RELIEF OF PAIN BY NEUROSURGICAL PROCEDURES

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NEUROSURGICAL procedures offer relief from intractable pain in many instances when medical and general surgical procedures fail. However, they should not be employed until all medical and physical means have been exhausted. Physical therapy and administration of an analgesic drug usually suffice to relieve pain due to inflammatory lesions such as neuritis, fibrositis, myositis, and arthritis. There is always a temptation to administer a narcotic for pain, but it should be remembered that the administration of a narcotic for more than a few days can readily lead to addiction. Administration of a narcotic is not justified for chronic conditions, with one exception, and that is for an inoperable malignant lesion when the patient’s life expectancy is only a few months.

Pain, an unpleasant, disagreeable, often debilitating sensation, results from irritation or stimulation of a sensory nerve or tract which in turn conducts the stimulus to the brain. Interpretation of such stimuli varies from person to person and the interpretation of their severity is exaggerated or minimized by emotions and environment. This variation is referred to as the threshold of pain and this threshold may be high or low in different persons with comparable lesions; that is, one patient may complain of pain from an irritating stimulus of the sensory nerves while another may ignore or minimize the discomfort from a similar stimulus.

Chemical injections of sensory nerves, rhizotomy, chordotomy, and tractotomy are accepted neurosurgical procedures for the interruption of sensory nerves and tracts which conduct painful sensations.

TECHNIC OF TREATMENT

Local infiltration of a sensory nerve with an anesthetic agent, such as piperocaine hydrochloride (metycaine®) will relieve pain for an hour or two. It has no lasting effect unless the psychic effect of an injection may be of some value when there is an associated neurosis. The anesthetic effect often is of diagnostic value in determining whether or not a chemical agent or operation employed to interrupt the function of the nerve is indicated or will be of value in relieving the painful sensation.

Alcohol Injection of Sensory Nerves.—Absolute alcohol or alcohol in concentrations of 95 to 98% is the most effective agent used to destroy a sensory nerve. It

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is wise to anesthetize the patient with nitrous oxide or thiopental (pentothal®) sodium during the injection of 2 to 5 cc. of alcohol, since the immediate effect of the injection is very painful. The destructive effect of the alcohol is decreased if the field is prepared by a local anesthetic, since it dilutes the alcoholic solution.

The injection of the second and third branches of the fifth cranial nerve with alcohol gives excellent temporary relief from trigeminal neuralgia. It is unwise to attempt injection of the first or ophthalmic branch as it enters the orbit, because the alcohol may infiltrate the oculomotor nerves, which lie in the same vicinity, and produce oculomotor paralysis. Injection of the ophthalmic nerve with alcohol at the supraorbital foramen may give slight relief; however, avulsion of this nerve will usually give a longer period of temporary relief.

The technic employed at the Mayo Clinic for alcohol injections of the second or third branches of the trigeminal nerve is as follows: A needle of the trocar cannula type, 8 cm. in length and 1.5 mm. in diameter, is employed. The cannula is graduated in centimeters in order to indicate the depth. The patient is anesthetized with nitrous oxide until he reaches the analgesic state. Then the needle can be inserted without pain. Anesthesia is not allowed to become so deep that the patient is unaware of pain when the needle touches the nerve. Once the surgeon is confident that the needle is close to the proper nerve, nitrous oxide anesthesia in increased until the patient is completely anesthetized before the alcohol is injected.

Injection is made into the mandibular branch of the fifth cranial nerve at its exit from the foramen ovale. The needle reaches this site by piercing the skin at a point 2.5 cm. in front of the descending root of the zygoma, which almost coincides with the anterior bony border of the external auditory meatus. The needle is directed slightly upward along the base of the skull and a little backward at a depth of 4 cm. For injection into the superior maxillary division, the skin is pierced, 0.5 cm. posterior to the external angle of the orbit, underneath the zygoma, and the needle is directed vertically to the anteroposterior line but inclined slightly upward in a direction which should reach the nerve, at a depth of 5 cm., as it emerges from the foramen rotundum.

