

MYELOGRAPHY WITH PANTOPAQUE IN THE DIAGNOSIS OF CERVICAL DISK HERNIATION

By

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The increasing tendency to treat disk herniation in the neck region by operative methods has placed greater demands on the roentgen diagnosis of the condition. Compared with the usually straightforward clinical picture of lumbar disk lesions, herniation of the cervical disks is associated with a rich variety of symptoms, and is indistinguishable from a number of other conditions. Furthermore, the bony changes seen on examination of the cervical spine, namely disk degeneration and osteophyte formations, are only partly and irregularly related to the clinical picture. Before any operative procedure can be undertaken, therefore, careful assessment of the anatomical relations of the nerve roots must be made, and this can be done by means of myelography.

Myelography of the cervical spine may be carried out with the aid of negative contrast media, usually oxygen, or with opaque substances of the iodized oil type.

Oxygen myelography is a safe method, the contrast medium being rapidly absorbed and leading to no undesirable late reactions. The investigation may be unpleasant for the patient, and mild side-effects such as headache and slight pyrexia sometimes occur. In combination with tomography and correctly employed, the method gives better and more reliable results than myelography with iodized oil. Cervical disk lesions producing deformity of the anterior subarachnoid space are thus readily visualized, but the root sheaths are as a rule impossible to assess satisfactorily.

Oil myelography with Pantopaque provides a better, and often very good, idea of the state of the cervical root sheaths, but views vary greatly regarding the use of oily contrast media. Bull (1951) writes, 'As a general rule Pantopaque is the contrast medium of choice', but Lindgren (1954) holds that this method is not as a rule justified.

The divergency of these views is not entirely based on radiological considerations.

One important reason why the method is little used in Sweden is the physical and chemical properties of the substance, and the consequent meningeal reaction, recently described again by Bonte (1958).

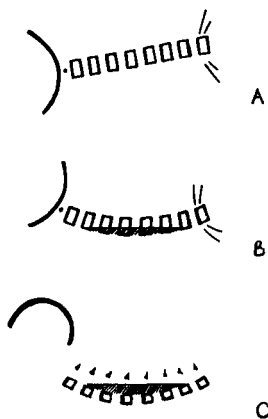


Fig. 1.

Schematic drawing. Position of the cervical spine, a) during puncture of the subarachnoid space, b) during injection of the contrast medium, c) during exposure.

Pantopaque (ethyl-iodophenyl-undecylate) is a mixture of isomeric esters. It contains 30.5 % of iodine, and has a specific weight of 1.26 at 20° C. Its coefficient of viscosity is 0.37 at 25° C. Theoretically it is absorbed very slowly, but removal of as much of the contrast medium as possible is recommended.

The substance is not a primary irritant, and the investigation can therefore be carried out without discomfort to the patient. During the following days there may be slight reactions of the same type and degree as occur after oxygen myelography (meningism, pyrexia). It is noteworthy that residual Pantopaque has been found to produce late meningeal reactions in the form of chronic arachnitis, but the clinical significance of such late reactions is not fully established.

Owing to the demand for improved pre-operative morphological investigation, and in the absence of other, non-irritant contrast media, we have adopted the method, but only in cases of possible involvement of the cervical roots.

