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CLINICAL DIAGNOSIS OF LUMBAR DISC HERNIATIONS

BY

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During the last decade investigations on herniation of the lumbar discs have led to a certain modification of relevant theories. Discussion now centres less on the part such herniations play in the pathogenesis of the sciatic syndrome—this being recognised by most workers—and more on either the treatment and its results, or on the diagnosis.

The diagnosis 'herniated lumbar disc' is based primarily on the presence of root pains caused by the hernia pressing on a nerve root. The objective and subjective symptoms vary according to the nerve root affected, or, in other words, according to the level of the hernia. Formerly the level was mainly diagnosed by myelography with a positive contrast medium, but the use of iodised oils was sometimes followed by complications in the form of arachnoiditis and they were gradually abandoned in favour of either a less irritating contrast medium, e.g. oxygen, or of a purely neurological diagnosis.

The distribution of the root pain and sensory impairment, the changes in the reflexes and weakness of individual muscles or muscle groups often provide sufficient evidence of the level of the lesion. *Norlén* (1944) gave a clear account of the various combinations of symptoms which are found with herniations of the different discs. Herniation of the disc between the 3rd and 4th lumbar vertebrae generally gives rise to symptoms of

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compression of the 4th lumbar root, viz: pain radiating down from the hip region along the inner side of the thigh, a weakened patellar tendon reflex, and sensory disturbance in the distribution of the 4th lumbar root; this is the *L4-syndrome.* Herniation of the disc between the 4th and 5th lumbar vertebrae generally gives rise to irritation of the 5th lumbar root and produces the *L5-syndrome:* pain radiating down the back of the leg and over the plantar surface of the foot to the toes, paresis of the big toe or of all the extensors of the foot, and disturbance of sensation in the distribution of the 5th lumbar nerve; the Achilles tendon reflex is normal. Herniation of the disc between the 5th lumbar and the first sacral vertebrae causes compression of the 1st sacral root, with pain radiating down the back of the leg to the heel, diminution or absence of the Achilles tendon reflex and disturbance of sensation in the distribution of S1; there is no paresis of the dorsal extensors: this is the *S1 syndrome.*

Norlén (1944) was able, by clinical neurological examination alone, to diagnose the level of the herniation in 70 per cent. of his cases; he thinks this figure could be further improved by a more thorough analysis of the neurological signs and symptoms. *Spurling* and *Grantham* (1940) diagnosed the level correctly in 50 per cent. of their cases. *Keegan* (1944), *Krayenbühl* and *Weber* (1945), *O'Connel* (1946) and other authors use mainly neurological examination for diagnosis. *Barr* (1947) believes he can predict the level of the lesion correctly in about half the cases. *Love* (1947) emphasises the great variations in the construction of the lumbro-sacral plexus and stresses that the level of space-occupying lesions in this region cannot be correctly diagnosed by neurological examination alone. *Young* (1947) considers neurological examination to be of value only as a confirmation of the diagnosis. In 40 per cent. of his cases there was a *total absence* of neurological signs. Thus opinions on the value of neurological examination in determining the level of the lesion are divided.

At the Orthopaedic Clinic, Lund, cases suspected of herniated intervertebral discs have usually been explored on the

basis of their neurological signs, especially disturbances of reflex action and muscle weakness. In doubtful cases, however, the neurological examination has been supplemented by myelography, using a negative contrast medium. Myelography and its results are referred to below.

Since 1945 we have used a standard procedure for the neurological diagnosis of herniated discs, giving close attention to even the smallest differences between the reflexes and muscle power of the two sides. Not only the ordinary Achilles tendon reflex, but also what may be termed the 'indirect Achilles reflex', i.e. triceps surae reflex as elicited by a tap on the sole of the foot, was tested. There is, of course, no real difference in the nature of these two reflexes; they merely test the same reflex, the stretch reflex of the triceps surae muscle, in different ways and differ only quantitatively, since a more ready response is necessary for eliciting the indirect reflex. That is to say, an impairment of the triceps surae reflex can first be detected as a weakening or absence of the indirect reflex (cf. *Wartenberg* 1945). The technique for eliciting the reflex is important if one is to detect a small, sometimes very slight, difference in the strength of the reflex on the two sides. The patient should kneel on a table with his legs parrallel and his feet just over the edge. The optimal tonus in the triceps surae for the elicitation of the jerk is obtained by lightly pressing the foot into dorsiflexion. The reflex is most easily elicited by a tap on the tubercle of the 5th metatarsal. With this technique one can detect even small differences between the reflexes of the right and left sides. Paresis of the dorsal extensors of the big toe often appears as a flaccid wobbliness of the toe. Not infrequently, however, the weakness is so slight that it reveals itself only as fatigue when the strength of the muscle has been tested several times in quick succession. In doubtful cases the test should be continued until the toe of the healthy side also shows signs of fatigue. This is the only way to demonstrate convincingly the presence of a very slight paresis.

