THORACIC INTERVERTEBRAL DISC PROTRUSION
A CLINICAL STUDY
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Protrusion of thoracic intervertebral discs is a rare condition and, according to some writers, an exceptional one. In 1950 Love\textsuperscript{16} stated that many neurosurgeons with considerable experience in disc surgery had never seen a protruded disc in the thoracic region. At present the situation has certainly changed to some extent, but we feel that a review of the literature together with a presentation of 12 cases verified at operation in our clinic may be of interest.

In 1911 Middleton and Teacher\textsuperscript{17} described the postmortem finding of a large herniated intervertebral disc at T12 in a man with traumatic paraplegia. The first clinical case is probably that of Antoni,\textsuperscript{2} reported in 1931, which opened the series of modern studies of this problem, obviously under the influence of the impressive work of Schmorl and his school [2 years later Hellmer\textsuperscript{9} published the roentgenologic study of this case]. Later, the following additional cases were reported:

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<tr>
<td>Elsberg\textsuperscript{4}</td>
<td>2</td>
<td>Kroll &amp; Reiss\textsuperscript{13}</td>
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<td>Love &amp; Kiefer\textsuperscript{6}</td>
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<td>Knutsson\textsuperscript{13}</td>
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Thus, the total number of cases in the literature is 95.

The rareness of this condition is demonstrated further by the incidence of thoracic lesions in various series of herniated discs operated upon at all levels of the spine, i.e. 2–3 per cent at the Mayo Clinic\textsuperscript{16} and 1 per cent at the Toscan Institute of Orthopaedics.\textsuperscript{6} Other statistics give somewhat higher figures: in the Neurosurgical Department, Ohio State University College of Medicine\textsuperscript{1} and at St. George’s and Maida Vale Hospitals, London\textsuperscript{15} the incidence is 1.5 per cent and 4 per cent respectively, but this is because of a very strict selection of cases. In our own series there were 12 thoracic discs among a total of 2544 intervertebral herniations operated upon between May 1, 1946 and Dec. 31, 1958—a percentage of 4.72. The incidence of thoracic herniated discs found at necropsy is quite different. Andráe [cited by Fineschi]\textsuperscript{6}, in examining 368 cadavers at random, found posterior pro-
trusions of thoracic intervertebral discs in 15.2 per cent of the cases. However, the great majority of these patients had been symptom free, as the protrusion seldom had reached a size big enough to give rise to clinical phenomena.

**Sex.** Of the 12 patients in our series, 9 were males and 3 were females, a ratio of 3:1.

**Age.** Arranged according to decades, the ages of the 12 patients were: 21–30 years (1), 31–40 (2), 41–50 (6), 51–60 (2) and 61–70 years (1). The extreme ages were 21 and 61 years. At the onset of the disease 2 patients were under 40 years of age, 5 were between 41 and 50 years old, and 3 were between 50 and 60 years of age; in 2 cases the time of onset could not be determined, but it was certainly long before admission to the hospital. The interval elapsing from the onset of the earliest symptom until the detection of an objective neurological picture of medullary (radicular) compression was more than 5 years in 2 patients (22 per cent), 2 years in 2 patients (22 per cent), less than 1 year in 4 patients (45 per cent) and in 1 patient (11 per cent) there was an acute onset (7 days).

**Etiology.** As to the rôle played by trauma, in 7 patients the disease set in immediately after trauma of the spine (a fall in an erect position from a height) or strain of the spine (the throwing of a spadeful of earth); in 1 patient the onset occurred 2 years after spinal injury; in 1 patient, who was a car-driver by profession and in whom the disease had a slow onset, aggravations were caused by various strains. Finally in 3 patients the case history disclosed neither trauma nor strain of the spine; in 1 of these patients the syndrome of medullary compression set in after spinal anaesthesia for genital surgery (Case 7) and in the other 2 (Cases 4 and 11) there was no particular incident in the past history.

A grouping of the patients according to their occupation shows: 3 clerks, 1 housewife and 8 manual workers; of the 3 clerks only 1 had no previous traumatisms of the spine; the other 2 had had falls, which obviously were related to the disease.

