Longitudinal myelotomy in the treatment of spasticity of the legs

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Longitudinal myelotomy at the level of the conus medullaris relieved severe spasticity in eight of nine patients. There was some recurrence of spasticity attributed to inadequate myelotomy. Sensation was impaired by the myelotomy in some patients. Bladder function was temporarily worse in all patients, but in all but one was eventually equal to, or better than, that before surgery.

Key Words: longitudinal myelotomy • spasticity • conus medullaris • bladder function • paraplegia • cerebral palsy • multiple sclerosis

Treatment of severe spasticity of the legs is a difficult neurosurgical and orthopedic problem. The aim must be to preserve, if not to improve, the residual mobility, sensation, and bladder function. All the conventional methods aimed at the interruption of the peripheral reflex arc have disadvantages. Section of the posterior roots, as advocated by Foerster in 1913, has sometimes caused a widespread sensory loss and increased the risk of bedsores. The anterior root section of Munro produces irrevocable paralysis. Cordectomy, described by MacCarty and Kiefer, is accompanied by motor and sensory loss, and, furthermore, the bladder is deprived of the neural connections.

In 1952, Bischof described the method of longitudinal myelotomy, which aimed at interruption of the spinal reflex arc between the anterior and posterior horns within the spinal cord. One of the objectives of the operation was to preserve both the motor and sensory pathways, which, however, is difficult to achieve. In his first patient, Bischof carried out the operation through a D10-12 laminectomy. He made a longitudinal incision that extended from L-1 to S-2 roots, on each side of the cord. In the second patient, the unilateral incision was made so deep that the knife severed the anastomoses of the other half of the cord as well, and bilateral relief of spasticity was obtained.

Bischof soon noticed that the lateral longitudinal incision interrupted the motor connections between the corticospinal tract and motor neurons, as well as the crossing sensory pathways. To avoid the motor lesion, he switched in 1967 to dorsal longitudinal myelotomy. The cord was incised along the midline, and, through an incision extending from D-11 to S-1, a stilet knife was inserted laterally and the reflex anastomoses cut on either side (Fig. 1). This technique allowed him to avoid interruption of the motor pathways, even though the crossing sensory fibers were cut at the level of the incision.

In the Department of Neurosurgery of the University Central Hospital in Helsinki, we have carried out longitudinal myelotomy on nine patients since 1966. The follow-up period for these patients ranges from 1 to 4 years. We are reporting this series, the surgical technique, and results.
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Clinical Material

The symptomatology of the patients and the results of surgery are briefly summarized in Table 1. One of our patients had traumatic spastic paraplegia, three had spastic paraplegia and athetosis due to cerebral palsy, and five had spasticity in flexion and paraplegia of multiple sclerosis.

Surgical Technique

One day before surgery, the level of the conus medullaris was checked by air myelography and marked on the skin. Laminectomy, usually from D-10 to D-12, was carried out under general anesthesia with the patient in the prone position. In the first two cases of this series, a lateral longitudinal myelotomy was done. The cord was incised along the denticulate ligaments between the dorsal and ventral roots. In Case 1, the incision was made from each lateral side, avoiding the commissure, while in Case 2 the cord was incised from the left side only, but so deep that the knife cut the commissure and the right-sided anastomoses as well. The remaining seven patients had a dorsal myelotomy. The dorsal midline vein as well as the underlying arachnoid and pia corresponding to the dorsal fissure were coagulated, and an incision 3 mm in depth was made. The lower end of the incision lay 2.5 to 3.0 cm above the tip of the conus, and the length of the incision was 5.5 cm (Fig. 2). Through the incision an angled stilet knife was inserted, and the reflex anastomoses were cut bilaterally by moving the knife up and down. Hemostasis was easily accomplished without using diathermy.

Results

Immediate Postoperative Course

All patients tolerated the operation well. One patient (Case 8) had paresthesias and pain in both legs after the operation, which gradually disappeared within 2 weeks. This particular patient, who had been paraplegic for 8 years, showed a remarkable recovery of mobility in both legs. Case 3 had repeated rectal prolapse after the operation, which disappeared later on.

Effect on Spasticity

The aim of the operation was to abolish spasticity of the legs and of the bladder. The extensor spasticity of the three patients with cerebral palsy had been so marked that they were unable to sit at all. Also, the nursing of these patients had been extremely difficult. In the adult patients, the spasticity was of the flexion type and often very painful.

The immediate effect of the operation on the spasticity was always good, but there was often some tendency for recurrence, especially in the distal parts of the limbs. The recurrent spasticity was marked in both patients who underwent a lateral longitudinal myelotomy; in one of these, dorsal myelotomy was carried out later on. The Achilles reflex reappeared in five patients, which implied that the lower end of the incision had been made higher than it should have been. There was no recurrence of spasticity in the knee or hip area, and the patellar reflexes were always permanently abolished. Simultaneously with the relief of spasticity, the pain connected with it disappeared, which made the patients pleased with the outcome of the operation.