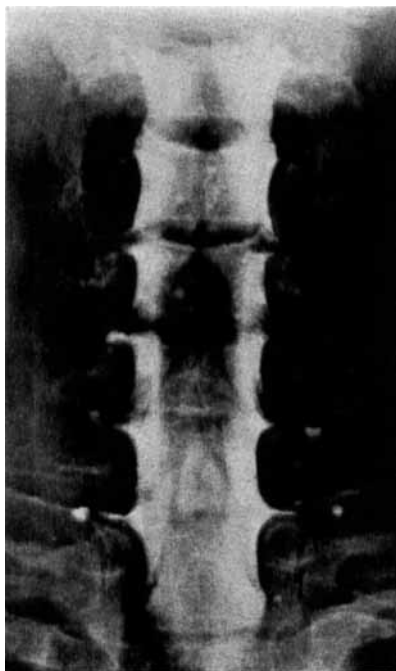


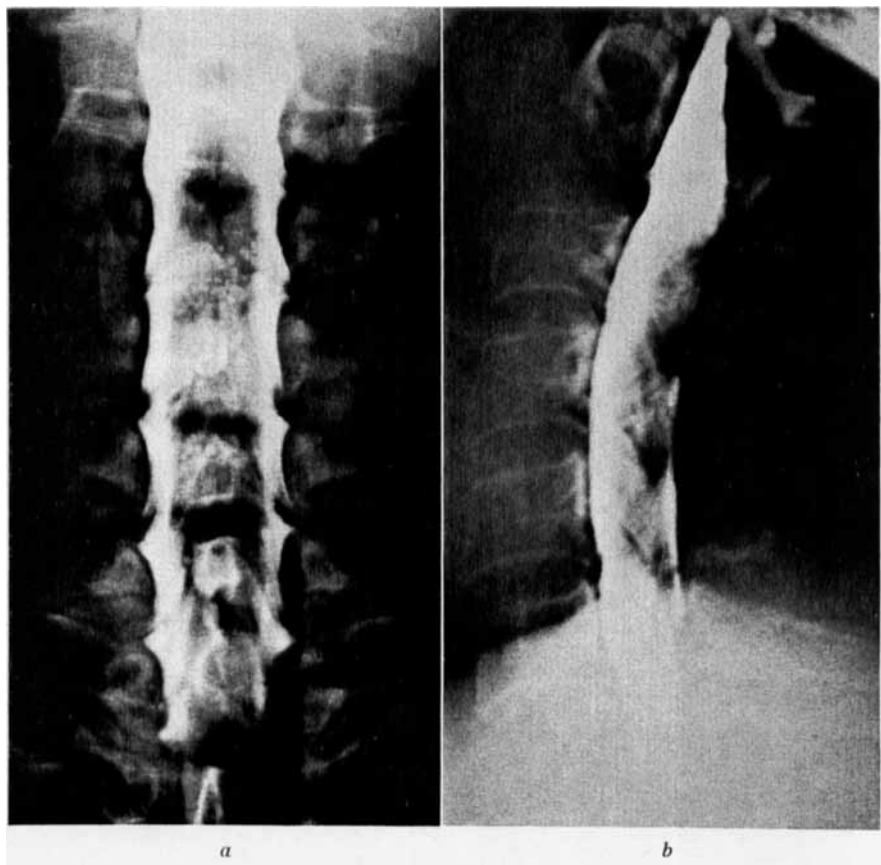
Fig. 2.

Frontal radiogram demonstrating small root cysts filled with the oily contrast medium.

TECHNIQUE

Each myelography is preceded by standard radiography of the cervical spine, in frontal, lateral, and oblique projections. Awareness of the existence of disk degeneration and the position and size of osteophytes is essential for the correct interpretation of the myelograms.

The patient is lightly premedicated, and placed on his side on a tiltable table with the head end slightly lowered (fig. 1 a). Suboccipital puncture is carried out in this position, the needle being introduced parallel to the base of the skull (i.e. not into cisterna magna). When the tip of the needle has entered the subarachnoid space the patient's head is raised slightly in order to bring the middle part of the cervical region to its lowest point (fig. 1 b). 7-10 ml. of Patopaque is now slowly injected, the exact amount depending on the size of the patient. The contrast medium will then collect in the middle part of the cervical canal. The needle is withdrawn, and the patient is placed in the prone



position with the chin slightly raised (fig. 1 c). In this position the exposures are made. It is of the greatest importance that the position of the head is carefully watched, or the contrast medium will pass up into the head, and it will be difficult or even impossible to get it to return to the neck. The position of the contrast medium in the canal may be adjusted by tilting the table.

The patient is examined in prone and half-prone (45°) positions. Radiograms are taken, with the beam in both vertical and horizontal directions. The procedure is facilitated by screening, but may, like lumbar myelography using water-soluble contrast media, be performed without this aid.

After the investigation the patient is allowed to sit up for about 5 minutes, and is then placed prone, in pronounced lumbar lordosis.

