Thoracic Intervertebral Disc Protrusion with Spinal Cord Compression*

DAVID L. REEVES, M.D., AND HOWARD A. BROWN, M.D.†
Santa Barbara and San Francisco, California

Since the original report of Middleton and Teacher in 1911, the sinister sequelae of central thoracic disc protrusion, operated or unoperated, have been increasingly appreciated. Their patient lifted a heavy steel plate, rapidly became paraplegic, and died. Necropsy disclosed a massive disc protrusion opposite the twelfth thoracic interspace. Of Muller's four cases, after operation three were left with an almost complete transection of the cord, and the fourth, after a slight, temporary improvement, with a total paraplegia. Of Hawk's three patients who survived operation, all with severe preoperative spinal cord damage, one was made worse and the others showed no benefit from surgery. Two of the four cases reported by Mixter and Barr became paraplegic postoperatively.

Of the 17 cases of Love and Kiefer, marked improvement in the sensory and motor impairment occurred in only one, and complete recovery in none. Usually the patients with compression of the cord prior to operation had residual disability indicative of irremediable damage to the cord.

Of Logue's 11 cases, the three severely disabled prior to operation developed a total transection postoperatively. In the first the proplase was excised, but in the other two surgical intervention was confined to decompression. Two patients showing degenerative changes in the cord at operation, and one with a preoperative paraplegia, were rendered worse by removal of the protrusion and then made slow incomplete recoveries over several years, so they were able to get around with the aid of canes. The remaining six cases were improved.

Arseni and Nash reported 12 cases, eight of which showed paraparesis, and in none did this disappear. One improved after 6 years, one after 4, one after 3, and one was made worse. Interestingly, complete paraplegia occurred postoperatively in three of the paraparetic patients. In two of these recovery was incomplete, but no indication of improvement was observed in the third.

More recently, Fisher described his experience with four cases, in which ventral erosion of the dura occurred in one and dorsal erosion in another. He found that necrosis of the cord meant a neurological deficit regardless of whether conservative or radical measures were used. Moreover, the simple unroofing of the lesion in one instance caused paraplegia such that later removal of the disc was of no value.

In 1965, Love and Schorn collected 61 cases, including the 17 reported in 1950 by Love and Kiefer. Although they believed the wisdom of operating on protruded thoracic intervertebral discs associated with marked neurologic deficit could be questioned, they emphasized that often the nature of the lesion is unknown until it is surgically exposed.

In visiting several neurosurgeons with considerable experience, Love in 1944 was surprised to learn that many had never encountered a protruded thoracic intervertebral disc. That the condition is uncommon, even though increasingly becoming more recognized, is apparent from an incidence of 0.4% reported by Logue and by Arseni and Nash. An additional indication of their infrequent occurrence is evident in 95 reported cases collected by Arseni and Nash in 1960 and by the fact that single case reports make their appearance in the medical literature.

Because of the many diagnostic and surgical problems involved, as well as their infre-
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frequency, it was believed justifiable to report two additional cases.

**Case Reports**

**Case 1.** A 50-year-old woman slipped off a porch during the winter of 1928. Afterward she was troubled with backache, accentuated by activity. Some 11 years later she noticed weakness of the right leg which increased during the next few months. She was operated on by one of us (H.A.B.) on December 29, 1939. In view of the gradually progressive history and the myelographic findings consistent with those of a neoplasrn, a spinal cord tumor seemed the likely diagnosis. Laminctomy of the 8th, 9th, and 10th dorsal vertebrae revealed, following the dural opening, a large bulging mass behind the ventral dura. The major portion of the disc material was removed extradurally. This relieved the hypersensitivity of the right leg but not its weakness. A few months after the operation she fell and experienced a temporary setback. By April, 1941, she had shown improvement in both legs but noted some residual spasticity and sensory impairment of the right leg. During May, 1950, she sustained a spiral fracture of the right femur when she slipped on a throw rug. Some 9 months later she was walking with the aid of a cane. In March, 1955, she fell again and noticed a temporary increase in the weakness of the right leg. She was examined from time to time between April, 1955, and August, 1961; her condition remained relatively stationary. The weakness in the right foot was helped by a spring brace. The vibratory sense was diminished in the right leg and the Babinski sign persisted.

**Case 2.** A 41-year-old married woman was seen in consultation at the Santa Barbara Cottage Hospital on September 2, 1961. During March, 1961, she had noticed numbness of the feet and clumsiness in walking, which she described as "tripping over things." On several occasions she actually fell but did not hurt herself. Soon after this she noticed hypersensitivity below the umbilicus, a girdle sensation associated with difficulty in voiding and urgency, diminished pain and temperature perception in the legs, and bilateral inguinal pain. Her knees became weak and tended to buckle; she staggered as though intoxicated.