**Pathologic Anatomy.** The site of the protrusion was median in 9 cases and lateral in 2 cases.

The levels of the protrusions are given in Table 1 together with the levels of thoracic involvement in published cases.*

In our series, 5 out of the 12 protrusions were found between T11 and T12 vertebrae (41.6 per cent); this confirms Epstein’s observation5 as to the high incidence of prolapse at this level; we agree with him in ascribing this to particular mechanical conditions and the high frequency of degenerative disease of the disc at this level. Of the 106 cases in Table 1, one-quarter of the discs were at the level of T10, T11, and T12, representing more than one-half of the total number of protrusions (51.9 per cent); it is therefore clear that the low thoracic region is more prone to the development of

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* We do not know the site of the prolapse in the case of Junget cited by Fineschi.4
prolapsed discs. This was emphasized by Kroll and Reiss,¹³ who pointed out that intervertebral discs are particularly exposed in 3 regions: the lower lumbar, the lower thoracic and the lower cervical (in order of frequency). On the basis of their cases of multiple protrusions of intervertebral discs they stressed the fact that these protrusions present the characteristics of a systemic disease. Since the first region to be impaired is the lower lumbar, they consider it quite probable that patients with protrusion of thoracic discs will also display disease of the lower lumbar discs.

In our series there were no cases of multiple thoracic prolapses but Case 12 displayed a hernia at T12 and one at L2, both of which were removed at a one-stage operation. However, Svien and Karavitis²¹ and Van Landing-

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<td>24</td>
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<td>T12</td>
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<td>13</td>
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<tr>
<td>12</td>
<td>94</td>
<td>106</td>
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ham²² each had 1 patient with 2 protrusions; and Abbott and Retter¹ had 2 patients with 2 protrusions but it is not clear from their paper whether the second hernia was removed or not, or whether it was a mere myelographic discovery at a subclinical stage. For this reason we have retained as cases of multiple prolapses of thoracic discs only the first 4 of the above-mentioned patients, each of them having been operated upon for 2 adjacent herniae.

Pathogenesis. Prolapse of a thoracic intervertebral disc is liable to produce impairment of the spinal cord by a twofold mechanism: (1) direct compression; (2) circulatory disorders brought about by compression of the anterior spinal artery.¹⁵ Direct compression of the cord apparently was the cause of sublesional neurologic symptomatology in numerous cases in which, following a slow and progressive clinical course, operation disclosed an old hernia and posterior angulation of the cord (Cases 8, 10 and 11). The vascular factor alone could account for the acute paraplegia in Case 9, in which pain had been present for many years (disc arthrosis), followed by transitory paraparesis and by the development, a few months later, of acute
paraplegia; in this case an old and partially calcified hernia was found at operation. As a matter of fact we believe that, apart from the mechanical factor, an important rôle is played by the vascular factor in the pathogenesis of any transitory paresis as well as in the supralesional neurologic symptomatology associated with herniated intervertebral disc, as has been observed by ourselves (Case 11) and by other authors. In this connection we may mention Kahn's hypothesis concerning the rôle of the dentate ligament in the pathogenesis of medullary disorders but we have registered no facts either confirming or invalidating this hypothesis.

**Symptoms.** In our cases the signs of medullary compression were in no way specific; we therefore agree as to the impossibility of describing a characteristic complex of symptoms.\(^1\) Our patients displayed:

1. Rigidity of the paravertebral muscles in 3 cases (25 per cent), in 1 (8.33 per cent) of which associated scoliosis was present.
2. Pains confined to the spine in 9 cases (75 per cent). In 6 cases (50 per cent) pain was also present in the lower limbs. *In 3 patients the hernia gave rise to no pain.*
3. Motor disturbances in 9 cases (75 per cent): paraparesis in 7 cases and paraplegia in 2.
4. Hypoaesthesia or anaesthesia with upper level in 11 cases (91.66 per cent). *In 1 case the upper level of the hypoaesthesia was two segments higher than expected.*
5. Sphincteric disorders in 8 cases (66.66 per cent).
6. Disturbances of potency in 2 cases (16.66 per cent).
7. Trophic disturbances in 2 cases (16.66 per cent).

Abbott and Retter\(^1\) outlined 3 major types of protruded thoracic discs according to the symptomatology:

I. **Lateral protrusion** with a clear-cut syndrome of radicular compression and hardly any medullary signs. This type of hernia is frequently mistaken for visceral disease.\(^5,13\) Our Cases 2 and 3 belong to this group (16.66 per cent). Even these 2 patients displayed signs of spinal-cord impairment. [That is probably why useless laparotomies were performed in our series, as may happen when radicular pain is attributed to some visceral disease; for instance, in Epstein's series\(^5\) 3 patients had had laparotomies before a neurosurgeon was consulted.]