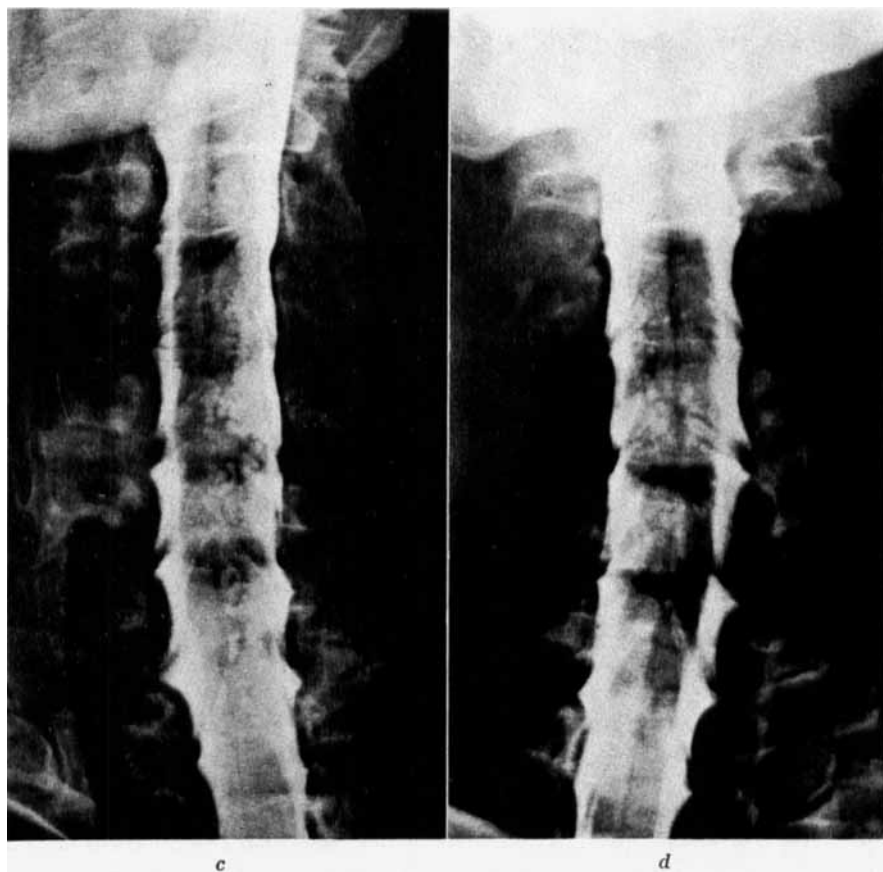


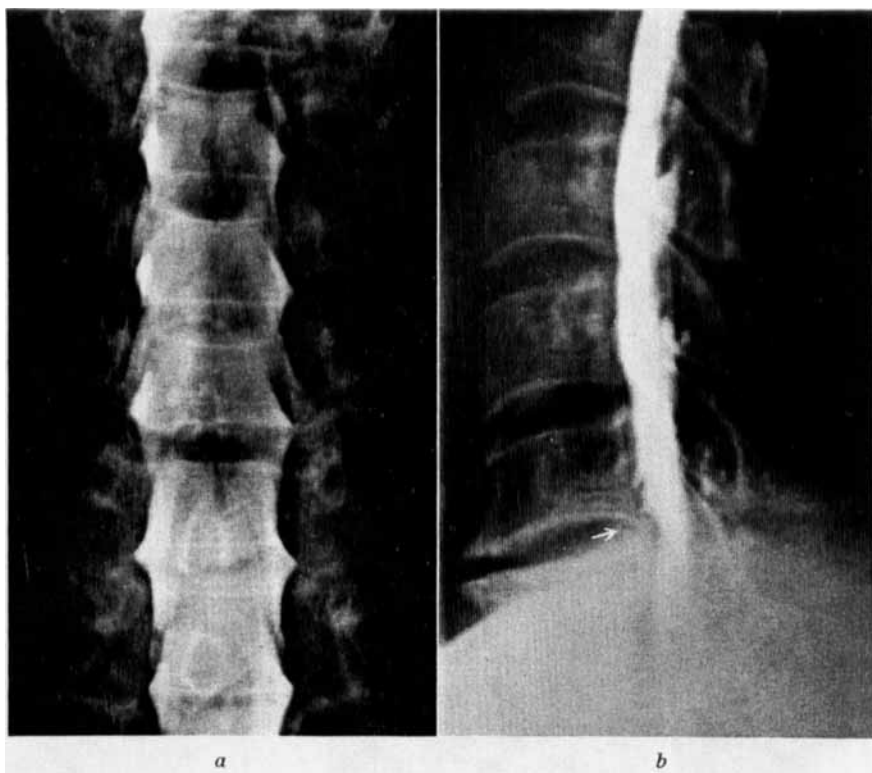
Fig. 3 a-d.

