CLINICAL DIAGNOSIS OF LUMBAR INTERVERTEBRAL DISK PROTRUSIONS

WITH INDICATIONS FOR THEIR OPERATIVE REMOVAL*.

BY

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Posterior crural or sciatic and anterior crural pain are familiar symptoms. In the past the commonly accepted view has been that such pain results from an interstitial neuritis of the sciatic or anterior crural nerves, or that it is referred from lesions of the muscles, ligaments, and joints of the lower back. While the milder cases recover with a variety of treatments based on these aetiological hypotheses the results of such

Table indicating the Common Clinical Features of Lumbar Disk Protrusions and Emphasizing the Signs of Localizing Value

Level of Disk Protrusion	L5-S1	L4-L5	L3-L4
Extradural nerve related to protrusion	1st sacral	5th lumbar	4th lumbar
Site of pain	Posterior crural—sole and lateral margin of foot	Posterior crural—dorsum and medial margin of foot	Anterior crural—medial malleolus
Site of paraesthesiae	Sole of foot	Dorsum of foot	Subcutaneous surface of tibia
Spinal deformity	Lumbar lordosis diminished Scoliosis Flexion: gross reduction	Lumbar lordosis diminished Scoliosis Flexion: gross reduction	Lumbar lordosis diminished Scoliosis Flexion: slight reduction
Spinal mobility	Extension: slight reduction	Extension: slight reduction	Extension: ? reduction more severe than with lower lesions
Straight-leg-raising test	++	++	— (+)
Drop test	+	+	—
Femoral-nerve-stretch test	—	— (+)	++
Motor disturbance	Wasting and loss of tone in glutei, hamstrings, and calf. Weakness in hallux	Wasting and loss of tone in glutei, hamstrings, and calf. Weakness in hallux	Wasting, loss of tone, and weakness in quadriceps
Dermatome in which sensation may be diminished	S1	L5	L4
Reflex {Knee-j. change {Ankle-j.	++ — (+)	+ + —	— (+) ++

therapy have been disappointing in the more severely affected patients. During the last ten years much light has been shed on the aetiology of these crural pains by neurosurgeons, led by Mixter (Mixter and Barr, 1934; Mixter and Ayer, 1935).

FIG. 1.—Showing extent and position of certain lumbar and sacral dermatomes (after Foerster).

Evidence has gradually accumulated to suggest that, at least when the symptoms are severe, by far their commonest cause is a lumbar intervertebral disk protrusion. The presence of anterior crural or sciatic pain should therefore immediately suggest the possibility that a protrusion of a lumbar intervertebral disk has occurred. This possibility becomes a

probability if the leg pain is associated with a characteristic series of physical signs in the lumbar spine and affected lower limb (as indicated in the accompanying Table; see also Fig. 1).

Diagnosis

A variety of different lesions may occasionally give rise to the syndrome under discussion. However, experience suggests that all of these are much less common than lumbar intervertebral disk protrusions, and but three occur with any frequency. These are a tumour within the spinal canal, inflammatory or malignant disease of the spinal column (the former usually tuberculous and the latter metastatic), and spondylolisthesis. Clinical examination alone will not infrequently suggest the presence of one of these three much less common causes of lower-limb pain, but accessory methods of investigation may be required. In the first place radiography of the lumbar spine must never be omitted, and will demonstrate the presence of spondylolisthesis or vertebral disease. Further, it may show changes suggestive of the presence of an intraspinal neoplasm, and will sometimes demonstrate the existence and the level of an intervertebral disk protrusion. The latter is revealed by narrowing of an intervertebral interval and perhaps localized osteo-arthritic changes at this level. Secondly, lumbar puncture with manometry and examination of the cerebrospinal fluid may be helpful if the presence of a neoplasm is suspected, since such a lesion is much more likely to be associated with a subarachnoid block than is the usual type of disk protrusion. This is due to the fact that most lumbar intervertebral disk protrusions occupy a relatively small proportion of the spinal canal and therefore interfere little with the passage of cerebrospinal fluid to and from the sacral cul-de-sac. On the other hand, by the time a tumour lying among the roots of the cauda equina is of sufficient size to give rise to well-marked symptoms it will usually have produced a subarachnoid block—often a complete one. Thirdly, myelography with oxygen or some radio-opaque material may be required. This can certainly be helpful in atypical cases, but in the present series the procedure has been employed with diminishing frequency as experience has increased. That myelography does not necessarily lead to more accurate diagnosis is shown by the following figures. Of 39 explorations on the basis of positive myelographic findings 6 (15%) proved negative, while of 201 explorations carried out without previous myelography 7 (3.5%) were negative.