Paravertebral Injections.—The important landmarks in paravertebral injections are the spaces between the tips of the spinous processes.¹ The anesthetist finds the selected space with the tip of a finger. When the injection is to be made in the lumbar region, the wheal (the superficial injection of the skin) is raised directly opposite the finger tip and about 4 cm. or 2 fingerbreadths from the median line. For an injection in the thoracic region the wheal is raised opposite the upper border of the finger tip; this corresponds to the lower border of the spine of the vertebra above the finger.

A needle 80 mm. in length is then passed in a plane perpendicular to the skin until the point of the needle comes to rest near the end of the transverse process of a vertebra. Following this the needle is partially withdrawn and directed upward and over the upper border of the transverse process. The needle is not passed beyond the space between the transverse processes. The solution is then injected. Since an injection of 2 to 5 cc. of 1% solution of procaine hydrochloride or piperocaine hydrochloride will saturate the spinal nerve as it emerges from the intervertebral foramen, at no time should the needle be directed toward the body of the

vertebra lest the solution may be injected into the spinal canal. This fact is especially important if an injection of alcohol is being made.

Cervicothoracic Sympathetic Block.—The space between the spines of the seventh cervical and the first thoracic vertebra is identified by the anesthetist with the tip of the index finger. A wheal is raised 2½ fingerbreadths lateral to the midline and opposite this space. An 80 mm. needle is inserted between the transverse processes until the point strikes the lateral surface of the body of the first thoracic vertebra. The point of the needle is advanced along the surface of the body of the vertebra until it lies almost even with its anterior surface. At this point, or just before the needle reaches this point, paresthesia may be obtained similar to the pain incidental to puncture of the wall of a vein. When such paresthesia is obtained, the needle should be immobilized immediately and 15 cc. of 1% solution of procaine or piperocaine hydrochloride should be injected. If the pain is the result of the needle actually striking the sympathetic trunk, the injection will be effective immediately. The effectiveness is usually evidenced by Horner’s syndrome developing almost as soon as the patient is turned on his back. When direct contact with the nerve is not made by the needle, Horner’s syndrome may not develop for 10 to 15 minutes.

Posterior Splanchnic Block.—The patient is placed in a prone position. A pillow is placed under the abdomen and the anterior-superior iliac spines in such a way as to elevate the vertebral spines and render them easily distinguishable. The prone position is desirable in order to insert the splanchnic needles, one on each side, before injection. Wheals are raised on each side 7 or 8 cm. from the midline near the lower edges of the 12th ribs. A needle 80 mm. long is thrust through each wheal and from 2 to 4 cc. of 0.5% solution of a local anesthetic agent (procaine or piperocaine hydrochloride) is injected along the course to be pursued by the longer needles (120 mm.). These longer needles are placed next, first on one side and then on the other, so that their points rest against the lateral surfaces of the body of the first lumbar vertebra.

If contact of the needle with bone is painful, 2 or 3 cc. of the local anesthetic solution is injected to facilitate moving the point of the needle to the region just anterior to the lateral surface of the body of the first lumbar vertebra. If blood appears, the position of the needle is changed to avoid blood vessels. Frequent aspirations usually will disclose whether the point of the needle has entered a blood vessel. After the point of the needle has made contact with bone (first position) the needle is rotated until the bevel lies against bone and then the needle is slid downward to the second position (step descent). The needle is again rotated until the bevel is down, and search for bone is made. If contact with bone is effected, the needle is again rotated (third position) and is advanced with the bevel against bone. Again the rotary motion is carried out; the bone is palpated with the bevel down (second position), and, if bone is no longer felt, the needle is advanced a short distance so that the point is about on a level with the medial portion of the body of the vertebra (fourth position).

When possible, the splanchnic needle is passed above the transverse process of the first lumbar vertebra, but if necessary on account of pain may be inserted below it. The spinal nerves should be avoided; any paresthesia should be slight and should serve as a warning. If patients are very large, the 120 mm. needle may be thrust in for almost its entire length. For smaller patients, usually two-thirds of the shaft of the needle disappears into the tissue before the prevertebral space is reached.
Lundy has advocated taking roentgenograms of the needles in position before injections are made to assure the accuracy of the injection.