Normal case. Standard examination normal. Myelography, a) frontal, b) lateral, c-d) oblique radiograms. The root sheaths normal. In the lateral view (b) slight protrusions of the disks between C. 2-C. 3 and C. 5-C. 6.

In this position as complete withdrawal as possible of the contrast medium can be achieved after lumbar puncture.

MORPHOLOGICAL CONSIDERATIONS

There are 8 cervical roots. Topographically this means that the first cervical root emerges between the occiput and the atlas, and that the 7th cervical root emerges above and the 8th below the 7th cervical vertebra. In the upper part of the cervical spine the nerve roots emerge at almost right angles to the medulla, but lie increasingly obliquely



towards the lower part. A nerve root can be compressed by only one disk, however, namely, that lying at the level of the intervertebral foramen through which the nerve passes. The root of C. 7 is compressed by the disk between C. 6 and C. 7, etc.

In assessing the myelogram note must be made of the state of the posterior surface of the vertebral body. This is smooth and even at the level of the peduncles but has besides a slight prominence at the middle of the posterior surface, with a shallow groove on each side. These last-named are important in assessing the profile view in myelography. (See below).

It is still considered that the osteophytes that penetrate the intervertebral foramen from in front are localized to the 'uncovertebral' joints (the neurocentral synovial cavities of Luschka). These joints are situated laterally on the vertebral bodies, at the level of the intervertebral foramen, in intimate relation to the nerve. Abnormal strain due to narrowing of the disk will lead to reactive changes in these joints,



Fig. 4 a-d.

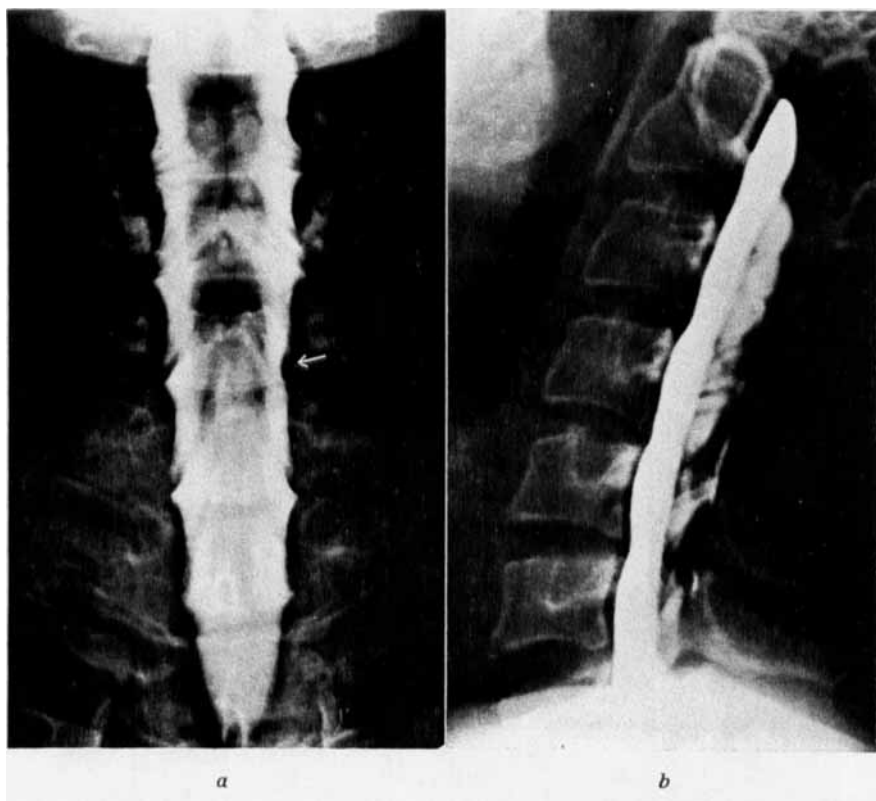
Disk protrusion. Standard examination revealed degeneration of the disk between C. 6 and C. 7, with osteophytes. Myelography, a) frontal, b) lateral, c-d) oblique radiograms. On the lateral view (b, →) a filling defect due to the disk protrusion can be seen. The root sheaths are not deformed.

consisting of periarticular swelling and subsequently the formation of osteophytes. The presence of these is best detected from the oblique radiograms of the vertebrae.

