Late Surgery for Incomplete Traumatic Lesions of the Conus Medullaris and Cauda Equina

BENJAMIN LANDAU, M.D., AND JOSEPH RANSOHOFF, M.D.
Department of Neurosurgery, New York University School of Medicine,
New York, New York

The role of laminectomy in spinal injury is a subject of great controversy. The various criteria that have been suggested in making the decision for or against surgery include the presence or absence of manometric block, the degree of neurological deficit or preservation of function, and the time between injury and surgery. Opinions regarding the time factor range from pessimism ("laminectomy after one year...had no practical value except when it was done exclusively for psychic reasons") to enthusiasm ("laminectomy should be carried out in every case of traumatic paraplegia, early or late"). Many shades of opinion lie between these extremes.3-5,7,8,10-14

This paper describes our own experience and is intended to lend support to the argument for surgery, even late, in the treatment of lesions in the region of the conus medullaris and cauda equina.

Analysis of Clinical Material

This study is based on seven consecutive cases of late laminectomy for traumatic lesions involving the conus medullaris or cauda equina, operated upon at the New York University-Bellevue Medical Center during a 5-month period in 1965.

Initial Paraplegia. Six of the seven patients had initially been rendered totally paraplegic, the seventh partially. However, all had experienced partial subsequent improvement.

Interval. The interval between injury and surgery ranged from 1 month to 17 years. Four of the seven patients were operated on 2½ years or longer after injury, while three were operated on 1, 2, and 9 months after injury.

Level. In all cases the injury involved the conus medullaris or the cauda equina. The distribution by levels was as follows:

<table>
<thead>
<tr>
<th>Spinal Level</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12-L1</td>
<td>1</td>
</tr>
<tr>
<td>L-1</td>
<td>3</td>
</tr>
<tr>
<td>L-2</td>
<td>1</td>
</tr>
<tr>
<td>L2-3</td>
<td>1</td>
</tr>
<tr>
<td>L2-4</td>
<td>1</td>
</tr>
</tbody>
</table>

Block. In six cases, myelography was carried out, and four of these demonstrated a complete block, two intradural and two extradural. Two other patients showed only partial block secondary to arachnoiditis. The remaining patient, in whom a myelogram was not done, had a complete manometric block.

Operative Findings. In all of the cases, we found significant scarring that bound the conus or roots to dura, arachnoid, or adjacent neural tissue. Four patients had bony fragments within the spinal canal, which in one instance penetrated the dura. In six patients, neurolysis was carried out; in the other, only decompressive laminectomy was performed because of the extreme density and strength of the scar tissue.

Results

Neurological Improvement. In each of the seven patients, improvement occurred in at least one category of neurological function. In one patient, although there was measurable improvement in both motor and sensory function, there was no increase in general performance. However, in the other six patients there was significant improvement in either motor, sensory, or bladder function. In two patients, there was improvement in all of these categories.

Of the three patients unable to walk even with braces and canes, all recovered the ability to do so, in two instances unaided.

Of two patients incontinent preoperatively, one achieved normal bladder function, the other almost normal function. Of four patients with bladder function rated as fair to poor preoperatively, two showed improve-
ment after surgery. One of these, rated as poor, regained normal control.

A correlation was suggested between improvement and the interval since injury, in that the two patients who showed functionally significant gains in all categories were operated upon sooner after injury (1 month and 2 months) than the others in the series. However, as will be noted in the case histories, functionally significant improvement also occurred in at least one category among those patients in whom the interval was longest.

In four patients, one or more categories of neurological function were initially worse postoperatively. In two instances this was transient and the patients ultimately surpassed their preoperative levels of function. In the other two cases, the increased deficits were still present several months postoperatively; however, the functional activity of each actually improved despite these slight deficits, probably because of significant gains in muscle strength.

Onset of Improvement. In the two patients operated on at 1 and 2 months after injury, improvement continued at the same rate as it had preoperatively, but in one was accelerated after 2 weeks. In another patient (Case 3), in whom injury had occurred 17 months earlier, improvement was noted 8 hours postoperatively. In the other patients, the onset of improvement ranged from 8 days to 6 months.