During the period March 1945-December 1947 306 cases

TABLE 1

Neurological signs in 306 cases explored for suspected lumbar disc herniation.

(Impaired sensibility recorded only when it was the *sole* neurological sign.)

Herniation or protrusion	Weakened »indir.« Achilles tendon refl.	Weakened Achilles tendon reflex	Absent Achilles tendon reflex	Paresis of extensor muscles	Weakened knee-jerk	Impaired sensation	Combination of several neurol. signs	Without definite neurol. signs	Total
L III—L IV	0	0	0	0	1	1	0	0	2
L IV—L V	1	12	7	53	4	3	29	8	117
L V—S I	9	42	52	9	0	3	42	10	167
L IV—L V *and* L V—S I	0	0	0	0	0	0	4	0	4
Neg. explorations	2	2	2	2	2	1	3	2	16
Total	12	56	61	64	7	8	78	20	306

were explored for suspected herniation of lumbar discs at the Orthopaedic Clinic, Lund. A survey of the material is given in Table 1. As usual, herniations of the 4th and 5th lumbar discs predominate. Herniation or protrusion of the third disc was found in only 2 cases. In 16 cases the findings at operation were negative. The most common neurological signs were, of course, impaired Achilles tendon reflex and paresis of the big toe, and about 66 per cent. of the cases presented pictures agreeing more or less completely with the syndromes already described. Not less than about 25 per cent., however, showed a combination of impaired Achilles reflex with paresis, or impaired Achilles reflex combined with an impaired knee jerk. In roughly 2.5 per cent. the only objective neurological sign was a disturbance of segmental sensibility, while in 6.5 per cent. there was no definite neurological sign at all.

Thus, in the majority of cases there was only one neurological sign to indicate the level of the herniation. There were 129 of these monosymptomatic cases in which impairment of the Achilles tendon reflex was the single sign detected; in

about 80 per cent. of these a lumbosacral herniation was found at operation, in 15 per cent. herniation of the 4th lumbar disc, and in less than 5 per cent. operation findings were negative. Roughly the same proportion was seen in the relation between paresis of the extensor muscles and the fourth disc: of the 64 cases which had paresis of the big toe as the only neurological sign, about 83 per cent. had a herniation of the 4th disc, 14 per cent. of the lumbosacral disc, and 3 per cent. negative operation findings. A diminished knee-jerk was the sole neurological sign in only 7 cases: of these, one had a herniation of the 3rd disc, four of the 4th, and exploration was negative in the remaining two cases.

TABLE 2

Concomitant neurological signs and findings at operation.

	Herniation or protrusion			Negative findings	Total
	LV—SI	LIV—LV	LIV—LV and LV—SI		
Weakened or absent Achilles tendon reflex + extensor paresis	35	29	4	2	70
Weakened or absent Achilles tendon reflex + impaired knee-jerk	6	0	0	1	7
Weakened knee-jerk + extensor paresis	1	0	0	0	1
Total	42	29	4	3	78

In cases which show several neurological signs, so that the different syndromes can be said to overlap each other, a clinical diagnosis of the level of the lesion appears a priori to be more difficult. Are the signs in such cases to be ascribed to more than one herniation at different levels, or is there only one herniation, and if so, where is it? Is it possible in these polysymptomatic cases to diagnose the level of the lesion correctly on the neurological signs alone?

A survey of these neurologically polysymptomatic cases is

given in Table 2. In two cases the finding at operation was normal; in one case a well-filled varicose vein was found in the interspace between the 3rd and 4th lumbar vertebrae, but no herniation or protrusion of the disc was detectable. The other 75 cases showed either a herniation (68 cases) or a protrusion (11 cases). (Four cases showed changes in both of the two lowest interspaces.)

In 29 cases two or more interspaces were explored; only in 4 of these cases was a protrusion of the intervertebral disc found in both the two lowest interspaces. This figure agrees well with that of *Echlin, Selverstone* and *Scribner* (1946), who found multiple changes in 10 out of 60 operated cases. In such cases one is of course justified in assuming that the various neurological signs are the result of compression of more than one root at different levels. However, these cases are evidently exceptions, the symptoms being generally attributable to only *one* herniation.

