

Diagnosis and treatment of thoracic intervertebral disc protrusions

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SUMMARY A series of 14 patients with a protruded thoracic intervertebral disc is reported. We believe that the true incidence may be as high as one patient per million population per annum. Trauma, sometimes mild, seems to have played a significant role in this series. This fact coupled with pronounced numbness and disagreeable paraesthesiae should suggest the diagnosis with thoracic spinal lesions. Armed with clinical suspicion, radiological verification of the lesion can be expected using a thorough myelographic technique supported if necessary by tomography. A posterolateral approach which combines laminectomy, complete excision of the ligamentum flavum, and the extradural removal of protruded disc is described. The technique is safe and effective.

Key (1838) appears to have been the first to describe spinal cord injury arising from a ruptured thoracic intervertebral disc. Operative treatment of these lesions was initially rare, and only sporadically reported. For example, publications from the Mayo Clinic show that their first admission for such a lesion (lying at D6) occurred in 1922 and that by 1950 they were able to report a total of only 17 patients with thoracic disc protrusions (Love and Kiefer, 1950). In 1963 Arseni and Nash gave details of the cases—191 in all—whose operative treatment had been recorded up to that time. However, we believe that this figure greatly underestimates the true incidence of the disease because our area records indicate that for a one million population there will be almost one patient per year who presents with neurological abnormalities arising from a protruded thoracic intervertebral disc. It is our belief that in spite of such articles as those by Müller (1951), Logue (1952), Arseni and Nash (1960), also Love and Schorn (1965), protruded thoracic intervertebral disc is not considered as a diagnostic possibility as often as it should be. Failure to remember the possibility may lead to delay in diagnosis which has serious consequences. It is the purpose of this article to stress the features both clinical and radiological which suggest the diagnosis, tentatively to introduce some fresh concepts concerning the pathological anatomy of these lesions, and to proclaim the good results which will follow prompt diagnosis and correct surgical therapy.

PATIENTS

Over the past nine years 14 patients have been operated upon for a prolapsed thoracic intervertebral disc. In one patient, after two years, a second operation was performed. There were 11 males and three females in the series. The ages ranged from 30 to 75 with an average age of 51 years. The case records of all these patients have been carefully reviewed together with all the available radiographs. In addition, one of us (J.G.) has conducted a systematic neurological reassessment of the 13 surviving patients in order to gain accurate information concerning the long-term results of treatment. One patient, who is unique in several respects, will be reported in detail before proceeding to a general description of the clinical features of the remainder.

CASE 1

A man, aged 37, apparently suffered an acute on chronic prolapse of a disc at T10/11 intervertebral space. His acute illness had commenced only 10 days before his admission to the Neurosurgical Unit.

He was turning to pass a long steel rod to a workmate when he felt a click in his back followed by a sudden pain across the lower ribs and back. His legs became numb and he had to use his bicycle for support when walking home. The pain became severe and when his doctor saw him at 11.00 a.m. the next day his right leg was numb and paralysed. One hour later the other leg was affected and he could not pass water. Four days later he was admitted

to his local hospital with post-renal uraemia. It was not until a further seven days had elapsed that a request was made to transfer him to this unit.

On admission, he was found to have a complete flaccid paraplegia with total loss of sensation below the level of his lesion. Immediate myelography confirmed a partial obstruction which was thought to be due to a disc. Because there was total interruption of cord conduction preoperatively, it was not surprising that in spite of a thorough removal of the protruded disc material there was no neurological improvement.

The man died of a pulmonary embolus two months after his operation. He is the only patient in the series who was admitted with total loss of cord function and whose paraplegia had rapidly followed the first symptoms of cord compression.

CLINICAL FEATURES

The remaining 13 patients constitute a fairly homogeneous clinical group. Their histories have varied in duration from seven years to one week, the mean figure being two and a half years.

The commonest initial symptom has undoubtedly been pain in the back, although some of the patients have complained of pains in the legs, groin, or pelvis. It is worth noting in addition that these patients have experienced pain either when the intraspinal pressure was raised or when certain movements including neck flexion were performed.

An early and outstanding symptom in half of our patients has been the presence of obtrusive and disagreeable paraesthesiae below the level of the lesion. Sometimes these phenomena have been confined to one side of the body, but Fig. 1 illustrates the possible complexity of the unpleasantly distorted sensations which these patients may experience. Some patients have spontaneously reported a considerable defect in temperature perception affecting one foot. For example, one man noticed this when walking on the cold bathroom floor. While we do not believe it has any special diagnostic significance, one patient in three has also complained of cold feet. We have been struck by the extent to which this group of patients has complained of numbness of the trunk or legs. Nine of them have made this complaint and with one exception it has been bilateral.

