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THE ROENTGENOGRAPHIC DIAGNOSIS OF THE SMALL CENTRAL PROTRUDED INTERVERTEBRAL DISC

INCLUDING A DISCUSSION OF THE USE OF PANTOPAQUE AS A MYELOGRAHIC MEDIUM

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INTRODUCTION

The characteristic lateral defect in the myelogram produced by the usual disc protrusion has become familiar through the studies of Hampton and Robinson, Bradford and Spurling, and others. There is a small group of patients with disc protrusions in which this defect is not found during the course of the usual myelographic examination.

It is the purpose of this report to describe the myelographic appearance in such cases in which a small central protruded intervertebral disc was found at operation.

Eck, in describing the location of disc protrusions, says: "Less commonly it (the protrusion) may occur centrally with symptoms of partial cord compression in the more severe cases, but with only moderate soreness in the milder cases. At some time following central rupture, however, the protruding material may migrate laterally with ensuing typical nerve root symptoms." Bradford and Spurling state: "A midline defect is unusual," and "The diagnosis of midline herniations is largely a roentgenographic problem because in such cases the symptoms are chiefly limited to the back without the characteristic radicular findings." Horwitz expressed doubt as to "whether such a minimal lesion (a small central disc protrusion) would be productive of sufficient symptoms and signs to warrant exploration."

TECHNIQUE

The practice of the Neurosurgical Section at this hospital has been to request a myelographic examination in every case of suspected protruded intervertebral disc where the lesion has been incident to Army service.

The patient is placed in the lateral recumbent position with his head towards the head end of the roentgenographic-roentgenoscopio tilt table. Care is taken, as with the usual lumbar puncture in this position, to see that both shoulders are in the same vertical plane, and that the head, trunk and knees are well flexed.

After preparing the skin, the subcutaneous tissues down to the interspinous ligaments are injected with novocain solution at the site of puncture, usually the third, but occasionally the second, lumbar interspace. On obtaining a free flow of spinal
fluid, the contents of one ampule of pantopaque, 3 cc., is injected firmly and steadily. If the injection is done hesitantly and intermittently, the opaque fluid may break up into globules.

The silet of the lumbar puncture needle is then replaced, and the patient cautioned to turn over slowly so that he will lie flat on his abdomen. He is then moved so that the soles of his feet are placed firmly against the foot rest of the tilt table.

This procedure usually leaves a homogeneous column of pantopaque at the level of the third lumbar vertebra. The table is then tilted so that the opaque fluid descends the spinal canal slowly; the advancing margin of the column is watched for slight deformities until the third lumbar interspace is bridged. If slight persisting deformities are observed, “spot” roentgenograms are made to show various degrees of development of the deformity. The table is tilted still further, and the fourth and fifth (lumbosacral) discs and the cul-de-sac are investigated roentgenoscopically and “spot” roentgenograms are made. The column is then allowed to ascend the lumbar spine as the table is tilted towards the horizontal and the advancing edge is observed carefully for slight deformities. The last three interspaces are then roentgenoscoped in each oblique and “spot” roentgenograms made.

The patient is turned again into the prone position, and by tilting the table, the opaque column is maneuvered beneath the needle. The oil is aspirated and a roentgenoscopic check made to be certain that as much of it was removed as was practicable. Using the over-the-table tube, a 10 x 12 inch film, centering on the lumbar puncture needle, is exposed. This film is used to orient the small films properly. The needle is withdrawn, and the examination is at an end.

Since most of the cases of protruded intervertebral disc have occurred at the fourth and fifth interspaces, only the last three interspaces are examined. This obviates extensive roentgenoscopic radiation of the patient, and the exposure of an excessive number of films. Where the clinical examination indicates, the upper segments of the spine are examined.

If a nerve sleeve fails to fill, the column is moved back and forth by tilting the table to “inject” the oil into the sleeve. The movement of the oil produced by coughing is also used as an aid.

The roentgenograms are made with the roentgenoscopic tube using a “spot” film device. The anteroposterior and moderate oblique views are the only ones made. The lateral projection, made with the roentgen-ray beam either horizontal or vertical has not been as helpful as the oblique views. In addition, satisfactory roentgenograms are obtained much more readily in the oblique position.