Theoretically, for *one* herniation to be able to disturb either both the Achilles and patellar reflexes, or both a reflex and muscle power, it is necessary that either the different functions are controlled by one root or that more than one root is affected by one herniation. The first alternative is the less acceptable. *Norlén*'s (1944) investigations showed that impairment of the Achilles tendon reflex is bound selectively to the S1 root, and that the extensors are innervated mainly through the L5 root. He also contended that a normal knee-jerk depends upon the intactness of the 4th, and possibly also the 3rd lumbar roots. Anatomically, it is possible for one herniation to impinge upon several roots at the same time, especially in the two lowest interspaces, where the distal roots run longitudinally and may therefore come into contact with both the two lowest discs (*Friberg*, 1941), and are fixed both at their exit from the dural sac and in the intervertebral foramen. A herniation in the midline always impinges on several roots, but as the roots are not fixed while within the dura the signs are generally slight, unless of course the hernia is very large. On the other hand a lateral hernia presses against a root which

is fixed and therefore unable to yield and easily compressed by even a medium-sized herniation.

As one would expect, herniations which caused several neurological signs were rather larger than those causing only one. The average volume of excised herniations was 0.9 ml. in the monosymptomatic and 1.1 ml. in the polysymptomatic cases. No statistical difference could be established between the sizes of the lumbo-sacral herniations and those of the 4th disc.

In all the 71 cases which presented more than one neurological sign and in which operation showed that the sciatic syndrome could be attributed to only one herniation or protrusion, the primary result of the operation was satisfactory, in that the root pains vanished. This definitely suggests that the excised herniation had been the cause of the symptoms and that there was no reason to suspect an undetected herniation as the cause of any of the neurological changes.

In 6 of the 7 cases in which both the patellar and Achilles tendon reflexes were impaired a herniation was found in the lumbo-sacral space; exploration was negative in the remaining case. The combination of diminished knee-jerk with paresis of the big toe occurred in only one case; the herniation was lumbo-sacral.

TABLE 3

Cases with concomitant extensor paresis and impaired Achilles tendon reflex.

Herniation or protrusion	Number	Achilles tendon reflex impaired first	Paresis appeared first	Absent Achilles tendon reflex	Also impaired segmental sensation LV—SI
L IV—L V	29	3	3	11	5
L V—S I	35	12	0	20	22
L IV—L V *and* L V—S I	4	1	0	1	1
Neg. findings	2	0	1	0	0
Total	70	16	4	32	28

The combination of neurological signs, which was the com-

monest and therefore the most important for diagnosis, was that of a change in the Achilles tendon reflex combined with paresis of the big toe (see Table 3). It occurred as frequently in herniation of the 5th as of the 4th disc, and it is therefore insufficient by itself for determining the level of the herniation, except that it shows that the lesion is at one of the two lowest interspaces. Further analysis of the signs is necessary to differentiate between these two interspaces.

Complete absence of the Achilles tendon reflex combined with paresis of varying degree occurred in 32 cases. In one of these there was a protrusion in both of the lowest interspaces, whilst of the remaining 31, 20 had a lumbo-sacral herniation or protrusion, and 11 had changes between the 4th and 5th lumbar vertebrae. Thus a complete absence of the Achilles tendon reflex seems to suggest that the chances of finding the herniation lumbo-sacrally are almost twice as great as of finding it protruding from the 4th disc.

In most of these cases the changes in the Achilles tendon reflex and the paresis of the extensors were already fully developed at the first examination, but in 20 cases only one of these signs was then detectable. In 16 of these the changes in the Achilles tendon reflex appeared first and paresis came later; of these, 1 had changes in both the two lowest discs, 12 in the lumbo-sacral disc and only 3 in the 4th disc.

Paresis of the extensors was the first sign in only 4 cases. In 1 of these exploration was negative, and in the other 3 the lesion was in the 4th interspace.

Thus in cases in which the neurological signs can be dated and the initial sign is known, it is evidently possible to diagnose the level with a relatively high degree of probability from this sign.

A further sign of value in determining the level of the lesion is the presence of a segmental disturbance of sensation. This was established objectively in only 28 cases, a somewhat surprising figure since one was dealing here with an affection of 2 roots. One of these cases had a protrusion in both the two lowest interspaces, 22 had a herniation or protrusion in the

lumbo-sacral interspace and only five in the interspace between the 4th and 5th vertabrae. Thus, in most cases disturbance of sensation corresponding to the segmental distribution of L5 and S1 points to a lumbo-sacral lesion if there are also changes in the Achilles tendon reflex and paresis of the big toe.

TABLE 4
Myelography and findings at operation.