Every patient has observed some weakness of the legs. At its worst the weakness has been sufficient to confine the patient to bed (three out of 14). Both legs were affected in eight patients.

The patient's past history may be relevant. For example, two male patients had served as paratroopers, one had been a professional weight lifter, and another had been a tumbler. A heavy fall on the buttocks (four patients) or onto the heels (one patient) had been the event which had precipitated—either acutely or sub-acutely—the onset of the

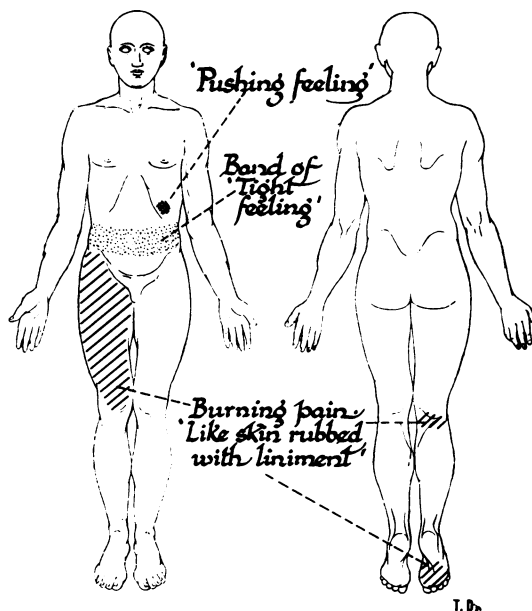


FIG. 1. Pattern of disagreeable paraesthesiae in patient with protruded disc at T4/5.

symptoms in one-third of the patients. It will also be recalled that in case 1, quoted above, a rotational strain was the cause of an acute sequestration.

The length of history and the possibility of spontaneous remission are well illustrated by the following case history.

CASE 2

A woman, aged 63, fell heavily on her buttocks in 1961. Ten days later she suddenly found she could walk only when using the furniture for support. She was admitted to hospital locally where she was thought to have a paraplegia probably arising as a result of a vascular accident to her dorsal cord. She was seen by a neurologist who dismissed the diagnosis of protruded thoracic intervertebral disc because the lumbar CSF protein was within normal limits and there was no manometric block. After nine months in hospital she was walking almost normally and, indeed, she continued well until August 1968. At this time she noticed numbness under both heels and one month later she tripped when walking over the carpet. Two weeks later she fell and, after this, noticed that her right leg was weak. In the next three months she deteriorated steadily. She could no longer walk without support and she had pain in her legs like 'tight cords'.

(The deduction we drew from this sequence of events is that a sub-acute sequestration occurred in 1961 from which she recovered spontaneously in the following year, probably because the relationship of the cord to the sequestered fragment must have changed. It is difficult

to decide amongst several plausible possibilities what caused her recurrent symptoms six and a half years later).

She was again admitted to hospital and myelography showed a complete block at T9/10 intervertebral space. She was transferred to the Neurosurgical Unit where a severe spastic paraparesis with a shelving sensory loss and sacral sparing was confirmed. Skin appreciation of vibration sense was diminished below T9 dermatome.

On 21 January 1969 a laminectomy was performed; using the right lateral approach, the disc fragments were removed. The ligamentum flavum appeared to be acting as an additional compressing agent and was excised. Over the ensuing six months she made a good recovery. After one year she was managing her house, entertaining visitors, and was able to go up and down stairs (albeit backwards) and to walk to the shops using one stick.

Preoperative spontaneous improvement has been encountered in two other patients; in one of them, the signs had never been severe and they regressed to the point of insignificance while he was awaiting operation. This last patient had a heavily calcified sequestered disc fragment (see Fig. 2a) of a type indicating that the disc prolapse must have occurred many months before, when his symptoms consisted only of back pain aggravated by coughing and by movements of the neck.

It is somewhat surprising that urinary symptoms were described by only two patients. Indeed, after excluding case 1, the two patients with the greatest motor loss (unable to walk preoperatively) both retained the ability to empty the bladder spontaneously.

