 2 mm. from the alignment of the needle (Fig. 2).

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Paul M. Lin, Philip L. Gildenberg and Pedro P. Polakoff

Fig. 1. Schematic drawing of the anterior approach for low cervical percutaneous cordotomy. The needle is inserted from the opposite side of the neck between the carotid sheath and the trachea-esophagus complex. It enters the disc space obliquely to avoid the anterior spinal artery or corticospinal tract.

The 500,000 cycle radiofrequency generator is commercially available (Radionics, Model RFG-2A). Its output is continuously variable between 0 and 12 watts. The current is monitored on an incorporated milliamperemeter.

The patient is placed supine on a stretcher with the head resting on a Franklin head unit and immobilized by a standard head clamp. The anterior portion of the neck is prepared and draped. The skin, subcutaneous tissues and prevertebral fascia are infiltrated with a local anesthetic. The needle is inserted medial to the carotid sheath and lateral to the trachea and esophagus, about 2.5 to 5 cm. above the sternoclavicular joint on the side opposite to the intended lesion. By palpation with the needle tip, either C 5-6, or C 6-7 disc space is identified and entered. The needle is directed diagonally through the disc, aiming toward the target point in the opposite anterolateral quadrant of the cord. This oblique angle is desirable in order to avoid injury to the corticospinal tract and anterior spinal artery in case of overpenetration. The placement of the needle is determined by repeated antero-posterior and lateral Polaroid roentgenograms, and appropriate corrections are made. Antero-posterior films are taken with the Franklin x-ray tube and lateral x-rays are taken with an overhead or portable unit, so that the patient’s head need not be moved during the entire procedure.

Although the intervertebral disc affords adequate immobilization of the needle, some fine adjustment is possible by maintaining firm manual pressure on the hub of the needle. Adjustments of more than 2 mm. may require complete withdrawal of the needle from the disc and reinsertion in a more appropriate direction.

When the tip of the needle emerges from the posterior portion of the intervertebral disc, the dura is encountered. It is advisable to use a sharp needle because, in this area, the dura may be more difficult to penetrate than in its lateral or posterior portion. Sometimes it is necessary to perforate the dura first with a stylet from a slightly longer lumbar puncture needle.

When the tip of the needle is in the subarachnoid space, free flow of spinal fluid occurs. Ten cc. of air are then injected through a 2-way stopcock and the anterior surface of the spinal cord is visualized by lateral Polaroid roentgenograms, as in an air myelogram (Fig. 3).

The target point is determined by the intended area of analgesia. To produce a segmental area of analgesia in the low cervical and upper thoracic dermatomes, the tip of the electrode should enter the cord 4–6 mm. from the midline, as determined by bisecting the interpedicular line. In order to produce lumbosacral analgesia, the tip of the electrode should be positioned more laterally, 8 to 9 mm. from the midline (Fig. 4).

Only the most anterior border of the cord is seen in the lateral projection, and this represents that portion of the cord nearest the midline. When the target is near the midline, the tip of the electrode...