	Myelographic findings agreeing with findings at operation	Myelographic findings disagreeing with findings at operation	Total
L III—L IV	1	0	1
L IV—L V	39	19	58
L V—S I	26	24	50
Neg. explorations	4	2	6
Total	70	45	115

In order to confirm or complement the clinical neurological diagnosis, myelography, using a negative contrast medium, was done in 115 cases (see Table 4). In 60 per cent. the operation findings confirmed those of the myelogram; either the herniation or a swollen root had been demonstrated or the myelogram and exploration were both negative. In 40 per cent. the myelograms were misleading, and the results of the clinical examinations were much more reliable, especially with lumbo-sacral herniations, of which only about half could be demonstrated on the myelograms. It is possible that better results could have been obtained with a positive contrast medium, and, in fact, this is suggested by results previously published. *Begg, Falconer* and *McGeorge* (1946) could diagnose 88 per cent. of their disc lesions from the myelograms, and *Barr* (1947) could find positive findings in about 90 per cent. of his cases; a positive contrast medium was used in both series. It is, however, quite reasonable, whatever the contrast medium, for

myelography to fail to reveal a certain number of herniations, especially those in the lumbo-sacral space, and those far out in the intervertebral foramen.

The material presented here suggests that one may draw the following conclusions on the determination of the level at which herniation of the lumbar disc has occurred. If, as is usually the case, either an impaired Achilles tendon reflex or paresis of the big toe is present as an isolated sign, the herniation will, in 8 cases out of 10, be in the lumbo-sacral and 4th lumbar interspace respectively. If several neurological signs are present together, especially an impaired Achilles tendon reflex together with paresis, total absence of the Achilles tendon reflex indicates a lumbo-sacral herniation twice as often as a herniation of the 4th disc. The first symptom to occur often indicates in which interspace the lesion should be sought. Negative myelograms and the absence of neurological signs by no means exclude the possibility that the sciatic syndrome is due to a herniation. Thus in most cases the clinical signs point to the interspace where the herniation is to be sought, but a negative finding there means that the adjacent space must be explored. Judging from the material presented here routine exploration of both the two lowest interspaces is unnecessary, even in cases with several neurological signs, and it is an exception to find a protrusion or herniation in both the two lowest interspaces in these cases.

SUMMARY

The author reports on 306 explorations for suspected lumbar disc herniations from the Orthopaedic Clinic, Lund, and discusses the clinical neurological diagnosis. In cases showing only one neurological sign the correct level can be determined in about 80 per cent. In cases with several neurological signs the level of the lesion is suggested by the first sign to appear. Myelography with a negative contrast medium was performed in 115 cases. In 60 per cent. the myelographic diagnosis was confirmed at operation; in 40 per cent. the

myelogram was misleading. Judging from the present investigation routine exploration of both the two lowest interspaces is unnecessary in cases of suspected lumbar herniation.

RESUME

L'auteur communique 306 observations de malades soupçonnés de prolapsus de disque intervertébral lombaire examinés à la Clinique Orthopédique de Lund et discute notamment du diagnostic clinico-neurologique. Dans les cas où il n'y a qu'un seul symptôme neurologique, on peut déterminer correctement le niveau de la lésion dans 80 % des cas. Dans ceux où il y a plusieurs symptômes neurologiques simultanés, il semble que le premier symptôme qui se soit manifesté indique le niveau de la lésion.

On a procédé à des myélographies avec contrastant négatif dans 115 cas. Dans 60 %, on a trouvé des données correspondantes aux trouvailles de l'opération, dans 40 % le myélogramme induisait en erreur. D'après les expériences qui ont été faites, il semble qu'il est inutile de procéder à l'exploration routinière des deux intervalles inférieurs dans les cas soupconnés de prolapsus de disque lombaire.

ZUSAMMENFASSUNG

Verfasser berichtet über 306 Untersuchungen bei Verdacht auf lumbale Discushernie aus der Orthopädischen Klinik in Lund und erörtert namentlich die klinisch-neurologische Diagnose. In Fällen, die nur ein neurologisches Symptom aufweisen, lässt sich die korrekte Höhe in etwa 80 Prozent der Fälle bestimmen. In Fällen mit mehreren neurologischen Zeichen has es den Anschein, als ob das erste sichtbare Zeichen in die Richtung weist, in der man die Lokalisation zu suchen hat.

Myelographie mit einem negativen Kontrastmittel wurde in 115 Fällen ausgeführt. In 60 Prozent der Fälle wurde die myelographische Diagnose bei der Operation bestätigt; in

40 Prozent hatte das Myelogramm zu einer falschen Deutung geführt. Nach der vorliegenden Arbeit zu urteilen ist eine routinemässige Untersuchung der beiden untersten Zwischenräume in Fällen von Verdacht auf lumbale Discushernie unnötig.

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