During the previous month she had had an extensive examination at the Sansum Medical Clinic which had included electromyographic studies, spinal fluid examinations, x-ray studies of the skull and the entire spine, as well as an electroencephalogram. All of these tests were normal. During the examinations, however, she had demonstrated intermittent Babinski responses with reduction in vibratory and position sense as well as a sensory level at the umbilicus. The myelographic findings on September 1 included that of a constant filling defect some 2 cm in length at the upper border of T-8. Immediately above, the spinal cord appeared widened.

**Examination.** When seen on September 2, verification was made of a sensory level just above the umbilicus, no vibratory sensation in the legs, and bilateral Babinski responses.

**Operation.** On September 7, laminctomy of T-6 through T-9 (D.L.R.) disclosed a firm area 2 cm long corresponding to the myelographic abnormality. Opening of the dura revealed upward displacement of the spinal cord. Careful retraction of the cord exposed a midline herniating intervertebral disc, which had not only compressed the cord but also comprised its blood supply. To relieve pressure on the cord, the dentate ligaments were sectioned on each side. When the capsule was incised, the disc contents were extruded as abnormally soft tissue much like toothpaste. Additional material was removed by curets and suction during careful retraction of the spinal cord. The microscopic diagnosis was that of intervertebral disc tissue and chondromalacia of the nucleus pulposus.

**Postoperative course.** Postoperatively, the patient was paraplegic. When she was transferred to the Orthopedic Hospital of Los Angeles for rehabilitation on October 10, 1961, sensation and leg movement had improved. A lumbar puncture October 13 showed no spinal fluid block, and the total protein was 21 mg%. Radiographs of the midthoracic area demonstrated no evidence of erosion or changes in the vertebral bodies or spaces. By October 31, she was able to move both thighs forward and backward, extend the legs at the knees, plantar flex the feet, and wiggle the toes. There was still some spasticity with sustained patellar and ankle clonus, and some loss of sensation to pain, light touch, vibration, and positioning in both legs.

When seen on March 27, 1962, she was able
to walk increasing distances without the short leg brace, although some back pain and spasticity of the legs persisted.

Discussion

Love and Schorn\(^\text{19}\) reported a single protrusion in all patients except one, who had multiple protrusions;\(^\text{22}\) these occurred at every level with T-11 being most common.\(^\text{6}\) There were 30 central, 18 centrolateral, and 14 lateral protrusions, occurring equally in men and women. Although the lesion is most common in middle life, the ages involved have ranged from 12 to 73 years.\(^\text{22}\) Logue\(^\text{16}\) found direct or indirect trauma played little part in the etiology. Love and Schorn\(^\text{19}\) observed that trauma was not an important factor in their series, although it had been a precipitating feature in four cases and an aggravating factor in 12. Interestingly, three other patients experienced symptoms following operation in the lithotomy position. In one of our cases, symptoms of backache occurred after an injury, but it was 11 years before important neurological findings became evident.

Of course, the normal disc does not protrude, but when the disc becomes degenerated from wear and tear or from some connective tissue disturbance such as in lathyrysm,\(^\text{8}\) normal exertion may cause it to protrude.

**Clinical Features.** According to Logue,\(^\text{16}\) the clinical findings are not materially different from those produced by spinal neoplasms. In many cases, Love\(^\text{18}\) found the mimicry so great that a diagnosis could not be made preoperatively. Moreover, he\(^\text{19}\) observed that symptoms and neurological findings varied widely, being dependent not only on the level of the protrusion but on its relation to the spinal cord and roots. Lateral protrusions with radicular compression with few medullary signs can be mistaken for visceral disease.\(^\text{25}\) Midline protrusions are associated with motor and sensory symptoms of variable severity, often unaccompanied by pain.

The duration of symptoms without a history of trauma has varied from a few weeks to years.\(^\text{19}\) In some patients, symptoms gradually increased, in some they were intermittent, and in a few they became worse rapidly or were constant from the onset.

**Cerebrospinal Fluid Examination.** Love and Schorn\(^\text{19}\) reported finding a normal Queckenstedt test in 28 of 50 cases, a partial block in 10, and a complete block in 12. In two of Logue's\(^\text{16}\) patients with normal spinal fluid protein and Queckenstedt tests, considerable neurological damage was present. Arseni and Nash\(^\text{9}\) found that neither proteinocytological dissociation nor the Queckenstedt test had any specific significance in cases of prolapsed thoracic discs.