After the needles are in position, 10 cc. of 0.5% solution of procaine or piperocaine hydrochloride is injected slowly, first on one side and then on the other, until from 25 to 50 cc. has been placed on each side. The amount of solution to be used and the rate of injection depend on the patient's ability to tolerate the solution. If signs of intoxication appear, injection may be delayed or discontinued.

As a rule the injection of the sympathetic ganglia and trunks is not too painful; thus, the local infiltration of the skin is sufficient and general anesthesia can be avoided.

Subarachnoid Injection.—Since absolute alcohol is lighter than cerebrospinal fluid, the hydrodynamic problem is to inject a few minims of alcohol into the subarachnoid space in such a manner that it will rise to the surface of the cerebrospinal fluid and come in contact with two or possibly three dorsal roots before diffusion and dilution have taken place. To accomplish this the patient is placed on his side with the spinal roots to be treated situated on the upper side. Further, to assure that the portion of the spinal canal which contains the two roots to be treated with alcohol is higher than any other portion of the canal, a firm pillow is placed under the patient opposite these dorsal roots. The field is prepared as for spinal puncture. A Becton or Dickinson 1 cc. syringe is used in order that too large a dose of alcohol may not be administered. The usual 18-gauge Barker-Luer spinal puncture needle suffices, but it is advantageous to use a smaller needle, one of 21 gauge. Absolute alcohol is preferable to 95% alcohol. In all instances it should be sterilized in an autoclave. The alcohol can be secured in 1 cc. glass ampules.

The needle is introduced through a vertebral space just below or just above the roots to be treated. After the needle has been introduced, 5 drops of cerebrospinal fluid is withdrawn before the alcohol is injected, in order that the alcohol may float across a "water" level and come in contact with the dorsal roots. The procedure is not painful when small quantities of alcohol are used. If the injection has been performed properly, the patient will observe a sensation of warmth over the body, corresponding to the distribution of the nerves that arise from the affected roots. In two or three minutes the painful sensations disappear and are followed by loss of pain and frequently by impairment in temperature and tactile sense. We prefer to give 6 to 8 minims (0.3 to 0.5 cc.) and to reinject, if necessary, rather than to chance injecting too large a dose and thus producing a motor disturbance. The patient is left in the position that has been described, for 15 minutes following the injection, in order that the alcohol may slowly diffuse into the cerebrospinal fluid without becoming concentrated about other structures within the spinal canal. If more than one pair of nerve roots is to be treated, injection should be performed on subsequent days.

Rhizotomy.—Rhizotomy may be applied to the fifth and ninth cranial nerves and to all spinal nerves. For section of the fifth cranial nerve, either a transtemporal or


a suboccipital approach may be used. We prefer the transtemporal approach. It consists of temporal craniectomy, decompression, elevation of the dura, control of middle meningeal bleeding, identification of retrogasserian fibers, preservation of the motor nerve, and partial or total section of the sensory root.

For section of the ninth cranial nerve, the glossopharyngeal, a suboccipital unilateral craniectomy is employed. The dura is opened; the cerebellar lobe is elevated, and the three nerves leaving the cranium through the jugular foramen are identified. The cephalad nerve, which is separated from the vagus by a dural band, is the glossopharyngeal nerve. This is then divided by a small right-angle knife.

Rhizotomy of sensory spinal nerves is performed after identification of the roots which lie dorsal to the dentate ligament. Caution should be employed not to injure the blood supply to the cord which follows the spinal roots. Hemostasis of arterioles in the sensory root is accomplished by electrocoagulation with a low current before the sensory fibers are divided. Unilateral hemilaminectomy suffices for exposure if the symptoms of pain are located on one side of the body.

Sympathectomy.—The technic of sympathectomy depends on the rami that are to be divided.4 If relief of causalgia in the hand is desired, division of the gray rami to the brachial plexus is indicated. This means thoracic resection of the sympathetic trunk, including the second and third thoracic ganglia. In order to improve the circulation and relieve painful lesions of the toes, feet, and legs, the lumbar sympathetic chain, including the second and third lumbar ganglia, must be removed. To perform splanchnicectomy for relief of visceral pains, an incision is made in the loin, and the splanchnic nerves are exposed by means of a subdiaphragmatic extraperitoneal approach.5 Ray and Console6 have recommended that a thoracolumbar sympathectomy with section of the splanchnic nerve be done, inasmuch as splanchnic nerve resection alone is not sufficient. A presacral sympathectomy with resection of the superior hypogastric plexus of Havelock is performed through a low midline incision.