Thus it is believed that in the majority of cases the existence of a lumbar intervertebral disk protrusion can be discovered by clinical examination alone, radiography of the lumbar spine being the only accessory method of examination used as a routine. Further, it is considered that careful clinical examination will not infrequently provide evidence which allows of the location of the level of the affected disk. This belief is based upon the observation that a disk protrusion of the usual type is related to one extradural intraspinal nerve only and the theory that the majority of the symptoms and signs depend on this relationship. The clinical picture resulting from the protrusion will vary according to the particular extradural nerve affected. In the Table the clinical findings in protrusions of the last three lumbar disks are contrasted. In this table it is not intended to suggest that such clinical findings will invariably direct one to the correct level, but simply to indicate that clinical examination gives considerable assistance in locating the affected disk. Should the level first explored at operation be normal a second level compatible with the clinical picture can be readily exposed. With the modern operative technique, which necessitates the removal of only a small part of one lamina to expose an intervertebral disk, there is little disadvantage in the exposure of two disks if it appears to be indicated.

An Essential Difference

Before considering the indications for operation in these cases it is important to emphasize the essential difference between an intraspinal neoplasm and the usual type of intervertebral disk protrusion. A neoplasm gives rise to progressively increasing compression of surrounding nervous tissue. A mass of disk tissue, when it protrudes into the lumbar spinal canal, usually occupies but a small part of this canal. The dorsal theca will usually be slightly displaced and deformed, but its

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contained nerve roots will rarely suffer as a result. On the other hand, the single extradural intraspinal nerve which is related to the protrusion can be displaced to a limited extent only because of its attachments—proximally to the dura and distally to the limb plexus to which the nerve passes. When the limit of possible displacement is reached the nerve will be stretched over the mass of displaced disk tissue. Were it not for its relatively fixed position in the antero-lateral part of the spinal canal the extradural nerve would be displaced like the dural theca and a protrusion of ordinary size would be almost symptomless so far as the lower limb is concerned. It is thus believed that the severity of the patient's symptoms is closely related to the degree of tension in the affected extradural nerve. With the passage of time after the occurrence of a protrusion several factors probably tend to bring about a reduction of tension in this nerve and thus a spontaneous diminution in the symptoms due to tension. The nerve may elongate before the stretching force and thus become less tense. With the passage of time the protrusion frequently tends to diminish in size, and in this way the stretching force will be diminished. In cases in which the protrusion has perforated the posterior longitudinal ligament such diminution in size may be due to the loss of fluid from the protrusion—so that in time it may be converted into a low calcified ridge. When the posterior longitudinal ligament is intact it seems likely that with the patient in the horizontal position the bulge of disk tissue may be withdrawn to some extent into the intervertebral interval which previously contained it. Again, a change in relationship of protrusion and extradural nerve may bring relief—the nerve slipping from a position of tension on the summit of the protrusion to one of relaxation in a trough to either side. Here, then, are possible explanations of the spontaneous improvement in or even disappearance of symptoms which frequently occurs in the presence of protrusion of a lumbar intervertebral disk.

It must be admitted that when a patient's symptoms disappear spontaneously and operation is therefore unnecessary it cannot be stated with absolute certainty that an intervertebral disk protrusion was responsible for the pain. However, there is much to suggest that the same lesion is responsible whether the pain be persistent or of short duration. Many cases in which the presence of an intervertebral disk protrusion is eventually confirmed by operation give a history of recurring attacks of pain separated by intervals of freedom. Moreover, in both groups the history and physical signs are identical. Finally, as has been indicated above, there are a number of reasons why pain due to an intervertebral disk protrusion may diminish spontaneously. It is thus believed that spontaneous recovery does occur in the presence of a lumbar intervertebral disk protrusion, and, further, that it is a frequent occurrence. In the neurosurgical department in which the series of patients now under discussion were treated probably less than one patient in every three referred because of low back and crural pain is submitted to operation. Each patient must receive careful study, and operation must not be based on the reasoning that because a patient has low back and crural pain he therefore has a lumbar intervertebral disk protrusion and it should be removed. Moreover, an operation which has not been preceded by adequate study may require a wide exposure and inflict unnecessary trauma, or indeed it may be performed uselessly and harmfully in the presence of some lesion other than a disk protrusion—such as, for example, a neurofibroma arising from one of the nerve roots of the cauda equina. A final reason for careful and complete examination of these patients is the advancement of knowledge which will result. Thus a better understanding of this large group of patients will be attained, and incidentally the development and disappearance of neurological disturbances due to nerve-root lesions of varying degrees of severity can be studied.