There are only three factors in the physical examination which we regard as important and specific. The first is that there may be difficulty in defining a sensory level by the standard techniques. When this is so, we have found skin vibration sense to be the most effective method of demonstrating the upper limit of the neurological deficit. Secondly, this deficit quite frequently has been observed to extend above the dermatomal level corresponding to the anatomical lesion. Most commonly the discrepancy has been of only one dermatome, but in two patients it has been of several dermatomes. A third feature is the occurrence of back and root pain on neck flexion in some of these patients. For example, one patient with a sequestered disc jammed in the intervertebral foramen at D10/11 experienced considerable exacerbation of pain in the flank with neck flexion. We are unsure whether this is a direct mechanical effect or whether it arises from a change in intraspinal pressure.

INVESTIGATIONS

Analysis of cerebrospinal fluid removed at lumbar

puncture has seldom contributed towards the diagnosis. There has been no abnormality of cell content. Although two patients showed a considerable elevation of the protein content—200 mg/100 ml. and 250 mg/100 ml.—the mean value observed in the others was only 47 mg/100 ml. Manometric responses were not consistently recorded, for we place little reliance upon them. (At least one patient in our series showed a normal manometric response in the presence of a complete myelographic block; furthermore, this discrepancy may be observed with other lesions which obstruct the spinal canal.)

Osteophytic lipping (beaking) of several of the lower thoracic vertebrae, sometimes accompanied by similar changes in the lumbar vertebrae, has been present in five patients. However, the protruded disc has not always occurred at the site of maximum lipping, and in any event such changes are not rare in patients in this age range. Thus we regard osteophytic lipping as a feature 'consistent with', but 'not diagnostic of' a protruded thoracic disc. The same sort of remark could be applied to calcification within the intervertebral disc space itself, for in only two of our patients has calcification within the disc space been found at the level of disc protrusion. In contrast, when a sequestered fragment lies within the spinal canal and is calcified it will be precisely diagnostic and may be plainly displayed by appropriate tomography (Fig. 2a and 2b). The affected disc space sometimes becomes narrowed, and when it does so, an approximation of the tips of the spinous processes may be recognizable.

MYELOGRAPHY

Although appearances such as those seen in Fig. 2 are, in our opinion, diagnostic, planning of the operative treatment will necessitate myelography. This was performed in all 14 patients. With increasing experience we have gradually learned that the following manoeuvres may well be necessary in order to establish diagnosis. Assuming that the Myodil (iopendylate) has been instilled into the lumbar sac, it should be run up the spinal canal with the patient prone, and both anteroposterior (AP) and lateral radiographs should be obtained. When the flow is completely obstructed the pattern observed may be as in Fig. 3a and b, and the correct diagnosis will be readily deduced. If the obstruction is incomplete, but there is difficulty in getting the contrast medium to ascend the spinal canal, we have found it useful to compare the ease with which the Myodil flows past the lesion with the patient lying first on one side and then on the other. A greater degree of obstruction is likely to be observed on the side of the greater

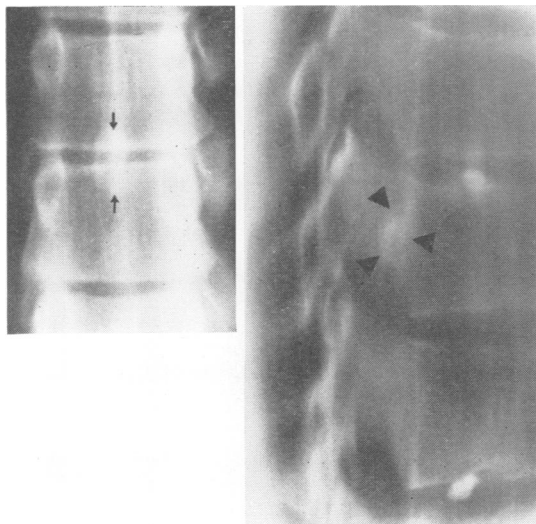


FIG. 2. (a, left): coronal tomographic cut showing oval calcified disc (at T6/7) lying within spinal canal. (b, right): sagittal cut to show calcified sequestered fragment (arrows) lying posterior to the body of T10. Note also calcification within the disc space at T9/10 and at T11/12 (see Fig. 9b for explanatory line drawing).