MORBID-ANATOMICAL CONSIDERATIONS

Lesions of the disks may be classified as follows.

Bulging of the annulus fibrosus, disk protrusion. The annulus fibrosus is intact, and protrudes as a result of approximation of the vertebrae. The loss in thickness of the disk is as a rule due to degeneration resulting from progressive diminution in the water content of the nucleus pulposus, but may also be due to interspongious herniation of



the nucleus. Protrusion is often total, that is, the entire disk bulges backwards, but partial protrusion may also occur. Marginal osteophytes are formed secondarily, principally in the uncovertebral joints.

Herniation of the nucleus pulposus. In such cases the annulus fibrosus is torn (except when the nucleus herniates into the spongiosa). The hernia may be medial or lateral. A hernia that is very lateral or situated in the intervertebral foramen does not cause pressure on the dural sac. Marginal osteophytes develop secondarily, chiefly in the uncovertebral joints.

Spondylosis deformans. Typical of this state is the multiplicity of osteophytes on the vertebral borders and of intervertebral disks showing some loss of thickness.

According to McRae (1956) a combination of the above changes is the rule and not the exception among middle-aged and elderly persons.

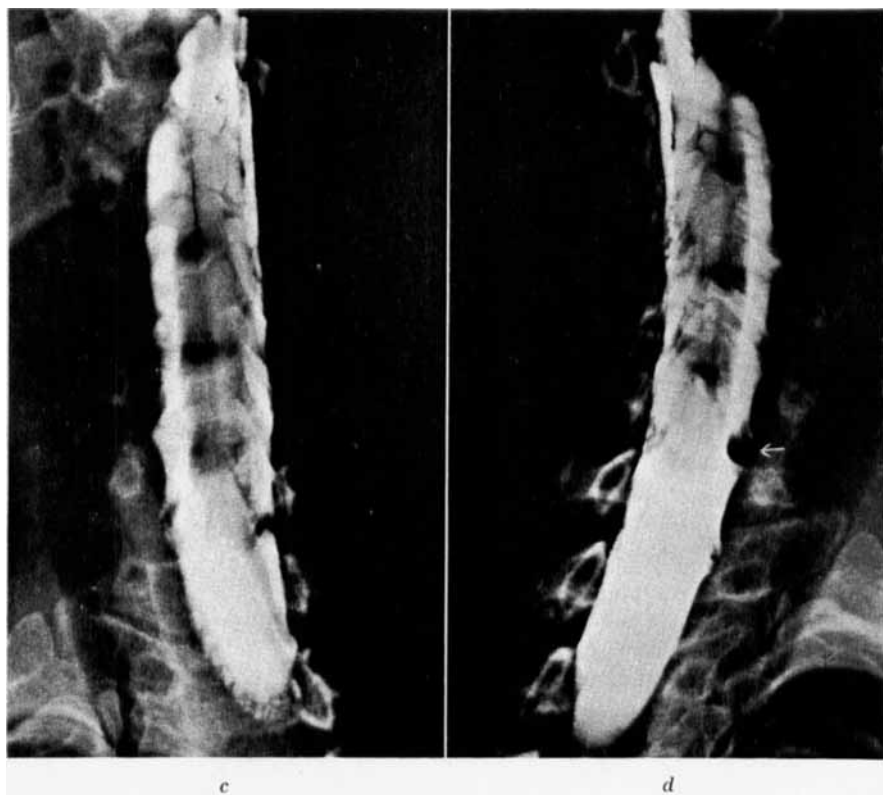


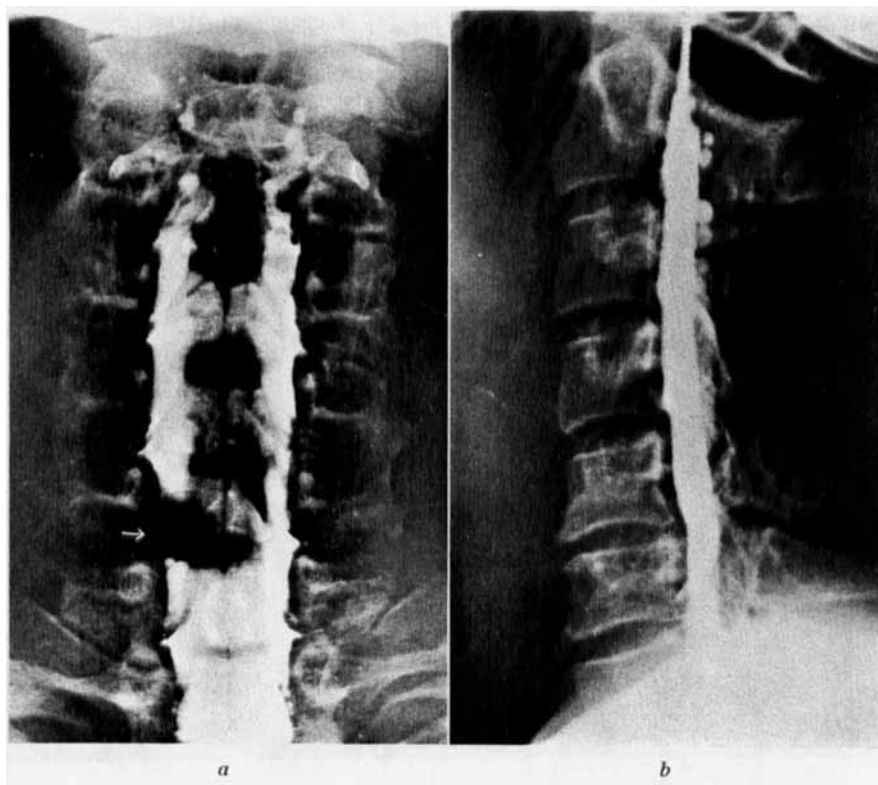
Fig. 5 a-d.

Disk herniation. Standard examination normal. Myelography, a) frontal, b) lateral, c-d) oblique radiograms. On the left side the root pouch of C.7 is shortened and compressed (a, →). The oblique radiogram reveals more clearly a defect in close relation to the root pouch (d, →). Lateral view (b) normal.