Chordotomy.—Chordotomy, or section of the anterolateral tract in the spinal cord, was advocated by Spiller and performed by Martin7 in 1912. Section of this tract is performed on the opposite side of the cord to that on which the pain is perceived. This procedure results in a loss of pain and temperature perception, with preservation of all other functions. Chordotomy may be performed unilaterally or bilaterally at one of two levels. To interrupt sensation from the feet, legs, and abdomen, chordotomy is performed between the first and second thoracic segments of the cord. In order to relieve pain in areas supplied by the brachial plexus, chordotomy is performed at the first cervical segment on the side opposite to the pain. The operative technic consists of laminectomy, opening the dura, cutting the


attachment of the dentate ligament and using it as a guide, after rotating the cord, to pass a knife into the cord in a position parallel with and below the dentate ligament for a distance of 3 mm. The knife then is brought downward and to the side to divide the anterolateral tract. White took exception to such a limited chordotomy and gave clinical evidence that axons subserving pain are scattered widely over the anterolateral quadrant of the spinal cord and that it is necessary to divide virtually the whole anterolateral quadrant to secure a high level of analgesia. He preferred to employ as anesthesia for this operation procaine infiltration supplemented by light thiopental sodium and nitrous oxide anesthesia.

After the incision in the cord has been made, the patient is allowed to wake and the level of analgesia is checked. White has stated that often successively deeper incisions are needed to secure satisfactory analgesia. Unilateral chordotomy rarely produces unpleasant sequelae. Extensive bilateral chordotomy may give rise to urinary retention and difficulty of defecation.

*Tractotomy of the Spinothalamic Tract.*—This is performed in the medulla oblongata or mesencephalic areas. Tractotomy in the medulla is performed after a high cervical laminectomy. It was designed and performed by Schwartz and O’Leary to relieve neuralgia of the shoulder and neck. Sjögquist developed a tractotomy of the medulla to relieve trigeminal neuralgia. There is no doubt but that occasions arise when tractotomy is indicated, but it should be employed only when every other measure has failed to give relief.

Walker developed a mesencephalic tractotomy for which a craniotomy approach is employed. The operation interrupts the pain tracts from the entire opposite half of the body by a section of the lateral lemniscus at the level of the mesencephalon. Walker stated that since the incision is well removed from the motor tracts, no motor or urinary disturbance develops; that postoperative burning paresthesia complicates the results of the operation in 10% of cases, that the mortality rate is 7%, and that mesencephalic tractotomy cannot be performed bilaterally without producing complete deafness.

*Prefrontal Lobotomy.*—Prefrontal lobotomy or leukotomy appears to be of value in a limited group of patients. The operative procedures are designed to interrupt frontothalamic fibers with a leukotome through trephine openings placed lateral to the longitudinal sinus and just anterior to the coronal suture. The patient selected for this surgical procedure is one who has a pain fixation as a psychoneurosis, who is elderly, and is a chronic invalid. This precaution regarding selection of patients for prefrontal lobotomy is due to the fact that a number of patients, following lobotomies, gave rise to unpleasant sequelae.


PAINFUL CONDITIONS RELIEVED BY NEUROSURGICAL PROCEDURES

Trigeminal Neuralgia.—This is a painful neuralgia of the fifth cranial nerve that may involve one or all three branches of the nerve. Temporary relief for one to two years is obtained by an alcohol injection of the second and third branches of the nerve as they leave the skull. Longer periods of relief of pain are obtained by avulsing the first or ophthalmic branch. Unfortunately, the avulsion cannot be repeated when the pain returns. Alcohol injections of the second and third branches can be repeated. The relief of pain following second and third injections is of less duration than that following the first injection. Therefore, we advise rhizotomy of the sensory root of the gasserian ganglion when pain returns after the first injection. If the pain is limited to the third branch or has been limited to the third and second branches for several years, subtotal section instead of complete section of the sensory root of the gasserian ganglion is the operation of choice. The advantage of preserving the fibers of the sensory root to the ophthalmic branch is that sensation of the cornea is preserved. Its preservation minimizes the possibility of traumatic keratitis from the entrance into the eye of foreign bodies which the patient does not recognize.