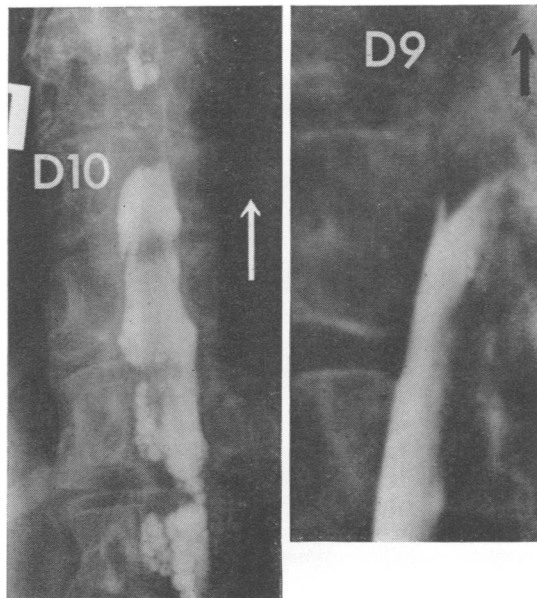


FIG. 3. (a, left): myelogram—prone position; AP projection to show complete arrest of Myodil at T9/10 with cord displaced to the left (arrow shows direction of Myodil flow). (b, right): myelogram—prone position; lateral projection to show complete arrest of Myodil at T9/10. Note that this was a lateral disc protrusion so that there is a double profile to the Myodil column at the point of arrest.

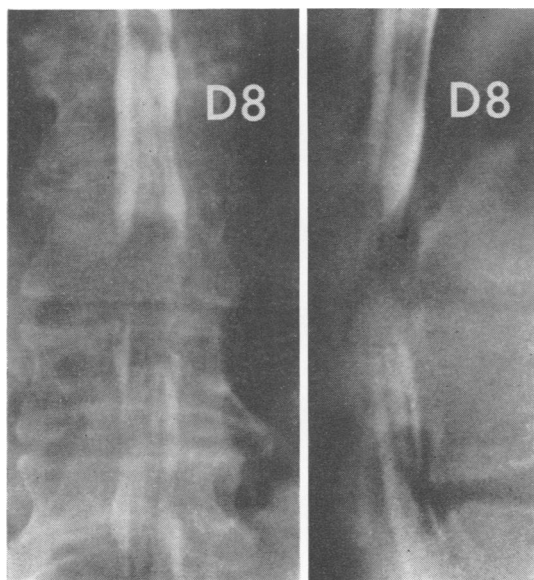


FIG. 4. Myelogram—patient supine. (a, left): PA projection. (b, right): lateral projection. Note that although the Myodil is not arrested, it reveals the lesion at T9/10 clearly even in the supine position.

neurological deficit. When the Myodil has been manipulated above the suspected lesion, the patient should be tilted upright and the contrast medium followed downwards. We have also observed that, when using only 6 ml. Myodil, diagnostic information may be obtained from both the AP and lateral radiographs with the patient supine (Fig. 4). The supine position makes it easy to 'pool' the Myodil at a chosen level of the thoracic kyphos.

The difficulties of establishing diagnosis by myelography are underlined by the fact that in half our patients the initial investigation was said to show no evidence of spinal compression. We would like to emphasize the importance of collaboration between the clinician who has made the presumptive diagnosis and the radiologist in order to ensure that the diagnosis is either confirmed or refuted.

PATHOLOGICAL ANATOMY

Before proceeding to discuss the operative treatment, we wish to digress briefly concerning the pathological anatomy of these lesions. It would appear that when an acute prolapse occurs—with seques-

trated disc fragments being forced into the spinal canal—the degree of compression of the theca is relatively slight. For example, in the patient whose radiographs are reproduced in Fig. 4, there is obviously incomplete obstruction of the spinal canal, yet this man had such weakness of his legs that he was unable to walk. In such lesions, we believe that the sequestered fragments impinge upon the anterior spinal artery so that the neurological manifestations result primarily from the disturbance of blood supply, rather than from compression. The lesion here was exclusively central and anterior. We suppose that only with larger disc protrusions does the element of compression become an important factor. In the patient whose radiographs are shown in Fig. 3a, not only was there a compressing mass of sequestered disc material anterior to the cord, but, after the laminae on either side of the affected disc had been excised, the lateral limit of the ligamentum flavum could be seen to be constricting the theca symmetrically on both sides. Figure 5a is a diagrammatic drawing of the appearance observed, while Fig. 5b shows the situation which we believe may well exist in longstanding lesions where narrowing of the disc space has resulted in a closer approximation of the affected vertebrae. The buckled ligamentum flavum may, thus, be in a position to constrict both the dorsal and lateral aspects of the dural tube (Fig. 6 reproduces a radiograph which confirms these features). It is from these considerations that in the last five operations, a laminectomy has been combined routinely with the actual removal of the discs.