Representative Case Reports

Case 1. A 25-year-old printer was admitted with a history of having fallen from an embankment 6 years earlier, sustaining a compression fracture of L-1. He was left with weakness and sensory loss in both lower extremities, but was able to walk. He was incontinent of both urine and feces, but sexual function was only mildly impaired. There had been no improvement in these disabilities for the last 3 or 4 years.

Examination. The patient had severe distal weakness in both legs, with complete paralysis of all toe movement. The anus was patulous, and normal superficial anal reflexes could not be elicited. Sensation was markedly decreased from S-1 through the coccygeal segments bilaterally. X-rays of the spine showed a compression fracture of L-1, and myelography demonstrated a complete block, intradural in type, with a split of the column of contrast medium at L-1 that suggested a bony spicule.

Operation. Laminectomy from T-12 to L-2 was carried out. The bony spicule was found and removed, disclosing a 5 mm dural defect in which elements of the cauda could be seen. The dura was opened, and the conus was found firmly attached to dura with scar tissue. No lysis was carried out for fear of reducing his fairly good sexual function.

Postoperative course. Within 3 weeks, there was definite toe flexion and extension, and improvement in ankle dorsiflexion. There was also improvement in sensation. By 11 months, significant further improvement had taken place in these categories, and bladder function had become normal, allowing the patient to discontinue use of an indwelling catheter. Sexual function had also improved. It should be stressed that this patient's spontaneous improvement had plateaued many years before this operation.

Case 2. A 35-year-old man was rendered paraplegic 2½ years earlier when he fell down an elevator shaft. X-rays taken at the time of the accident had shown a fracture of L-2, with dislocation of L-1 over L-2. Laminectomy had been carried out within 24 hours, and enlarged a few weeks later because of persistence of myelographic block. Following these procedures, and a later fusion at the level of the laminectomy, the patient had slowly improved and stabilized at a level where he had regained partial bowel, bladder, and sexual function, and was able to walk with braces. Only questionable minimal progress had resulted during the last year, which had been spent in the regular activities of a rehabilitation program.

Examination. There was extreme weakness in both lower extremities, especially distally, where except for a trace of plantar flexion of the left toes all toe and ankle movement was absent. Quadriceps function was absent on the right, and present only as a trace on the left; deep tendon reflexes were absent in both lower extremities. There was severe sensory loss on the right below the knee, slight impairment in the left foot, and scattered loss in the sacral dermatomes. Myelogram showed a complete block, epidural in type, at L2-3 plus evidence of arachnoiditis.

Operation. A dorsal decompression from
T-12 to L-4 was carried out. A nubbin of bone from the previous fusion mass was seen indenting the dura at L-2, and after its removal the dura appeared to be fully decompressed. When the dura was opened, the roots of the cauda were found to be quite adherent to dura; these roots were then freed.

Postoperative course. Initially, the lower extremities were somewhat weaker but had improved within 1 month; right quadriceps function, which had been absent since the accident, now had improved. At 5 months he was rated by his physiotherapist as having improved in almost all muscle groups at the hips and knees. The patient stated that control of bowel and bladder was better than preoperatively.

Case 3. A 38-year-old nurse had been in a toboggan accident 17 years earlier. She had been completely paraplegic for 3 weeks, but then experienced substantial slow recovery over the next 1½ months. Improvement then ceased and had not changed in the last 15 years. For the first month after the accident she had had no voluntary bladder function, but then developed a pattern of almost hourly frequency and urgency, which she could control if she was sitting; if standing she would be incontinent. Weakness in the right leg and foot was such that there was difficulty in maintaining good control of the accelerator pedal of her automobile. This was her status at the time of the present admission.

Examination. There was moderate weakness of both gastrocnemii with atrophy of the right calf, and marked weakness of all toe movement on the right. Achilles reflexes were absent bilaterally, but the other deep tendon reflexes were active. The superficial anal reflex was absent bilaterally. Sensation was impaired in a spotty distribution within the S-1 and S-2 dermatomes bilaterally, and in the left S-3 and right L-5 dermatomes as well. Cystometry demonstrated a reflex bladder pattern. The electromyogram showed denervation, primarily in the muscles innervated by the S-1 and S-2 roots bilaterally, with involvement of the external anal sphincter as well. X-rays demonstrated a compression fracture of L-1, and myelography showed evidence of arachnoiditis, with a partial block at T12-L1.