Sjöqvist has devised tractotomy in the medulla oblongata for the disease. Technically, his operation is more difficult than rhizotomy of the sensory root of the gasserian ganglion, since, if the incision is placed too low, not all the pain fibers are cut, and if placed too high, ataxia will result.

Glossopharyngeal Neuralgia.—This neuralgia involves the ninth cranial nerve. The paroxysms of pain are extremely severe and resemble those of trigeminal neuralgia except that the pain follows the distribution of the ninth cranial nerve instead of the fifth cranial nerve. The patient is permanently relieved of pain by intracranial section of the nerve. Alcohol injections of the peripheral branches of the ninth cranial nerve are not employed because of the close proximity of the vagus and glossopharyngeal nerves as they leave the skull.

Sluder’s Neuralgia.—This is supposed to be a neuralgia of the sphenopalatine nerve. It is considered by some to be a neuralgia of the vidian nerve. Treatment and results are unsatisfactory. Rhizotomy of the sensory root of the fifth cranial nerve does not give relief. Applications of cotton pledgets dipped in a solution of silver nitrate to the mucosa of the nose under the middle turbinate occasionally give relief for what Sluder called a “lower half head pain.”


Occipital Neuralgia.—This involves chiefly the second cervical nerve on either side. At times, however, the first and third cervical nerves are involved with the second. When the neuralgia is confined to one nerve, the second cervical, a para-vertebral injection of alcohol may suffice to give temporary relief. More often than not, intraspinal rhizotomy of the sensory components of all three nerves (first, second, and third cervical nerves) is required for complete relief of occipital neuralgia.

Intercostal Neuralgia.—One or more of the thoracic nerves may be involved. The same type of pain (sharp, lancinating pain extending along the course of the nerve with hyperesthesia of the skin) may affect any of the spinal nerves. However, the treatment of pain must differ from that employed on sensory nerves when the involved nerve is a mixed nerve which contains important motor fibers such as are found in the brachial and in the lumbosacral plexuses. Intercostal neuralgia may accompany or follow herpes zoster or may develop independently of skin eruptions. It usually involves two or three dermatomes. Not infrequently the disease progresses to involve additional sensory ganglia of spinal nerves at higher or lower levels and nerves of the opposite side. When the disease remains localized, sub-arachnoid injection of alcohol usually affords relief. Paravertebral injection of the involved nerves with alcohol rarely gives relief because the injection fails to destroy the dorsal ganglion of the nerve. A limited unilateral laminectomy with rhizotomy of the sensory roots frequently has to be resorted to. Even rhizotomy may not give too satisfactory results if the disease is progressive and if the patient has become a narcotic addict.

Lesions of the Brain and Cord.—It is obvious that radical removal of tumors of the brain and spinal cord becomes necessary to relieve the symptoms of headache, localized pain, and spinal root pain. Brain abscesses must likewise be drained to relieve the symptoms of intracranial pressure. The pains produced by meningitis are usually controlled by spinal fluid drainage and by the administration of antibiotics and the sulfonamides.

Protruded Intervertebral Disk.—The terms “lumbago,” “sacroiliac disease,” and “sciatica” have frequently been employed to describe low-back pain with extension of pain all through the sciatic nerve.15 Although inflammatory lesions of the muscles and bony joints occur, a condition known as a “protrusion of the intervertebral disk” is often responsible for the pain. At the onset of symptoms, physical therapy and conservative treatment should be employed. However, with recurring attacks of incapacitating pain, a protruded disk must be suspected as the cause of the pain. Differential diagnosis and removal of the protrusion, if diagnostic findings suggest its presence, are then required.