SURGICAL PROCEDURE

Because it is essential to identify the vertebrae

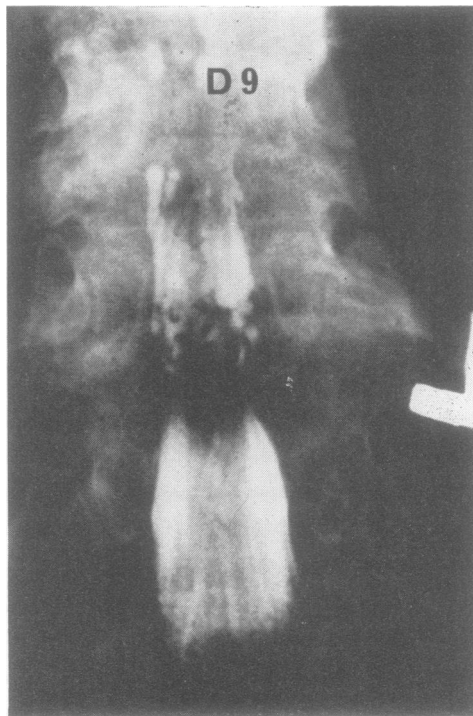


FIG. 6. Myelogram with protruded disc at T10/11. AP projection to show diffuse constriction of the theca opposite to the disc.

accurately, shortly before the operation a length of metal pin is always inserted under sterile conditions into one of the vertebral spines close to the lesion. A lateral radiograph, which is sufficiently large to

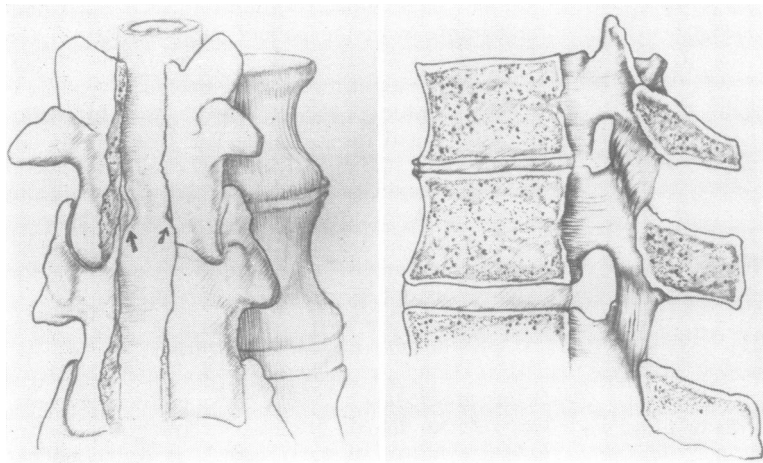


FIG. 5. (a, left): diagram to show how the lateral portions of the ligamentum flavum (arrows) may grip the theca. (b, right): diagram to indicate that when the vertebral bodies become approximated the ligamentum flavum, lying posteriorly to the theca, buckles and compresses it.

show unmistakable landmarks is then taken. Subsequently the pin is removed during the operation.

The patient is usually placed in the knee-elbow position in order to obtain maximum reduction of the venous pressure in the epidural plexus. A mid-line incision is used to expose and remove the spines and laminae of the vertebrae on either side of the affected disc. Two points, concerning the removal of the laminae, must be stressed. The first and most important is that the spinal canal must not be narrowed during the bone removal by insertion of the blade of a bone forceps deep to the lamina. There is seldom room within the canal to accommodate the cord, protruded disc material, and forceps. Indeed, during some of the operations, one can demonstrate that the lateral portion of a lamina is actually touching the surface of the laterally lying disc lesion. Thus, the bone removal must be accomplished almost entirely by cuts parallel to the deep aspect of the lamina. The only instrument which is ever placed within the canal is the lower jaw of the small 3.5 mm Hajek punch forceps. This instrument is always used with a deliberate and gentle movement and it is not employed at all until it can be inserted well lateral to the mid-line—that is, as far as possible tangential to the lateral curvature of the theca. The second point is that the removal of the laminae must be carried out as far as the lateral limits of the dural sleeve, so that the extreme anterolateral portions of the ligamentum flavum may be completely punched away.