CASE REPORTS

The 5 cases of small midline protruded intervertebral discs were detected by myelography using pantopaque. All were proved at operation. In each instance the patient obtained relief of symptoms following removal of the protruded disc. The cases formed part of a group of over 150 cases examined by myelography, 86 of which were operated upon.

Case 1. F. A. C., aged thirty-one. This soldier was admitted to a station hospital complaining of progressively severe backache following Judo instruction. His back was strapped, but he could not get out of bed the next day. On examination, the patient listed to the left; straight-leg raising was limited to 90 degrees on the right and to 45 degrees on the left. There was localized tenderness over the left erector spinae. Clinical examination showed the lumbosacral joint to be normal.

Examination at this hospital showed a slight scoliosis of the spine, convexity to the left. There was about 10 degrees' limitation of motion, and a positive Lasègue sign, on the right side. The right ankle jerk was diminished.

The myelographic examination showed no abnormalities until the inferior margin of the opaque column was brought to the upper edge of the lumbosacral disc (Fig. 16). At this point the edge of the pantopaque showed a defect, concave downwards, on the right side. As the
opaque material was slowly advanced across the interspace, it was seen to envelop progressively a rounded defect on this side (Fig. 1a). Yet when the interspace was completely bridged the column was apparently normal (Fig. 1a). On close inspection a small trans-

lucent area can be made out at this site and there is a slight asymmetry in the levels of the nerve exits. The oblique myelogram (Fig. 1d) showed a defect on the anterior aspect which also suggested the diagnosis of a small protruded intervertebral disc.

At operation a small central protruded disc was found and removed.

Case II. J. D. J., aged twenty-eight. This soldier had a moderate back injury in 1932, without residual difficulty. He began to experience an ache in his lower back four weeks after admission. It was gradual in onset and of low intensity. It later became constant, and soon radiated to the left thigh and leg. The backache was aggravated by coughing and sitting.

On physical examination, leg stretching was painful on the left. The left knee jerk was decreased, and the ankle jerk absent.

Myelographic examination showed a slight indentation in the left side of the pantopaque column at the level of the lumbosacral disc (Fig. 2a). On allowing the edge of the opaque fluid to enter this area gradually, a moderate-protrusion, almost in the midline, was seen to push a flattened nerve root posteriorly and laterally. The disc substance was removed.

Case III. W. W. T. This soldier began to have pain in the small of the back in April, 1943, following a ride in a vehicle. The pain had become gradually worse, but still remained localized to the same area. The backache was aggravated by coughing, sneezing or bending.

The back was tender to pressure over the third and fourth lumbar vertebrae. Flexion of the back was limited. He experienced pain when he returned to the upright position after bending. The reflexes were active and equal. The hyperextension test was normal, as was the Lasègue sign. There were no sensory disturbances. All laboratory studies on the blood and urine were normal.

Myelographic examination showed a pronounced defect in the right side of the pantopaque column when the edge of the oil was allowed gradually to enter the level of the fourth intervertebral space (Fig. 3, b and c); not only was this seen when the column was brought

Fig. 1. Case I. a, the pantopaque column, lying fully across the lumbosacral disc, shows no defect or alteration of the nerve sleeves. b, when the oil is allowed to enter the level of the interspace gradually, a defect is produced, concave downward, in the right side of the advancing edge. c, with the oil advanced still farther, a defect in the right side is more clearly outlined. Referring to (a), an area of slight translucency may be detected at this site. d, in the oblique view, there is a characteristic defect in the anterior aspect of the pantopaque.
Fig. 2. Case II. a, there is slight flattening along the left side (arrow) which was persistent on several of the myelograms. b, when the edge of the oil was allowed to enter this region, there was evidence of a definite defect. The evidence noted in (a), without that observed in (b) was insufficient for a diagnosis of a disc protrusion.

downwards, but the lower margin of the defect was outlined when the oil was allowed to ascend from the cul-de-sac (Fig. 3d). When the oil bridged the entire interspace no defect could be seen (Fig. 3a), but there was a slight elevation of the left nerve root as compared with the right. The oblique projections also showed the defect in the opaque column (Fig. 3e).