Anginal Pain.—Angina may result from vasospasm or sclerotic changes in the coronary arteries or a combination of the two which produces ischemia of the cardiac musculature.16 Internists and cardiologists prefer to control this pain by medical regimens. Some physicians hold that interruption of nerves conducting pain sen-

Solutions destroys the patient's danger signals; thus, the patient may attempt to perform physical tasks beyond his endurance and succumb suddenly. However, removal of the upper fourth or fifth thoracic ganglia, which interrupts the sympathetic fibers carrying vasomotor control to the coronary arteries, has proved of value and is indicated for younger persons. Once sclerotic changes have developed in the coronary arteries, medical regimens including vasodilating drugs fail to control angina pectoris. Neurosurgical procedures then are sought for relief. Since the physical reserve of patients with angina is below normal and often life expectancy is limited, a palliative procedure is warranted. The one of choice is a paravertebral alcohol injection of the upper four thoracic nerves on the left side. A similar injection on the right side also may be indicated. The injections can be repeated. If the patient's physical condition will endure an operative procedure, rhizotomy of the sensory roots of the same nerve can be performed. Sympathectomy of the upper thoracic trunk also has been employed with reasonable success. The mortality rate accompanying these procedures is necessarily high.

Causalgia.—This is characterized by burning sensation with profound hypersensitiveness of the area. It follows crushing injuries of the extremities, chiefly of those tissues supplied by the median nerve.17 The reason for the pain is not too clearly understood, but apparently it is due to a vascular condition—vasospasm or ischemia of the tissues—since cervicothoracic preganglionic or postganglionic sympathectomy relieves the pain in most instances.

Painful Stumps.—Stumps are painful in about 10% of amputated extremities. In a few instances, a neuroma is actually present in the scar at the level of the amputation.18 Removal of the neuroma and division of the nerve at a level above that of the amputation gives satisfactory relief from pain.

The real problem is that of the patient who after amputation is unable to wear a prosthesis because of a painful stump, even though the surgeon is unable to palpate a neuroma. If by chance the patient also complains of a phantom extremity, the problem becomes still more complicated. If the patient is carrying on a gainful occupation, chordotomy may give some relief. Nerve sections, injections of alcohol, sympathectomies, or rhizotomies are futile. Psychiatric advice may help the patient accept his discomfort, since one of the factors responsible for the development of this group of symptoms has been environmental influences present at the time of the injury. If the patient who complains of a painful stump or a phantom limb is unable to work and is addicted to narcotics, the situation is almost hopeless. The only procedure that may offer assistance to the withdrawal of narcotics is a prefrontal lobotomy.

Raynaud's Disease, Thromboangiitis, and Thrombophlebitis.—Pain of Raynaud's disease and the spasm of collateral arteries in the presence of thromboangiitis obliterans and endarteritis obliterans are relieved by extensive sympathectomy interrupting rami carrying vasomotor stimuli to the arteries supplying the involved extremities. Resection of the sympathetic trunk with removal of ganglia has proved.

18. White, J. C.: Painful Aneurysms of the Aortic Arch: Relief by Paravertebral Injections of Procaine and Alcohol, J. A. M. A. 99:10-13 (July 2) 1932. White.8
more effective than periarterial sympathectomy. Alcohol injection has been employed in lieu of the sympathectomy for the same diseases but does not give as complete relief. The injection of the lumbar sympathetic trunk has given some temporary relief when the pain was due to thrombophlebitis.

**Dysmenorrhea.**—Resection of the superior hypogastric plexus of Havelock (a presacral sympathectomy) has offered relief to many patients with so-called idiopathic dysmenorrhea.19

**Visceral Pain.**—The sensations of visceral pain apparently follow afferent fibers which are associated with sympathetic rami until they reach the nerve roots from which the rami have taken their origin. From that area they enter the sensory roots and the dorsal ganglia of spinal nerves. This fact being true, it is possible to obliterate pain that results from pancreatic calculi and fibrosis of the pancreatic gland by resection of the splanchnic nerves,20 or preferably the lower thoracic and upper lumbar sympathetic chain together with the splanchnic nerve.

**Malignant Lesions.**—Neurosurgical procedures are not employed to relieve pain for primary malignant lesions until every attempt has been made to remove the neoplasm or control the primary or metastatic lesions by irradiation therapy.21 We should like to reemphasize the point that rhizotomy, chordotomy, or tractotomy should not be resorted to if analgesic drugs control pain, and further that the administration of narcotics is justified if the life expectancy is only a few months. It should also be remembered that castration with the administration of stilbestrol is effective in controlling the progress (growth) of certain malignant lesions of male patients, and administration of testosterone and irradiation of the ovaries have a similar effect on certain malignant lesions of females.