II. **Median hernia** in the upper and middle thoracic spine with a more or less severe motor and sensory symptomatology but associated mainly with pain and paraesthesia. Our Cases 1, 6, 7, and 11 (33.34 per cent) are examples.

III. **T11 and T12 protrusions** which compress the medullary cone and cauda equina, with thoracolumbar pain referred into the lower limbs, sphincteric disorders and a complete or dissociated sensorimotor cauda equina syndrome. Our Cases 4, 5, 8, 9, 10, and 12 (50 per cent) belong to this group.

**Clinical Course.** Prolapse of thoracic intervertebral disc displays two distinct forms of evolution: either (i) a more or less violent vertebromedullary
traumatism associated or not with lesions of the bone, generally in a young male, is followed after a short interval by a backache rapidly evolving towards a clearly defined picture of motor and sensory deficit within a period ranging from a few days to 6–7 months; or (ii) there is a classical picture of slow and progressive medullary compression in the absence of any noteworthy past traumatism in a patient generally past middle age, in whom radiographic signs of chronic and often multiple lesions of intervertebral discs are present.

Attention should be called to a few salient facts derived from the analysis of our cases (Table 2): In the first place, the trophic ulcer of Case 8, which set in 10 years after onset of the disease.

In 1940, the patient fell and landed on her feet from a height of 12 ft.; this was followed by pain in the back and antalgic stiffness of the dorsolumbar muscles for the next 10 years. Trophic ulcers of the distal phalanx of both great toes appeared in 1950, and in 1952 there was onset of a left foot drop. In 1955 the trophic ulcer in the left foot healed but in the great toe on the right side it extended considerably both in surface and in depth. In 1956 the foot drop became bilateral and the patient complained of urgent micturition.

On admission to the Clinic the patient exhibited a sensorimotor and sphincteric cauda-equina syndrome with bilateral sensory level at L5 and the above-mentioned trophic ulcer. Queckenstedt-Stookey test revealed a partial block of the cerebrospinal fluid; the fluid contained 0.54 gm. per cent protein and 2 cells. Myelography disclosed a partial block at the level of T11.

At operation (performed by Dr. G. Sandor) a large calcified hernia at this level was removed entirely through a transdural approach.

Ten days after operation the ulcer healed in a most spectacular manner—it had been present for 7 years. Reexamined 10 months after operation, the patient was pleased with the result; she no longer experienced any pain, was able to walk without help, the foot drop was improved, the trophic ulcer was cured and there were no sphincteric disturbances. She lived alone and was able to meet all the requirements of daily life.

Trophic ulcer of the “mal perforant plante" type is a comparatively common symptom in tabes, syringomyelia, etc. It has also been mentioned in relation to various persistent syndromes of medullary compression such as those caused by epidermoid tumors, but, as far as we know, it has hitherto not been encountered in cases of prolapse of thoracic intervertebral discs.

We consider our Cases 4, 7 and 11 to be particularly interesting. According to our survey of the literature, it appears that the main difference in the symptoms of protruded intervertebral discs at various levels of the spine is that the thoracic lesions are far less frequently associated with a past history of trauma. Moreover, many writers emphasize the high frequency of cases of median thoracic hernia without pain, a feature that is not encountered in other regions. We consider that our series might help in clarifying this problem, in that the 3 cases in which no pain was present were precisely those in which there was no past history of trauma (Cases 4, 7, 11).
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Case 4 is that of a male patient aged 21 years who had suffered from nocturnal enuresis since childhood, and satyriasis because of a T12 hernia.

Case 7 is that of a female aged 43 years. Spastic paraparesis and hypoesthesia with an upper level at T6 developed during the 5 years that followed a spinal anaesthesia. The cause was a T4 hernia.