RADIOLOGIC CONSIDERATIONS

For a correct assessment of the myelograms it is essential that the injected oil collects into a continuous column. If this becomes fragmented, it becomes extremely difficult to form a reliable opinion. In such cases the contrast medium may be reassembled in the lumbar region, and then transferred to the cervical region again.

The great absorbancy of Pantopaque, in other words its great roentgen density, carries with it the disadvantage that impressions in the contrast medium need only to be coated with a thin layer of oil in order to be completely concealed. A variety of projections, including oblique



views, are therefore necessary, and in selecting the exposure values attention must be paid to the amount of contrast medium, which should be no more than that a continuous column is obtained.

The high viscosity of the contrast medium and its inability to mix with the cerebrospinal fluid are disadvantages, as the substance passes with difficulty into small spaces and through fine canals. As can be seen from fig. 2, however, Pantopaque can provide filling out of root cysts that are connected with the root sheaths by only fine pedicles. The physical properties of Pantopaque are such that care must be exercised in assessing partially filled root pouches, however.

The normal myelogram (fig. 3). The normal myelogram of the cervical region is characterized by the total or almost total absence of disk protrusions in the profile view. If the column of contrast medium is thin, any barely discernible protrusions can also be detected on the frontal view as strip-like translucent areas at the level of the disks. The protrusions correspond to the degree of lordosis. In hyperextension