Fig. 3. Case III. The myelograms are arranged so that the affected disc (fourth) lies at the same level in all. a, the full column of oil shows no defect or alteration of the nerve sleeves. b, no defect is seen as the oil enters the upper level of the interspace. c, as the oil slides just a little farther, it outlines the left side of a defect. d, the oil was allowed to descend to the cul-de-sac and then brought upwards; the lower edge of the defect is outlined. e, the oblique view demonstrates a characteristic defect in the anterior aspect of the oil column.
At operation, a centrally situated disc protrusion was discovered and the disc substance removed.

Case IV. F. M. N., aged thirty. In January, 1943, this patient noted low backache while doing desk work. About a month later he had a severe attack of backache, without radiating pain, which lasted three or four days. About two months after the onset of the original pain, he had another severe attack, this time with severe pain in his left leg. He improved slowly with bed rest. A month later he was hospitalized for persistent back pain, with radiation to his left leg, which was aggravated by coughing and sneezing.

There was deep tenderness at the level of the fourth lumbar vertebra on the left side. Hyperextension of the leg was limited by pain. Straight leg raising was possible to 85 degrees on the right and 50 degrees on the left, with a positive Lasègue sign on this side. There was a zone of hyperesthesia to pin prick on the lateral aspect of the left lower leg and the external malleolus. The left ankle jerk was slightly decreased and easily exhausted.

On myelographic examination, a small concavity was noted in the lower edge of the pantopaque column at the lumbosacral interspace (Fig. 4b). When the entire interspace was bridged by the opaque oil, no defect could be seen (Fig. 4d). These findings were not discovered during the roentgenoscopic examination. A small amount of pantopaque remained in the dural sac, so the patient was re-examined. Even though the amount of oil was small, it appeared to surround the upper pole of a small disc protrusion (Fig. 4, c and d). Another examination with the full amount (3 cc.) of the oil definitely outlined the small protrusion which had been suggested at the time of the first myelographic examination (Fig. 4, e and f). There was evidence also of a small protrusion of the fourth lumbar disc.

At operation, a small but definite central protrusion was seen at the lumbosacral disc, accompanied by localized scarring of the posterior longitudinal ligament.

Case V. J. A. K., aged twenty-four. While on maneuvers in October, 1941, a vehicle in which this soldier was a passenger overturned. He
suffered an acute low back strain which incapacitated him for three days. Since then he has had constant low back pain, which was worse on arising in the morning. He had suffered acute attacks of left sciatic pain which lasted from a few minutes to several days. Coughing often aggravated the pain.

There was deep tenderness at the left side of the third lumbar vertebra. Flexion was one-half of normal; all other movements were normal. Straight leg raising was impaired, and a positive Lasègue sign was present on the left side. Naffziger's sign was also positive. The knee and ankle joints were normal. There were no sensory changes.

The myelographic examination showed no defect in the margins of the pantopaque column, but did show a persistent localized translucency in the midline at the level of the third lumbar interspace (Fig. 5, a, b and c). The oblique views showed an indentation at the anterior aspect of the opaque column (Fig. 5d).

At operation, on exposure of the left side of the third lumbar interspace the nerve sheath was seen to be pushed posteriorly and slightly laterally; it was adherent to a large protrusion of the third lumbar intervertebral disc; the disc was removed.

**Discussion**

In this group of cases—all central disc protrusions—4 were detected by careful
observation of the slowly advancing edge of the pantopaque column to outline a small herniation or rupture of the disc substance. In 4 of the 5 cases the outline of the oil column was practically normal when it completely bridged the level of the protrusion aside from asymmetry of the nerve exits. In the other case (Case 11) there was a slight deformity which in itself was insufficient to warrant a positive diagnosis. In 1 of the cases (Case 5) only a translucent area in the frontal projection suggested the presence of the small disc protrusion.

The defect in each case was small, yet in each case it was productive of pain and, in each case, relief from the pain was obtained after removal of the protruding disc.

The discovery of these lesions was undoubtedly facilitated by the use of pantopaque. This new opaque myelographic medium was introduced within the past two years. Clinical use at this hospital in over 150 myelographic examinations in the period of slightly over a year has supplied convincing proof of its many advantageous properties.