Case 11 is that of a female teacher aged 61 years who exhibited spastic

<table>
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<tr>
<th>Case and Hosp. No.</th>
<th>Sex and Age</th>
<th>Level and Position</th>
<th>Onset, Duration, and Evolution of Symptoms</th>
<th>Neurologic Findings</th>
<th>Operation and Type of Prolapsed Disc</th>
<th>Results and Period of Follow-Up</th>
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<tbody>
<tr>
<td>1 8731</td>
<td>M 56</td>
<td>T1 median</td>
<td>Trauma 3 yrs, slowly progressive</td>
<td>Thoracolumbar rigidity, pain lower back and left leg, spastic paraparesis, sphenicteric disturbances, Hypoesthesia level T2</td>
<td>Laminctomy CT-T1 Transural removal Firm disc</td>
<td>Fair (Postop. pat. no pain, no neurologically unchanged)</td>
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<tr>
<td>2 401</td>
<td>M 49</td>
<td>T10 left lat.</td>
<td>Trauma 7 days acute</td>
<td>Lumbar rigidity, thoracolumbar pain, Radicular hypoesthesia T10-T12</td>
<td>Laminctomy T10-L1 Extradural removal Soft disc</td>
<td>Fair (Postop. pat. no thoracolumbar pain, paraparesia lower limbs)</td>
</tr>
<tr>
<td>3 6011</td>
<td>M 49</td>
<td>T11 left lat.</td>
<td>Strain 2 mos, acute</td>
<td>Sciosis, thoracolumbar pain, right sciatica, Hypoesthesia level T12</td>
<td>Laminctomy T10-T12 Extradural removal Soft disc</td>
<td>Unimproved 4 yrs.</td>
</tr>
<tr>
<td>4 7538</td>
<td>M 21</td>
<td>T12 median</td>
<td>No trauma since childhood Insidious</td>
<td>Nocturnal enuresis, satyriasis, right patellar and Achilles reflexes absent</td>
<td>Laminctomy T10-L3 Partial extradural removal Calcified disc</td>
<td>Good 3 yrs.</td>
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<tr>
<td>5 17,040</td>
<td>M 44</td>
<td>T11 median</td>
<td>Repeated strains 3 mos, Subacute</td>
<td>Spastic paraparesis, sphincteric disturbances, Hypoesthesia level T11, Muscular atrophy left leg</td>
<td>Laminctomy T11 Transural removal Soft disc</td>
<td>Fair (Postop. pat. slightly improved, discrete paraparesis)</td>
</tr>
<tr>
<td>6 89,095</td>
<td>M 50</td>
<td>T10 median</td>
<td>Strain 3 yrs, Insidious</td>
<td>Spastic paraparesis, more marked on right, Sphincteric and sexual disturbances, Hypoesthesia level T11, Bilat. sciatica</td>
<td>Laminctomy T9-T11 Transural removal Soft disc</td>
<td>Good (Postop. pat. has resumed work)</td>
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<tr>
<td>7 32,499</td>
<td>F 43</td>
<td>T4 median</td>
<td>No trauma 3 yrs, slowly progressive</td>
<td>Spastic paraparesis, more marked on right, Sphincteric disturbances, Hypoesthesia level T6</td>
<td>Laminctomy T4-T5 Transural removal Soft disc</td>
<td>Unimproved 3 yrs.</td>
</tr>
<tr>
<td>8 56,884</td>
<td>F 35</td>
<td>T11 median</td>
<td>Trauma 17 yrs, slowly progressive</td>
<td>Cauda equina syndrome, Hypoesthesia level L3, Trophic ulcer left great toe, Back pain</td>
<td>Laminctomy T11-T12 Transural removal Calcified disc</td>
<td>Very good (Postop. pat. normal muscular weakness, has resumed work)</td>
</tr>
<tr>
<td>9 31,801</td>
<td>M 36</td>
<td>T11 median</td>
<td>Repeated strains several yrs, Unilateral</td>
<td>Flaccid paraplegia, Hypoesthesia level L1, Bilat. Lasègue</td>
<td>Laminctomy T10-T12 Transural removal Calcified disc</td>
<td>Good (Postop. pat. normal sphincters, bedsores healed, some movements recovered 3 mos.)</td>
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<tr>
<td>10 40,740</td>
<td>M 48</td>
<td>T11 median</td>
<td>Strain 1 yr, Unilateral</td>
<td>Lumbar rigidity, bilateral Lasègue, thoracolumbar pain, spastic paraparesis, Hypoesthesia level T11</td>
<td>Laminctomy T8-T10 Trans- and extradural removal Soft disc</td>
<td>Fair (Postop. pat. no pain, postop. paraplegia now discrete paraparesis)</td>
</tr>
<tr>
<td>11 40,789</td>
<td>F 61</td>
<td>T9 median</td>
<td>No trauma 7 yrs, slowly progressive</td>
<td>Discrete paraparesis, more marked on right, Hypoesthesia level T6</td>
<td>Laminctomy T8-T10 Transural removal Calcified disc</td>
<td>Aggravated (Postop. paraplegia, bedsores)</td>
</tr>
<tr>
<td>12 42,527</td>
<td>M 52</td>
<td>T12 median</td>
<td>Strain 3 mos, Unilateral</td>
<td>Acute cauda equina syndrome, Flaccid paraplegia, Hypoesthesia level L4</td>
<td>Laminctomy T12-L2 Transural removal Soft disc T17 and L2</td>
<td>Good (Postop. pat. some muscular weakness still present)</td>
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paraparesis, more marked on the right side, which evolved in the course of 2 years, caused by a T9 hernia.