Indications for Operation

The indications for excision of the intervertebral disk protrusion in these cases will now be considered. In some patients the need for operation is obvious. The pain may be intensely severe though of short duration (e.g., two months), or it may be less severe but have caused long-standing disability. At the other extreme there are patients with pain so mild or of such short duration that nothing more is necessary than to explain the

natural tendency to spontaneous recovery. It is in the cases with symptoms intermediate in severity between those of these two groups that careful judgment is required in selecting patients for surgery. Three aspects must be considered—the severity and duration of the symptoms, the severity of the neurological signs, and the severity of the tension signs.

The first consideration is therefore the patient's estimate of the severity of his symptoms. This has obvious importance, but is rarely enough in itself to indicate operation if not supported by physical signs. As is true in the treatment of other chronic pains, so also in crural pain it is desirable that one avoid submitting to operation patients whose capacity to bear pain is markedly subnormal and also those who, for various reasons, may be exaggerating mild symptoms. The duration of the pain is important too. It is only in rare cases that operation has been performed for pain of less than three months' duration, and then only when it has been extremely severe. The second consideration is the severity of the neurological signs. The importance of these signs in diagnosis has already been discussed. Further, when the neurological disturbance is severe it will constitute an indication for operation. Occasionally a lumbar intervertebral disk protrusion may give rise to severe cauda equina injury, with the usual motor sensory and sphincteric disturbance. Less uncommon is the group of cases in which gross weakness and sensory loss are present in one lower limb. A series of such cases in which the disk protrusion occurred during labour has been reported elsewhere (O'Connell, 1944). However, in the majority of patients the neurological signs are unobtrusive and do not constitute an indication for operation. As is widely recognized, an ankle-jerk lost during an acute attack of sciatica may still be absent years after the sciatic pain has disappeared, and the same may at times be true of muscle-wasting and areas of sensory loss. The third consideration, and certainly the most valuable indication for operation, is the severity of the tension signs. When these are well marked and the symptoms are of sufficient duration operation is clearly required.

Several of these tension signs have been discussed in a previous communication (O'Connell, 1943). It has been suggested that the diminution or absence of lumbar lordosis and lumbar scoliosis (including the alternating form) were postures designed to relax the stretched extradural nerve. The straight-leg-raising test was positive because hip flexion with an extended knee quickly caused a further increase of tension in the extradural nerve crossing the protrusion. Such an increase in tension would of course aggravate the patient's pain, and the greater the tension already present in the extradural nerve the lower the angle through which raising of the straight leg will be permitted. A modification of the straight-leg-raising test which has been previously described as the drop test has been found useful (Fig. 2). Both legs are raised together to a point just

FIG. 2.—The drop test.

short of that which causes pain. The sound leg is then allowed to drop to the bed, and an exacerbation of pain occurs if the test is positive—as it very often is in cases requiring surgery. Another tension sign that has been found of value in upper

lumbar disk protrusions is one which has been called the femoral-nerve-stretch test. A protrusion of the second lumbar disk is related to the third lumbar nerve and one of the third lumbar disk to the fourth lumbar nerve, and while little tension is developed in them by straight-leg raising it has been shown (by dissections) that they rapidly become tense when the hip is hyperextended and the knee flexed. In cases of upper lumbar disk protrusion the movement causes a marked increase in the patient's pain (Fig. 3).

FIG. 3.—The femoral-nerve-stretch test.

In this discussion of operative indications attention has been centred upon cases with lower-limb pain. Most of these patients have low back pain in addition, but cases are also seen in which low back pain is the only symptom, any leg pain having cleared up spontaneously. In the majority of such cases which have been seen it has been felt that an operation to remove a disk protrusion would be unsound, and they have been referred to the orthopaedic surgeon for treatment—including spinal fixation in the more severe cases. In a very few cases in which severe low back pain was associated with attacks of locking, a disk protrusion has been removed with gratifying relief of symptoms.

Conclusion

These observations are based upon the clinical and operative findings in a personal series of over 220 proved cases of lumbar intervertebral disk protrusion treated at St. Bartholomew's Hospital and in an E.M.S. neurosurgical unit during the period Jan., 1938, to May, 1945. Many of the cases have been referred to me by Mr. S. L. Higgs, at whose request I have made this communication and for whose help and encouragement I should like to express my gratitude. Among other colleagues who have referred the patients in this group to me I am particularly in the debt of Mr. L. W. Plewes and Wing Cmdr. J. H. Hunt.