Radiology. Eight of Logue's 11 cases had calcification of the nucleus pulposus, as did 18 of the 61 patients of Love and Schorn. Logue noted that five of his eight cases showed calcification only in the nucleus pulposus of the disc which had herniated. No calcification was reported in the 12 cases of Abbott and Retter.\(^\text{1}\) Arthritic lipping of the thoracic vertebral bodies was no more common nor extensive than that observed in patients of this age group without disc protrusion. Narrowing of the affected disc space was not a constant feature and, in fact, was often seen in discs that had not protruded. In general, except for showing presence of a calcified disc, plain x-ray films were not diagnostically helpful.

**Myelography.** Because of the superimposed shadows of the heart and great vessels as well as the convexity of this part of the spinal column, the thoracic region is difficult to visualize.\(^\text{1,16}\) As soon as the contrast material runs over the thoracic hump, it tends to glide rapidly past the remaining vertebras to gain the lordosis of the lumbar or cervical regions, often breaking up into globules. During this rapid flow, it is possible to overlook small filling defects which may be the only sign of a thoracic prolapse. Nonetheless, all authors agree that myelography is the most valuable means of diagnosing the condition. It may reveal a total or partial block, a filling defect, or sometimes merely a disturbed passage of the opaque oil at the level of the herniated disc.

Fineschi\(^\text{3}\) believed that a notched appearance at the limit of the opaque medium is typical of an anterior extradural process. Although good lateral films are difficult to obtain, they often will demonstrate the obstruction lying anteriorly. The use of a large volume of Pantopaque has been advocated.

**Mechanics of Spinal Cord Compression.** Prolapse of a thoracic intervertebral disc is likely to produce dysfunction of the spinal
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cord by direct compression as well as by circulatory insufficiency of the anterior spinal arteries and veins. Vascular interference of this sort would explain the appearance of a neurological picture resembling that in cases of anterior spinal artery thrombosis. It would also account for the severe damage inflicted on the cord which frequently is out of all proportion to the size of the protrusion, and the poor recovery sometimes resulting despite complete removal of the apparent cause. As Kahn\textsuperscript{13} has suggested, it is likely that the ligamenta denticulata in resisting the backward displacement of the cord may interfere with the vascular supply as well as cause direct compression.

In contrast to the slowly increasing compression from benign cord tumors which is often followed by relatively good recovery after surgery, the sudden application of cord compression associated with thoracic disc protrusion may explain the lasting neurological deficits.\textsuperscript{14}

Surgical Management. The surgery of lesions compressing the spinal cord from the anterior side is never easy. It is more difficult in disc protrusion because the spinal cord may be vulnerable to even slight surgical trauma.

According to Logue,\textsuperscript{16} all dentate ligaments in the operative field should be sectioned and the prolapse removed intradurally so that displacement of the cord can be kept under control and minimal: Rhizotomy has also been helpful in the rotation of the cord. A lateral extradural approach similar to a costotransversectomy for spinal tuberculosis has been advocated by Crafoord\textsuperscript{5} and Hulme.\textsuperscript{11} Despite the lateral approach, Chesterman\textsuperscript{4} reported a paraplegic result.

In view of the frequent necessity of opening the dura to establish the diagnosis and to eliminate the possibility of an intradural lesion, laminectomy is often necessary. Hulme\textsuperscript{11} has emphasized that the lateral approach is appropriate only when an accurate preoperative diagnosis has been established. He pointed out that the exposure is limited and inadequate for a more extensive exploration. He also emphasized the additional risk of compromising the blood supply of the cord by interruption of the spinal arteries accompanying the intercostal nerves. In the lower thoracic region, an important radicle often enters the longitudinal anastomosis so that severing this might imperil the blood supply to a number of segments.

Removal of the disc extradurally is preferred by many;\textsuperscript{19} transdural removal has been advocated\textsuperscript{18} as being less traumatic particularly when there is a firm midline disc protrusion adherent to the dura.

It is, of course, the central or centrolateral thoracic disc protrusion that leads to serious neurological consequences.\textsuperscript{1} Any sudden change in the relation of the disc protrusion to the cord may result in a severe neurological deficit. With this type of protrusion, no surgical approach holds any particular advantage.

Summary

We have reported two cases of thoracic intervertebral disc protrusion with serious compression of the spinal cord and have reviewed comparable reports by others. We have discussed the related diagnostic and operative problems and reemphasized the prognostic hazards involved.

References

10. Horwitz, N. H., Whitcomb, B. B., and Reilly,