In cases of herniated discs, pain, either local or referred over several segments, is caused by two mechanisms: distention of the dorsal portion of the annulus fibrosus and ligamentum longitudinale posterius, where Roofe found sensory nerve branches and sympathetic fibres whose injury induces violent and intractable pain in the back, and likewise radicular compression. In the thoracic region, unlike the lumbar or cervical regions, the spinal roots have a very short intraspinal portion and therefore their contact with intervertebral discs is restricted to a distance of only a few millimeters. This particular anatomic feature determines the extreme rareness or even absence of radicular pain in cases of median hernia of thoracic intervertebral discs.6

Thus, only the former mechanism is possible: pain in the back caused by distention of the annulus fibrosus and ligamentum longitudinale posterius. Yet, as a rule, prolapse of thoracic discs does not set in suddenly after an injury, thus giving rise to acute distention of these structures but, on the contrary, its evolution is slow and distention of the fibroligamentous system takes place gradually for a long time. The chronicity of the process is demonstrated by calcification of the nucleus pulposus, which appears frequently in the thoracic region and exceptionally in other regions of the spine. It goes without saying that this chronic distention will give rise to pain much less frequently than an acute process. Additional proof is found in Andrae’s statement that a large number of protruded thoracic intervertebral discs found at necropsy had caused no clinical symptoms.

We may therefore safely assume that many median thoracic protrusions are not associated with pain because they are not in close proximity to the roots, and, on the other hand, there was no trauma to produce an acute distention of the annulus fibrosus and ligamentum longitudinale posterius.

Ancillary Methods of Diagnosis. Examination of the cerebrospinal fluid and manometric tests in our experience have yielded data similar to those mentioned in the literature. The amount of proteinocytologic dissociation, as well as the evidence of a block by the Queckenstedt-Stookey test, depend on the degree of compression produced by the hernia. As in any extradural process there is no definitive relation between a positive Queckenstedt-Stookey test and the severity of the morbid process. Cases of herniated thoracic disc with an obvious syndrome of medullary compression and a normal cerebrospinal fluid were present in our series (Cases 4 and 11) as well as in those of other authors.1,7,15 In other cases of our series (9, 10, and 12) the cerebrospinal fluid contained an increased amount of protein ranging from 0.60 gm. to 2.64 gm. per cent with 1–5 cells and there was a partial or totally positive Queckenstedt-Stookey test, these data being similar to those of others.14,16

It may be said that positive proteinocytologic dissociation and the Queckenstedt-Stookey test have no specific significance in cases of prolapsed thoracic discs; if negative, this diagnosis cannot be discarded.
A roentgenologic examination was performed in all our cases: simple radiographs showed no particular changes in 3 cases. Narrowing of the intervertebral space was found in 1 case (8.33 per cent). Single or multiple protrusions of the nucleus pulposus into the vertebral spongiosa at the site of dorsal protrusion or elsewhere in the spine were noticed in 5 cases (41.65 per cent). Static changes of the thoracic spine (scoliosis, straight spine) were found in 2 cases (16.66 per cent). In 3 patients (25 per cent) the nucleus pulposus of the herniated disc was calcified. A wedge-shaped appearance of one of the two vertebrae adjacent to the hernia was described in Cases 8 and 11 (the patient in Case 8 had sustained a severe traumatism). A marked posterior bulging of the disc into the vertebral canal was present in Case 8; finally in 1 case a localized decalcification of the vertebral body adjacent to the herniated disc was seen (Fig. 1). Case 11 with T9 hernia displayed a T12-L1 vertebral block of undetermined etiology, which seriously complicated the diagnosis, but the flow of lipiodol at this level was normal. Myelography (using lipiodol in 11 cases and air in 1 case) revealed the site of hernia accurately in 10 cases (83.34 per cent). It was inconclusive in Case 1, and findings were normal in Case 7. In this latter case the level of the hernia was determined on the sole basis of the upper level of the hypoaesthesia.