Rhizotomy of the fifth and ninth cranial nerves and rhizotomy of the sensory roots of the upper cervical nerves are employed to relieve pain due to primary malignant lesions and metastatic lesions of the mouth, face, pharynx, and cervical regions. Rhizotomy of the sensory roots of the brachial plexus has been employed for metastatic lesions of the axilla and brachial plexus. However, a high cervical (first cervical cord segment) chordotomy is more effective in relieving pain for this area than is the rhizotomy.

Painful inoperable and metastatic lesions of the legs, pelvis, spinal cord, or spinal column below the diaphragm and abdominal cavity are amenable to high thoracic (first thoracic cord segment) chordotomy. Occasionally unilateral chordotomy suffices, but more often than not bilateral chordotomy is required.

**COMMENT**

Although interruption of sensory nerves and tracts obliterates painful sensations, the patient must be informed prior to operation that anesthesia must be accepted in lieu of pain.


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Relatives of patients who are about to undergo one of the major operations for relief of pain due to a malignant lesion should be tactfully informed that the chordotomy or tractotomy is designed to reduce pain only and is not designed to cure the malignant lesion.

DISCUSSION

Dr. Wallace P. Ritchie, St. Paul: Dr. Svien has very properly emphasized personality changes in prefrontal lobotomy for the relief of pain. This certainly can stand reemphasizing because of the increased demand for this procedure throughout the country, and I don't feel that these personality changes have been properly emphasized to the family and the physicians. It is all very well to do a prefrontal lobotomy in patients who have had some previous personality disease, because anything in such a case is usually an improvement, but in a patient who has no personality changes it is very difficult to return the patient to his family, particularly if he is apathetic and lackadaisical and with very little emotional reaction when he wasn't that way before the prefrontal lobotomy. We use the procedure, but before it is performed the patient's family and the patient himself should be given the worst prognosis. The patient's parents should be told that he will not be himself, that he will be apathetic and unemotional. They have to accept the procedure on that basis, and if they will accept it on that basis, then prefrontal lobotomy is a very excellent way of relieving pain.

Dr. Harry B. Zimmermann, St. Paul: This discussion is directed to the general surgeon. I should like to leave with you a warning from something that happened in my experience. I saw a patient who three years before had had a prefrontal lobotomy done. She had been doing quite well, was able to do her own housework and look after her family. Four days before I saw her she began to refuse her food and to look bad; she had no pain, in fact she had a sense of euphoria, but wouldn't eat.

When I saw her she was in circulatory collapse, had some slight abdominal distention, no rigidity, no tenseness. A flat plate of the abdomen showed an enormous amount of gas beneath the diaphragm. She never recovered from her circulatory collapse sufficiently to be operated upon. She died. The autopsy showed a diffuse peritonitis that had been present at least four days, and a perforation of the anterior wall of the duodenum.

I think one has to be extremely careful about these people who have been operated upon for relief of pain or psychopathic disturbance, and keep in mind that pain is an important diagnostic aid.

Dr. David L. Reeves, Santa Barbara, Calif.: I found Dr. Svien's paper very interesting. He certainly covered the field very quickly and very completely. There were a few thoughts which occurred to me that I wish to mention.

First of all, I don't believe there is anything more difficult to control than postherpetic pain. It has not been our experience that alcoholic injection is very successful, nor have we found rhizotomy very helpful. The most effective results have been achieved by means of early x-ray therapy and sympathetic block. The employment of some of the antibiotics has been useful.

Not too infrequently the injection of the sympathetic nervous system with alcohol leads to a troublesome neuritis.

What Dr. Zimmermann had to say about sympathectomies for the relief of pain masking symptoms certainly is very timely, particularly in sympathectomies for hypertension.

Dr. Hendrik J. Svien, Rochester, Minn.: I just want to thank the discussers for calling to mind and bringing to our attention some of the limitations and the shortcomings of some of these procedures. It is very important that we don't pass them by, and I am very happy that they were brought up.