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The Central Council for Health Education will hold one residential summer school in England this year, at Somerville College, Oxford, from Aug. 14 to 28 inclusive. The directors of the school will be Miss D. E. M. Gardner, M.A., head of Child Development Department, University of London Institute of Education, and Dr. Robert Sutherland, medical adviser and secretary to the council. The school is intended primarily for those who have to do with the training and care of children and young people—teachers, youth leaders, health visitors, school nurses, educational and medical administrators, training organizers, welfare superintendents, sanitary inspectors, and students. The object of the school is to present the general content, methods, and applications of health education. Mornings will be devoted to lectures in physiology, psychology, the biology of infection, sociology, and health, as well as to lectures, demonstrations, and discussions on the methods and applications of health education. Evening lectures will deal with wider educational, psychological, social, philosophical, and spiritual aspects. There will be opportunity for discussion under experienced leaders, for viewing health films and acquiring technique in visual aids. The afternoons will be left free for optional visits, sports, and physical recreation under expert leadership. Those wishing to book accommodation or to be supplied with further details about the school should write to the medical adviser and secretary, Central Council for Health Education, Tavistock House, Tavistock Square, W.C.1.

SURGICAL TREATMENT OF DYSENTERIC LESIONS OF THE BOWEL AMONG ALLIED PRISONERS OF WAR IN BURMA AND THAILAND

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Dysentery has levied a tragic toll among prisoners of war engaged in constructing the Thailand-Burma railway. Multiple diseases have been the rule and malnutrition rife. For example, numerous prisoners suffered simultaneously from dysentery, malaria, tropical ulcer, and gross malnutrition. Avitaminosis, particularly that associated with the B₂/B₆ complex, has been common. Some of the special problems in the treatment of dysentery have been:

(i) The appalling severity of the lesions, in many cases demonstrated to have *Entamoeba histolytica* infection.

(ii) The ever-embarrassing shortage, and in many cases the complete absence, of specific amoebicidal drugs.—For example, in working camps providing the most wretched conditions of life, at times not even magnesium sulphate could be obtained, and recourse was had to such pathetic devices as the administration of charcoal manufactured locally. Emetine, when available, was often obtained only sporadically, in clandestine ways, and had to be used with the utmost economy, with a view not to cure but to prolong life.

(iii) Facilities for microscopy were very frequently not available as a diagnostic aid in the early stages.

(iv) Chronicity of the bowel infection and the establishment of an "emetine-resistant" subject deriving little relief from treatment, or almost immediately relapsing.—This may be due in large part to the extremely low vitality of the individual through the multiplicity of diseases, malnutrition, and complete exhaustion. Many subjects were forced to continue working with established dysentery, and commonly months went by with only the crudest symptomatic treatment being possible, so that the bowel suffered gross damage. When this chronicity was established large quantities of emetine, even to a total of more than 50 gr. (3.25 g.) given over the period of illness, quite failed to provide relief.

Pathology

In practically all those seeking surgical relief *E. histolytica* had been demonstrated in the stools, and in most cases proctoscopy revealed typical amoebic ulceration in the lower bowel. Only one case in the series under discussion was not proved to be amoebic. Undoubtedly in some subjects both amoebic and bacillary infection were present, as reflected by the inclusion in the stools, in addition to *E. histolytica*, of a bacillary type of exudate and macrophage cells. In the acute phase of the disease, with constant passage of blood and mucus—up to 60 motions daily—ulceration was often not the usual limited and circumscribed amoebic lesion, but took on very florid forms associated with devastating lesions of the large bowel, notably a gross cellulitic swelling; and tumour formation occurred, or even huge patches of sloughing gangrene, spreading at times to the peritoneal coat. These florid lesions were chiefly in the caecal region and right half of the colon; spread to the ileum, however, was negligible.

The complication in this type of infection was all too frequently peritonitis, due either to the seeping of infection through the bowel or, less commonly, to actual perforation. In a few cases severe haemorrhage occurred, associated with passage of sloughs.

In the more common cases of prolonged chronic infection with the passage of blood, mucus, and pus over long periods, and gradual exhaustion, it was often noted at operation that inflammation, scarring, and fibrosis were present in the caeco-appendicular area. The caecum and ascending colon were fixed and indurated, with adhesions, and the peritoneal folds and