Fig. 1. Lateral roentgenogram of inferior thoracic spine. Intervertebral space T11-T12 is slightly narrowed. Localized decalcification of the dorsal one-third of T11 vertebral body is seen (prolapse of intervertebral disc T11).
In a simple radiograph the signs of hernia of a thoracic disc are narrowing of the intervertebral space and calcification of the nucleus pulposus (arthritic changes are not more frequent in patients with herniated thoracic discs than in controls).\(^{15}\)

Narrowing of the intervertebral space is inconstant; on the other hand a narrowing does not necessarily imply the presence of a protruded disc at this level.\(^{16}\) In fact, because of the small height of thoracic discs, narrowing of the intervertebral space is difficult to interpret. Still, narrowing of the intervertebral space sometimes helped in determining accurately the level of the prolapse,\(^{5,6,13,16,24}\) as in our Case 10.

Calcification of the nucleus pulposus is far more important as its elective site is in thoracic discs. Fineschi assumed that, as a rule, calcification of the nucleus pulposus is followed by a protrusion of the intervertebral disc and only in exceptional cases by a posterior protrusion. Calcification of the herniated disc has been demonstrated by many authors (our Cases 8 and 11).\(^{8,9,16,18,19}\) Logue\(^{19}\) found calcification of the disc in 8 out of his 11 cases (70 per cent) whereas among 100 controls calcification was evident in only 4 cases; likewise in 25 cases of thoracic medullary tumors he never found this

![Fig. 2. Lateral roentgenogram of inferior thoracic spine. Intervertebral space T9-T10 is narrowed. Many small calcifications of the intervertebral disc are shown. T9 vertebra presents a ventral osteophyte and the dorsal zone of vertebral bodies T9 and T10 are united through a bony bridge (prolapse of intervertebral disc T9).](image-url)
roentgenologic sign. Nevertheless Logue insisted upon the fact that the level of the hernia was revealed by the calcification in only 5 of the 8 cases; he concluded, therefore, that a diagnosis of protruded thoracic intervertebral disc can be made with certainty if in a patient with thoracic medullary compression a calcification is found consistent with the level of sensibility. Yet we found exactly the same conditions in a patient with a spinal neurinoma.

The best possible information that can be obtained from a simple radiograph is the shadow of the protrusion bulging into the vertebral canal, as in our Cases 8 and 11 (Fig. 2), Antoni’s case reported by Hellmer and that of Garcin et al. 7

In Abbott and Retter’s experience 1 simple radiograph supplied no positive data in 11 patients carrying 13 thoracic protruded discs. All authors agree that myelography is the most valuable means of diagnosing this 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. In our cases myelography was conclusive in 10 out of 12 cases; in Love and Kiefer’s 15 series the proportion was 12 out of 13; one normal myelogram was also reported by Knutsson. 12 In connection with the pattern of the block, Fineschi 8 stated that a notched appearance of the limit of the lipiodol column is typical for an anterior extradural process; he also maintained that in cases of herniated thoracic disc, even if there is a total block, a control examination performed after a 24-hour interval shows the iodized oil at the lower end of the spinal subarachnoid space. In his endeavor to find a differential characteristic of the myelographic pattern, Liedberg 14 suggested the following test: after performing myelography in the ordinary position of lordosis and finding a block, the spine should be positioned in maximum kyphosis. If the block disappears the morbid process is a protruded disc; if it persists it is a tumor of the spinal cord.

RESULTS

The 12 patients were all operated upon. Laminectomy was performed over 1–4 vertebrae and the dura mater was opened even in those cases in which the protrusion was removed by an extradural approach. In cases of transdural removal the dentate ligament was divided over 2–3 segments. Radicotomy was necessary in a few cases. Attempts were always made to withdraw the lipiodol from the spinal subarachnoid space, but this was not fully successful except in a restricted number of cases. The hernia was always removed in fragments, especially in cases of calcific herniae. In 2 cases (1 and 4) the hernia could not be removed in its entirety. In 4 cases (4, 5, 6, and 9) the dura mater was left open. Decompressive laminectomy without the removal of the hernia was never performed.