Effect on Mobility

All patients but one (Case 9) were preoperatively completely paraplegic. This patient was able to move his left hip and knee in bed, but was not able to walk. After the operation two patients with multiple sclerosis regained some mobility in both limbs. In Case 6, voluntary movements of the ankle and knee reappeared on the second postoperative day, but were not strong enough to
<table>
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**TABLE 1: Results of longitudinal myelotomy in nine patients**
Longitudinal myelotomy for spasticity

allow the patient to walk. One patient (Case 8), who had been completely paraplegic and bedridden for 8 years, had had a left thalamotomy 1 year before myelotomy. She regained good mobility in both legs, and 3 months after myelotomy could walk with the help of a knee-supporting splint. The mobility further improved during the follow-up of 1 year. In her left leg there was still a marked intention tremor, while the right was normal.

Effect on Sensation

There was complete sensory loss below the D-4 level prior to surgery in Case 1. In Cases 8 and 9, there was a complete preoperative sensory loss below D-6, and in Cases 5 and 6, a partial sensory loss in both limbs. Sensation in the patients with cerebral palsy (CP) was presumably normal, but examination was difficult and unreliable. After the operation, sensation was impaired in all patients who preoperatively had had residual sensation. Three years later, however, only one of the CP patients showed a sensory deficit, in the left foot. One year after myelotomy, one patient with multiple sclerosis (Case 5) developed purulent ulcers in the toes of both feet.

Effect on Bladder

The operation always had a transitory adverse effect on bladder control. In Case 1 with traumatic paraplegia and Cases 5, 6, and 9, there was some bladder automatism preoperatively, which was impaired after surgery but returned to the preoperative level within 2 months. In Cases 1, 6, and 9, a fair degree of automatism was regained within a year after surgery. One patient (Case 7) had normal bladder function preoperatively; this deteriorated, and 1 year after operation an indwelling catheter became necessary. In this case, inexperienced urological care was presumably responsible for the poor outcome. In Case 8, a catheter had been required for years, and the operation, which had a good effect on mobility, did not improve bladder function. One of the three CP patients had normal bladder function preoperatively, while the other two were partially incontinent. The myelotomy caused a transitory deterioration, but the bladder function regained its preoperative level within 3 months.

Discussion

This study shows, as did some earlier studies,6,8,9 that longitudinal myelotomy is a good operation for the relief of spasticity of the legs. In principle, Bischof’s idea of cutting the spinal reflex arc between the motor and sensory pathways within the spinal cord was ingenious, in practice, however, this is difficult to accomplish. If the operation is carried out by a lateral incision of the cord, as in Bischof’s original technique, the offshoots from the corticospinal motor tract to the spinal motoneuron will be severed. This will increase motor deficit or may prevent any latent motor power from reappearing when spasticity disappears. When incision is made in the dorsal midline and extended laterally in both directions, the mobility may be preserved. The crossing sensory fibers together with the reflex anastomoses are severed, which may increase the sensory deficit.

Fig. 2. Diagram showing extent of myelotomy. The cross-hatched area shows the site and extension of the dorsal longitudinal myelotomy with extension as shown in Fig. 1.
We found the dorsal approach superior to the lateral one, because increased sensory loss is less troublesome than an additional motor deficit. The sensory defect connected with the operation seems to show a tendency to regress spontaneously, probably due to the fact that the decussation of the spinothalamic fibers is spread over two to three segments and also because some pain fibers run uncrossed into the posterior column. Bischof also found the dorsal approach much better than the lateral one. Another advantage of using the dorsal approach is that the midline can easily be identified by the tortuous vein. This is particularly important in the CP patients, who often have marked lordosis and scoliosis, which cause rotation of the spinal cord.

On the other hand, Moyes with his Canadian collaborators seems to have used the lateral approach only.

Preservation of the motor pathways is very important, since some patients show a dramatic motor improvement after the spasticity has gone. This was well demonstrated in two of our patients with multiple sclerosis. In one case the reappearance of the mobility was dramatic. A 28-year-old woman who had been paraplegic for 8 years started moving her legs voluntarily on the first day after operation, and 3 months later was able to walk with the help of knee-supporting braces. One year after surgery she was able to walk with a cane, and the motor power was still improving. Another patient with multiple sclerosis regained some mobility, which was not sufficient to allow her to walk.

In the patients who are selected to undergo this operation, bladder function is usually disturbed. The operation seems to increase urinary dysfunction temporarily. Our follow-up study showed that automatism was restored in two patients and improved in one, while incontinence remained unchanged in four patients. Bladder function became worse in one patient and in another remained normal. The Canadian series, in contrast, did not show a single case of improvement of bladder function, which gives a further reason for using the dorsal approach in myelotomy. Moyes feels, and we agree with him, that longitudinal myelotomy in its present form is a crude procedure. It may be possible to improve the technique in the future, and we are doing experiments in this respect.

Conclusions

Even in its present form, we feel that dorsal myelotomy is the method of choice in the treatment of severe spasticity of the legs. It can well be used in patients with traumatic paraplegia, in advanced cases of multiple sclerosis, and in cerebral palsy, in which spasticity and pain make nursing very difficult and the life of the patients miserable.

References


Received for publication September 21, 1970.
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