Operation. Laminectomy was carried out at L-1, and partially at T-12 and L-2; adhesions involving the conus, cauda, and dura were lysed.

Postoperative course. Sensation began to improve the evening of the day of surgery, and at the end of 2 days was almost normal. Motor function has steadily improved in both legs, starting 3 weeks after operation. Actually, the electromyogram study done 2 weeks postoperatively anticipated the clinical improvement by showing loss of fibrillations and an increase in the number of polyphasics in the external anal sphincter. Bladder function was initially slightly worse, but has since returned to its preoperative status.

Discussion

In two cases operated on at 1 and 2 months following injury, the relationship between surgery and improvement was not clear, since improvement had begun and was continuing before surgery. In one of these, the operative findings suggested that the recovery probably would not have been as complete without surgery; in this case, which had a complete epidural block, there was a return of dural pulsations following freeing of scarred roots and conus, and in less than a month the patient was walking.

In the other cases, however, the evidence for the value of laminectomy, with or without neurolysis, seems incontestible. In each, improvement occurred long after injury, at a point when the neurological status had reached a plateau or was improving at a very slow rate. In Case 1, the dramatic recovery of bladder function and the concomitant clearing of previously chronic urinary tract infections 6 years after injury was impressive. Case 3 demonstrated unexpectedly rapid motor and sensory improvement in response to neurolysis 17 years after the injury.

It is important to note that no patient was made worse permanently, although four showed transient deterioration in one or more neurological categories. All eventually recovered at least the preoperative level of function. This fact suggests that the possibility of neurological deterioration, which has been used as an argument against surgery, is not likely in a carefully executed procedure. Moreover, the position that surgery should be carried out only in the presence of a complete block also seems unduly restrictive, as demonstrated by the results in two cases where
significant intradural scarring had produced only partial myelographic block.

It should be pointed out that, preoperatively, all of the patients in this series had some degree of neurological function below the level of their lesion, function which either had never been lost or had returned since injury. Thus, one might predict that the number showing improvement should be greater than in a series which included patients with total loss of function. However, even if function of a root or of the whole cord is completely interrupted at a given level, the certainty of anatomic transection can rarely be determined without operation. Therefore, the degree of reversibility of the deficit must also remain uncertain.

Release of neural tissue from the effects of traction and compression by scar tissue probably played a major role in the improvement of several of these patients. We plan to carry out neurolysis with the aid of the dissecting microscope in the future.

Case 2 demonstrates that the history of a previous laminectomy does not preclude the possibility of further improvement by later procedures. This does not mean that all patients who do not improve dramatically after initial laminectomy deserve reoperation, but simply that further gains sometimes result from secondary procedures, particularly if in the presence of significant scarring of neural tissue.

The chance of recovery afforded by surgery becomes an important, subtle, psychological factor with some patients. For example, one of our patients was not getting the most out of physiotherapy because of his feeling that an operation would magically correct his difficulties. Following surgery, he became highly motivated toward expending maximum effort in his rehabilitation program.

Lesions in this region involve the peripheral nerves as well as the spinal cord. This probably contributes to the greater incidence of neurological improvement following laminectomy at the level of the cauda equina when compared to the results of surgery at higher levels. However, in other series as well as ours, some improvement in spinal cord function has also occurred.

Summary

We have reported and discussed a series of seven consecutive cases of laminectomy for traumatic lesions involving the cauda equina or conus medullaris, operated upon from 1 month to 17 years following injury. Post-operative improvement in neurological function occurred in all cases, and was functionally significant in six. On the basis of these findings, we plan to continue the procedure of decompressive laminectomy and lysis of adhesions in patients with traumatic paraplegia or paraparesis, regardless of the length of the interval since injury.

Acknowledgments

The authors wish to thank Drs. James Campbell, Arthur Battista, and Jerome Schlachter for permission to include their case material in this report.

Addendum

Since this paper was prepared for publication, records of two more patients have been found that demonstrated similar functional improvement following decompression and neurolysis 2½ years and 5 years after injury to the conus and cauda.

References

Surgical Treatment of Cauda Equina and Conus Lesions