We believe that the technique suggested by Hulme10 for the approach of the protruding disc, based on the fact that manipulation of a spinal cord with prolonged pre-existent impairment is liable to bring about severe irreversible lesions, is logical and is worth being tried. He advocates a lateral approach to
the hernia after resection of the proximal portion of the 2 adjacent ribs and widening of the foramen intervertebrale. The author's results are said to be good; he gives no other details but we hope he will do so in a future report. We have not yet had the opportunity to try his procedure.

In our series complete paraplegia occurred postoperatively in 3 previously paraparetic patients (6, 10, and 11); 2 of them recovered (6 and 10) but the third still displays no signs of improvement (operation was performed on Oct. 14, 1958). There was no postoperative mortality; in 3 cases the results were bad in that the patients obtained no benefit from the treatment (25 per cent). In 4 cases the results were fair (33.35 per cent); in 5 cases the results were good or excellent (41.65 per cent).

In the literature we found the following results: Kroll and Reiss32 did not present their results in sufficient detail and in our opinion the authors are overoptimistic in stating that they had no postoperative recurrences or residual disorders. They concluded that surgical success is more certain in cases of thoracic than in lumbar hernia. Logue's15 results in 11 patients were as follows: 18 per cent deaths, 27 per cent poor results, and 65 per cent good results. In 11 cases Abbott and Retter1 recorded 9 per cent deaths, 9 per cent poor results, 27 per cent fair results and 46 per cent good results. Love and Kiefer16 gave no general results but presented them according to the 3 major symptoms (motor weakness, sensory disturbances and pain): of 14 patients with motor incapacity 57.12 per cent were unimproved, 42.88 per cent were improved, and there was no complete recovery; of 12 patients with an objective sensory syndrome 57.12 per cent were unimproved, 42.88 per cent were improved, and there was no complete cure; of 12 patients with pain 16.66 per cent were unimproved, 41.67 per cent were improved, and 41.67 per cent recovered. Their conclusion, with which we are in complete agreement, is that the results of surgical management depend on the stage at which the patient is operated upon; long-standing lesions of the spinal cord are incompatible with full recovery. Improvement in the results of treatment of herniated thoracic intervertebral discs is conditioned by their early detection and by immediate surgical intervention. For this purpose every neurologist, surgeon or orthopaedist must be acquainted with and bear in mind the possibility of this diagnosis.

SUMMARY

1. At the Neurosurgical Clinic in Bucharest 2544 protruded intervertebral discs at various levels were operated upon between May 1, 1946 and Dec. 31, 1958. Among them there were 12 protrusions of thoracic intervertebral discs.

2. Comments are made on the main data from the literature covering 95 cases; the 12 personal cases are analyzed from the clinical and roentgenologic standpoint (a total of 107 cases). A description is given of 3 clinical forms and 2 types of evolution of thoracic protrusions. The authors present a hypothesis explaining the absence of pain in cases of median protrusions of thoracic in-
intervertebral discs having a slow evolution, and in which the past history discloses no vertebromedullary traumatism. The value of various clinical and radiological symptoms is discussed.

3. Results depend in the first place on early diagnosis and an adequate operative technique.

Postoperative mortality was nil. The results were poor in 25 per cent of the cases, fair in 33.35 per cent, and good in 41.65 per cent.

ADDENDUM

After this paper was prepared for publication another patient (the 13th) having prolapse of a thoracic intervertebral disc (at T7) was operated upon.

He complained of pain of radicular type, no medullary symptomatology whatsoever being present. The cerebrospinal fluid was normal as was the Queckenstedt-Stookey test. Radiography disclosed a calcification of the intervertebral disc at T7 and myelography showed a filling defect at the same level on the left side (Fig. 3). For the first time we used Hulme's\textsuperscript{10} operative approach, with complete satisfaction. The result was excellent, and we intend to use Hulme's technique in other cases in the future.

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Fig. 3. Anteroposterior roentgenogram of thoracic spine. Intervertebral space between T7 and T8 vertebrae is narrowed, the nucleus pulposus is calcified and the column of iodized oil shows a filling defect on the left side at the same level (prolapse of intervertebral disc T7).
REFERENCES

2. Antoni, N.  Cited by Müller. 19