Contrast myelography, first described by Dandy in 1919, has since come into considerable use, particularly in the detection and localization of protruded intervertebral discs. Air was the first contrast substance suggested and used. It is still staunchly advocated by a few, although the consensus that its accuracy and definition are well below that of lipiodol can hardly be questioned. This latter substance, introduced by Forestier and Sicard, came into extensive use. Thorotrast, despite its many desirable features, is not used because of its radioactivity and the inconvenience encountered in its complete removal.

Of late there has been a great decrease in the use of lipiodol in spite of the excellent use which had been made of it in the past. This may be due in part to occasional clinical reactions, the frequent difficulty encountered in its removal and the aggravation of symptoms which frequently occur when it is incompletely removed.

Pantopaque is a very freely flowing, oily substance which has given the distinct impression that it has less tendency to break up into globules than does lipiodol. It maintains itself in a homogeneous column, which fills the nerve sleeves very readily.

Pantopaque casts an excellent shadow on the roentgenogram but it is not so opaque that it obscures fine gradations of density. It is not radioactive. It is a stable solution which is not miscible with spinal fluid. Chemically it is a mixture of ethyl esters of isomeric iodophenylundecylic acids. The material has proved to be nontoxic both on experimental and clinical use. In most of the patients all but a few droplets have been removed. Occasionally, because the needle was somewhat off center, it was found impossible to remove any or all of it.

In all but one of the patients in whom the opaque material has been allowed to remain, no ill effects of any kind were suffered. There were no symptoms other than those for which the patients were admitted to the hospital. This includes 2 of the patients examined for cervical protruded discs in whom a small amount of pantopaque entered the cranial cavity. One case in which the material was inadvertently injected epidurally also showed no symptoms or reactions to the drug. The only case in which symptoms occurred was a recent patient whose upper dorsal spine was examined; about 1 cc. of the material entered the cranial cavity in the region of the pontine cistern. This patient became nauseated and vomited. It is conceivable that the reaction was not specific for pantopaque but could have been produced by any fluid which had been displaced in the same way.

Pantopaque is said to be absorbed slowly (about 1 cc. a year). We have had no follow-up studies longer than six months after the original examination and therefore cannot attest to its absorbability. Since the material is so innocuous and unproductive of reactions, the question of absorbability seems unimportant, either clinically or medicolegally. Most of the pantopaque in the few patients examined up to six months
after myelography had remained freely movable; the rest usually extended along the lumbar or pelvic nerves. It may be deduced from this that a reactive arachnoiditis has not resulted.

The great variety of conditions with low back pain, with or without sciatic radiation as a manifestation, makes a differential diagnosis difficult from a clinical point of view. While it is true that a well developed case of protruded intervertebral disc may be detected in the majority of the cases (about 60 per cent) by clinical examination alone, it seems unreasonable to resort to exploratory procedures in the other cases when a harmless and easily performed method of investigation is available.

The accuracy of the procedure using pantopaque can logically be expected to be greater than that of the clinical investigation alone. With very few exceptions, in experienced hands, this method will permit discovery of a disc lesion. It lends itself admirably to the detection of the early small protruded disc, which has been demonstrated to our satisfaction as the causative lesion in a small group of cases of troublesome low backache.

The myelographic examination will also demonstrate the level of the protrusion, whether it is single or multiple, and, frequently, whether the defect is due to a disc lesion or a tumor.

SUMMARY AND CONCLUSIONS

The characteristic lateral defect in the opaque oil column which is indicative of a protruded intervertebral disc is absent in a small but significant group of cases when careful roentgenoscopical observation of the moving opaque column is employed. Frequently the patients in this group complain of low back pain which does not radiate early in the course of the disease. Often there is serious doubt from the clinical examination concerning the diagnosis of a protruded disc unless myelographic evidence of a small central disc protrusion is elicited.

In the performance of myelography in cases which are suspected of suffering from disc protrusion it is important to allow the edge of the oil column to advance slowly and gradually so that the margins of a small protrusion will be outlined before the bulk of the oil obscures it. Five cases of small central disc protrusions were discovered in this way.

The myelographic examination is greatly facilitated by the use of pantopaque, a new medium developed especially for this purpose. It is of low viscosity, unproductive of reactions, tends to remain homogeneous, and is not excessively opaque.

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