Once the laminectomy has been completed, a transverse incision is made into the skin at the level of the disc as seen at operation. This incision is then progressively deepened through the erector spinae muscle mass, using diathermy to cut the muscle and to coagulate the vessels as they are divided. The depth and extent of this incision must be designed so as to allow an approach to the disc which lies only slightly posterior to the horizontal plane (Fig. 7). The medial part of the articular facets close to the disc can then be nibbled away to allow the punch forceps (which will be passed in front of the theca in order to remove the disc material) to be introduced as nearly as possible parallel to the back of the vertebral bodies. When the osteophytic lesion is excessively hard it may be weakened by pushing a Steinman pin, held in a hand holder, into the hard area and rotating it. Because of the need to be extremely gentle, one usually has to be content to remove only very small pieces of osteophytic bone with each bite of the forceps. It is only when a recently sequestered fragment of disc lies in the canal that any large piece of tissue may be removed intact with safety. The specimens have not all been

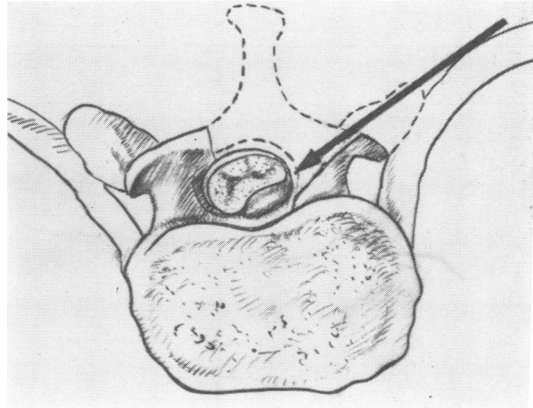


FIG. 7. Diagram to show access to the disc protrusion.

weighed, but on the seven occasions when this has been done, the tissue removed has had an average weight of 1.2 g with a maximum weight of 2.2 g.

RESULTS

One man (case 1 already referred to) had irreversible cord damage preoperatively. The only other total paraplegia developed because the pathological diagnosis had not been recognized preoperatively and a laminectomy was performed in the belief that the lesion would prove to be an intradural neoplasm. Operative exposure showed the true pathology and revealed some bruising of the cord which presumably had been inflicted during the bone removal. Furthermore, the correct diagnosis had not been made preoperatively in the only patient who showed pronounced—although temporary—deterioration after operation. In these two disturbing results, the initial approach to the cord had been posterior and at that time the procedure of combining a T-shaped incision with a posterolateral approach in the same operative field had not been devised. One may summarize the results by saying that in two-thirds of the patients the outcome was either excellent or functionally fully satisfactory (Table). Indeed, two of the excellent results were obtained in patients who were unable preoperatively to support their own weight. It would appear, not surprisingly, that the quality of result has improved with increasing surgical experience and perhaps also with the introduction of laminectomy as a routine accompaniment of disc removal. The effectiveness of this operation in removing the lesion is illustrated by Figs. 8 and 9.

TABLE
RESULTS

Patient, date	Level of lesion	Preoperative condition	Result	Comments
J.V. 1966	T10/11	Total cord lesion	Unchanged	Died from pulmonary embolism 2 m after operation
R.S. 1960	T9/10	Moderate incapacity	Worse	Total paraplegia
H.W.-B. 1960	T7/8	Mild incapacity	Temporarily worse—finally unchanged	Severely handicapped by pain
T.D. 1961	T4/5	Moderate incapacity	Excellent	Working
C.C. 1961	T8/9	Mild incapacity	Good	Working
M.E. 1964	T9/10	Severe incapacity	Definite improvement	Working
H.C. 1965	T8/9	Moderate incapacity	Improved	Later developed myelopathy due to multiple disc lesions
A.H. 1965	T10/11	Moderate incapacity	Improved	Working
E.B. 1967	T9/10 T10/11	Severe incapacity	Improved (1st op.)	Second operation for residual pain—fresh protrusion at new level
1969			Further improvement	
A.H. 1968	T10/11	Moderate incapacity	Good	Working
K.R. 1968	T6/7	Mild incapacity	Excellent	Working No abnormal neurology
K.J. 1969	T9/10	Severe incapacity	Good	Independent existence at home
A.E.H. 1969	T9/10	Severe incapacity	Excellent	Walking normally Looking for employment
H.T. 1970	T10/11	Very severe pain No motor deficit	Excellent	Plans to resume work Pain free. Walking well

DISCUSSION

The description of the pathology of thoracic intervertebral discs published by Haley and Perry (1950) is of considerable interest. Among 99 unselected cadavers examined in an anatomy department they found two thoracic disc protrusions greater than 4 mm. Although these probably came from a selected population, this very high incidence may be used to underline our own contention that for a population of one million, about one patient per year develops a recognizable syndrome of thoracic cord compression from a protruded disc. We think it an advantage to consider the frequency of these lesions in relation to population, rather than in relation to the numbers of patients treated for protruded lumbar and cervical discs, because only in this way can one be stimulated to search for the previously undetected cases. Indeed, we would suggest that unless the diagnosis is being achieved as often as our statistics would predict, then some of these lesions are being misdiagnosed.