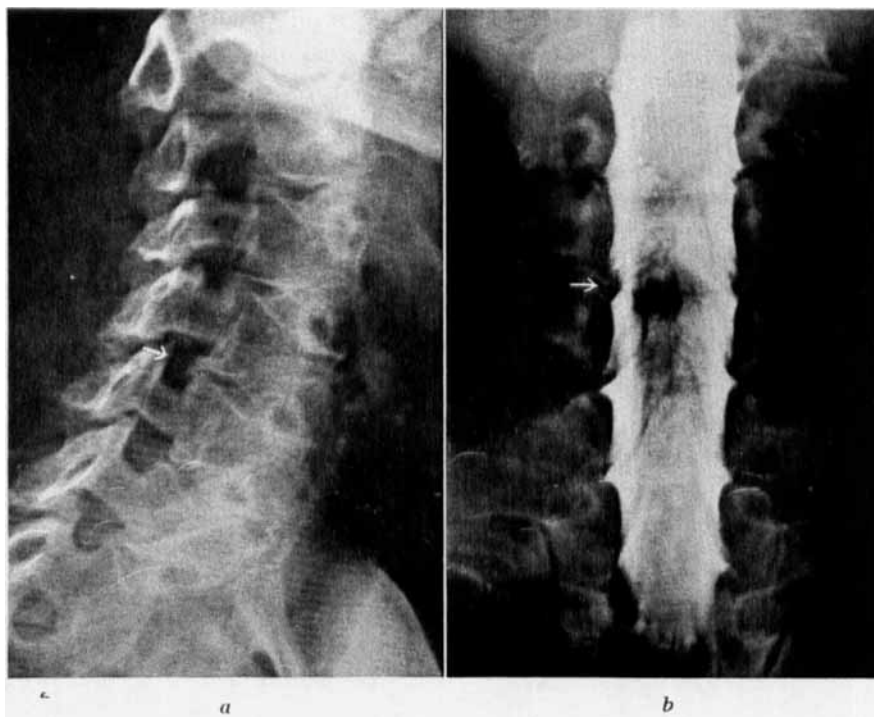


Fig. 6 a-c.

Disk herniation. Standard examination: disk degeneration between C. 5 and C. 6, with reduced intervertebral space and small osteophytes in the corresponding right unco-vertebral joint. Myelography, a) frontal, b) lateral, c) oblique radiograms. A large filling defect is seen on the right side (→). The root pouch of C. 7 is not filled (a, c). Lateral view: a very slight protrusion of the disk C. 5-C. 6.—The patient has been successfully operated upon.

a certain measure of protrusion occurs naturally, and at the same time the vertebral arches approximate and the ligamenta flava become relaxed. As a result slight impressions may appear laterally and posteriorly. A normal cervical myelogram shows filling out of all root pouches. These are shorter and broader than those in the lumbar region. The breadths may vary, but are symmetrical. Both anterior and posterior nerve roots may often be distinguished as long, narrow defects.

The myelogram in disk protrusion (fig. 4). Depending on the degree of protrusion and the thickness of the oil-layer, a disk protrusion appears on the frontal myelogram as a ribbon-like thinning of the contrast



medium at the level of the affected disk in question. If there is a marked degree of protrusion the root pouches may be deformed or even nipped off. In the profile view a concavity in the column of contrast medium can be seen at the level of the protruding disk. If the lesion is to be detectable in the profile view it is a condition that the whole of the posterior border of the disk be protruding: in the lateral view partial protrusion of the disk is totally masked by the contrast medium in the shallow grooves on the posterior surface of the vertebral bodies. Oblique views are essential in the assessment of partial disk protrusion.

Myelogram in disk herniation (fig. 5 and 6). The frontal myelogram in this state typically shows a unilateral defect in the column of contrast medium, with deformity or total crushing of the adjacent root sheath. More lateral herniation affects only the root pouch. The profile view may be negative, as the disk prolapse may be completely concealed by contrast medium lying alongside the disk hernia or in one of the lateral shallow grooves. In such cases oblique projections supply the necessary information.

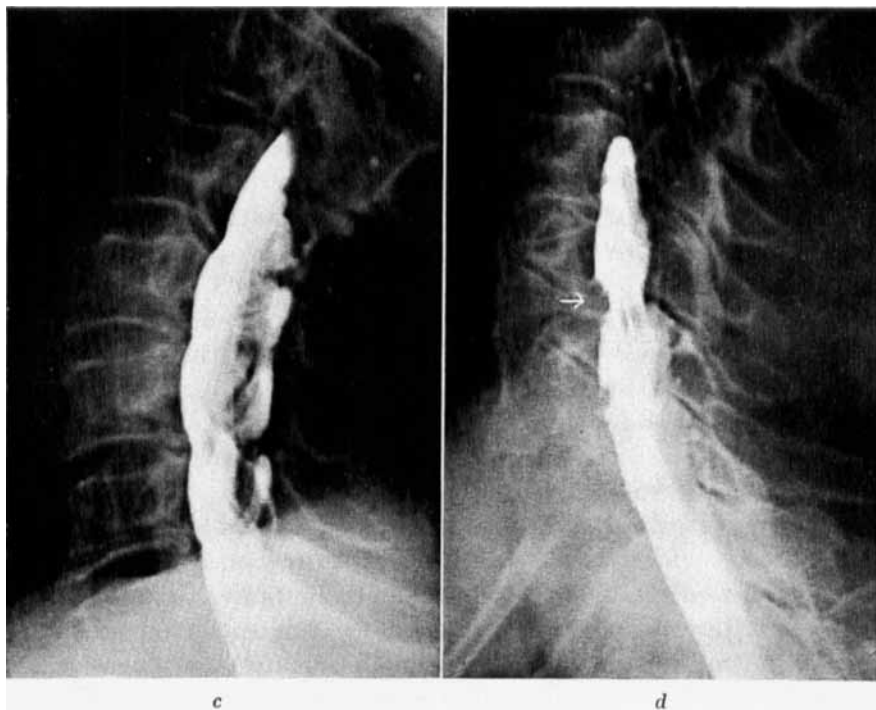


Fig. 7 a-d.

Standard examination, (a) large osteophytes narrowing the intervertebral foramen C. 6-C. 7 ($\rightarrow$). Myelography, b) frontal, c) lateral, d) oblique radiograms. The right pouch of C. 7 ($\rightarrow$) is shortened, with a small filling defect (b,d) due to the osteophytes. No protrusion of the corresponding disk visible on the lateral view (c).

The myelogram in spondylosis deformans (fig. 7). The myelogram varies according to the size and site of the osteophytes and the presence and degree of reduced intervertebral interval. There may be signs of disk protrusion as described above, or of some greater or lesser degree of deformity or compression of root pouches. In the event of the latter some direct anatomical relation between the position of the osteophytes and the filling defects may be demonstrable.

DISCUSSION

It is clear that in straightforward cases it is possible with the aid of myelography to distinguish between disk protrusion, disk prolapse, and changes due to spondylosis deformans. In elderly patients, however, in whom a combination of these conditions is commonly found,

the differential diagnosis may be uncertain or impossible. Compression of a nerve root may be caused by disk prolapse, partial protrusion, or osteophytes. Disk prolapse, which is the most important of these lesions from the operative point of view, is easiest to establish in those cases in which the thickness of the disk is unchanged and osteophytes have not yet developed. It is important to remember that disk herniation situated extremely laterally need not necessarily affect the dural sac or root sheath: negative myelographic findings do not exclude disk prolapse.

Our series so far includes 45 patients examined since January 1st 1958. In a few cases, we have seen side-effects in the form of slight pyrexia and transient meningism. The observation period is still too short to express an opinion concerning late complications, but it has been possible to remove about 90 % of the injected contrast medium in practically all cases.

Myelography with Pantopaque is extremely valuable in assessing the state of the spinal nerve roots in the cervical region. Having regard to the divergent views on late reactions and their clinical significance, the indications for the investigation must be limited, and it should be carried out only in cases in which involvement of the nerve roots is suspected, and in which operation is contemplated.

S U M M A R Y

An account is given of the technique of cervical myelography using Pantopaque. The value of the method in investigating the state of the cervical nerve roots is emphasized. Owing to the possible risk of late complications, however, the procedure should only be carried out in cases in which involvement of the nerve roots is suspected, and in which operation is contemplated.

R E S U M E

Il est rendu compte de la technique de la myélographie cervicale utilisant le pantopaque. La valeur de la méthode pour examiner l'état des racines nerveuses cervicales est soulignée. Toutefois, en raison du risque de complications tardives, le procédé ne doit être appliqué que dans les cas où l'on soupçonne que les racines nerveuses sont en cause et où l'on envisage de procéder à une opération.

ZUSAMMENFASSUNG

Es wird über die Technik der cervikalen Myelographie mit Pantopaque berichtet. Der Wert der Methode zur Untersuchung des Zustandes der cervikalen Nervewurzeln wird hervorgehoben. Wegen der möglichen Gefahr später Komplikationen sollte das Verfahren jedoch nur in Fällen ausgeführt werden, in denen eine Erkrankung der Nervenzellen vermutet und eine Operation erwogen wird.

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