We believe that, because of a history of trauma and because of the intensity of the symptoms of numbness and painful paraesthesiae, the correct

diagnosis should be considered in the majority of affected patients. There are great dangers in proposing a diagnosis of disseminated sclerosis when there is only a single lesion in the dorsal cord. Because remissions may be part of the clinical picture of thoracic disc protrusions a diagnosis of demyelination is often very tempting. Unless the clinician constantly considers the diagnosis of disc protrusion and has cooperated personally with the radiologist in obtaining a detailed myelographic examination of the type described above, he is at risk to overlook these lesions. The importance of high class myelography has been stressed previously by Kroll and Reiss (1951) who attributed the fact that they had amassed such a large series of cases to the consistent excellence of the radiology. The virtues of clinical suspicion, skilful myelography, and tomography (when necessary) are confirmed by Thomson's (1966) series of 10 verified lesions encountered in a nine year period.

Our own view as to the importance of trauma in the evolution of the clinical picture has been shared by Tovi and Strang (1960) and also by Arseni and Nash (1963). Although Logue (1952) did not believe that trauma was relevant, we feel that this dis-

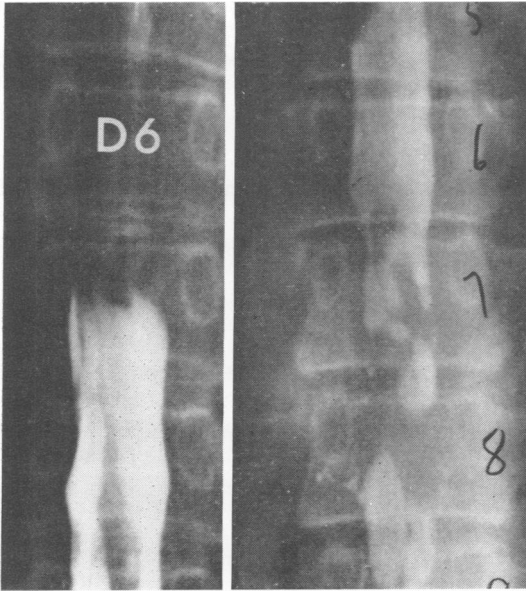


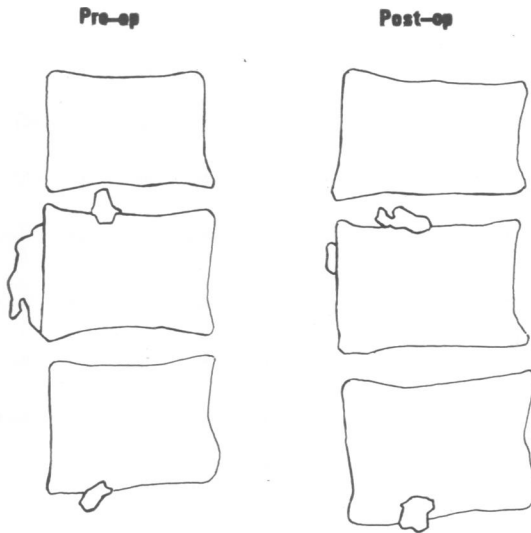
FIG. 8. Myelogram—prone position. (a, left): with complete arrest at T6/7 preoperatively; (b, right): with free flow postoperatively.

crepancy may be reconciled by the fact that the trauma may be relatively minor such as a fall onto the heels or buttocks, or else may lie several years in the past. In addition, rotational strains which one would expect to be well tolerated may sometimes induce cord dysfunction. Because calcified sequestered discs have been found in patients with short neurological histories, one must conclude that the original disc protrusion may sometimes pass unnoticed. Thus one may have to ask leading and direct questions going back at least over the preceding seven years in order to discover the traumatic incident.

It is curious that, although the features of perverted sensation and numbness crop up so frequently in the case histories throughout the literature concerning this lesion, they have, with one exception, never previously been stressed as having any diagnostic significance. The exception is the paper of Kühlendahl (1951), which has received very little attention. Kühlendahl was convinced of the diagnostic value of the pronounced subjective sensory changes occurring with relatively slight motor defects and we share his view that this is almost unique. It is remarkable how so many previous authors have denied the existence of a recognizable syndrome, yet as recently as 1965 Love and Schorn mention that



(a)



(b)

FIG. 9. (a) Same patient as in Fig. 2b. Lateral tomogram after operation. (b) Line drawings of Figs. 2b and 9a for direct comparison.

of 61 patients 30 had perverted sensations, and 35 had numbness. Furthermore, when neck flexion induces back or root pain with lesions lying below the mid-thoracic level we regard this phenomenon as strongly suggestive of a protruded thoracic disc. We think it important to challenge the pre-existing view that there is no way in which the correct diagnosis can be anticipated on clinical grounds, because only when thoracic disc protrusion is suspected will a high proportion of diagnostic myelograms be obtained. Should the myelogram leave any doubt about the pathology of the lesion displayed, it is useful to remember that thoracic disc protrusion, partly because of the element of arterial compression, may evoke a neurological level which lies above that anticipated by the site of the compressive lesion (Hawk, 1936; Arseni and Nash, 1960).

Most of the recent publications concerning the lesion take an optimistic view, and stress that with early diagnosis good results can be expected. The bad name which these lesions have earned for themselves (Müller, 1951) should now be a thing of the past. Our own results in getting two patients, previously unable to walk, ambulant again illustrates this. The main reason for bad results has always been a failure to make the diagnosis preoperatively. Operation on an unsuspected lesion encountered by one of us (A.J.) in the first of our cases resulted in a total paraplegia. This sort of result is likely to follow whenever insufficient caution and gentleness are used while exposing the cord.

The fact that laminectomy when performed both patiently and meticulously may achieve good results has been shown by O'Connell's (1955) successes in a series of four cases. These results support our own views concerning the importance of removing the ligamentum flavum. However, the fact that some disc lesions distort the cord tremendously and may even erode the dura mater (for example, Fisher, 1965) implies that it is usually desirable also to remove the anterior protrusions. Some surgeons—for example, Abbott and Retter (1956), Arseni and Nash (1963), Love and Schorn (1965) have operated transdurally. However, in our opinion this increases the risk of damage to the cord. Both the dura mater and the intact CSF cushion, which lie between the cord and the surgeon's manipulation, afford a valuable protection. The various surgical manoeuvres described above all play their part in minimizing the risks of operation and in offering the best opportunity for improvement to occur. Love and Schorn (1965) referred to a myelopathy arising from compression of the cord between the disc in front and the ligamentum flavum and lamina behind. The fact that buckled ligamentum flavum is sometimes capable

of gripping the theca on its lateral aspects is an additional feature which has not previously received specific mention. This possibility means that the laminectomy must be carried laterally until all the ligamentum flavum can be seen to have been punched away.

An anterolateral approach to the front of the thoracic dura for the treatment of kyphotic tuberculous spine was originally devised about 1933 by Capener (1954) and a rather similar procedure was later reported by Alexander in 1946. It was Alexander who suggested to Hulme (1960) that a similar approach should be employed in order to remove protruded thoracic discs. Hulme's technique, sometimes with minor modifications, has proved very useful (Arseni and Nash, 1963; Thomson, 1966). Crafoord, Hierton, Lindblom, and Olsson (1958) devised a more complex approach to this region, but this technique has not gained general acceptance. However, interest in the transthoracic approach has been revived as is shown by two recent reports of this method with good results in five cases (Perot and Munro, 1969; Ransohoff, Spencer, Siew, and Gage, 1969). The operation described here is considerably simpler and has the unique advantage of providing a circumferential decompression. By bold transection of the erector spinae muscles it is possible to combine laminectomy, removal of the entire ligamentum flavum, and removal of the disc fragments in one procedure. The operation is well tolerated by the patient and does not appear to cause great pain. The divided muscle has always healed without event. Because the approach to the lesion is slightly oblique (posterolateral) one might theoretically expect a bilateral operation to be required. However, to date, we have seen no evidence that this is so, and both the clinical improvement and the postoperative radiographs bear witness to the efficacy of the technique described. We believe that a postoperative myelogram should be performed wherever possible so that the surgeon may check the completeness with which the lesion has been excised and may correlate this with the patient's postoperative course.

By combining a preparedness to make the diagnosis preoperatively, with first-class radiological techniques, and with rational and gentle surgery, good results will invariably be obtained in any patient with a protruded thoracic intervertebral disc who has not already suffered an irreversible lesion.

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ADDENDUM

Two more patients with thoracic disc protrusion have been operated on since this paper was prepared. This confirms the estimated frequency—namely, approximately one patient per million population per annum.