Notes on the Diagnosis of Herniated Nucleus Pulposus in the Lower Lumbar Region

ALTHOUGH accurate statistics will probably never be available, pain in the back is probably one of the most common human ailments. The problem is no less important in army medicine than in civilian practice for apparently backache is no respecter of age or of physical fitness. The soldier who is incapacitated with low back pain must be cared for, particularly if it is the result of military service. The prompt and permanent relief of such symptoms depends primarily upon a correct diagnosis. In many cases, when the diagnosis is established, the soldier with proper treatment may be returned to full military duty within a reasonable period of time.

The purpose of this report is to discuss the role of the lumbar intervertebral discs in the larger problem of low back pain. We are fully aware that disc pathology is responsible for symptoms in only a small percentage of lame-back patients; yet this lesion is common enough to justify inclusion in all differential diagnoses. Furthermore, the clinical manifestations of lumbar intervertebral disc lesions are as a rule sufficiently clear-cut that reasonably accurate diagnoses can be made in most cases on clinical findings alone.

HISTORY

In almost every instance of traumatic lesions of the lumbar intervertebral discs, the first symptom is backache. Only about 40 percent of the cases give an unequivocal history of trauma precipitating the first attack. The usual history is “when in a bent forward position, lifting a heavy object, a sudden catch is felt in the back and straightening upright can only be accomplished with excruciating pain.” The outstanding characteristic of the back pain is its mechanical nature.

Some patients will fall to the ground with severe pain; in others the pain begins mildly and gradually increases until each movement of the back produces discomfort. Relief of pain is usually obtained by lying still in bed for an hour or more. Some patients state that comfort is obtained only in a sitting position.
and that they may even learn to sleep in a chair. So long as the pain persists, it is intensified by bending or lifting. Strangely enough, some patients get relief from manipulation while others are relieved by complete immobilization.

Backache without radiation of pain into either leg is seldom caused by herniation of the nucleus pulposus.

There is reason to believe that the lumbago associated with intervertebral disc lesions is caused by stimulation of the sensory nerve ending in the posterior annulus fibrosis and the posterior longitudinal ligament. When the nucleus pulposus herniates through a tear in the annulus fibrosis, the intraspinal mass thus formed may impinge upon one or more components of the lumbo-sacral plexus with the production of sciatic pain.

There may be one or more attacks of backache before the onset of sciatic pain. However, where trauma produces gross injury to the intervertebral disc, the leg pain may occur simultaneously with the low back disability. Pain is usually present along the entire course of the sciatic nerve. The points of maximum intensity are the gluteal region, the posterior thigh, and the lateral aspect of the leg or ankle. The gluteal region is the area to which the pain produced or intensified by coughing, straining, or sneezing is referred. Usually the sciatic pain remains unilateral, but there are instances of bilateral pain, and not infrequently the pain will shift from one leg to the other during successive episodes.

Partial or complete remissions of symptoms occur characteristicly in lumbar herniations of the nucleus pulposus. Recurrent attacks with freedom from pain between attacks is the usual history.

A patient with severe sciatic pain usually keeps the knee flexed; it is hard to him to get his heel to the floor. Slight flexion of the knee and thigh gives relief of pain by relaxing the pull on the sciatic nerve. Any bending movement, sitting, or exercising exaggerates the pain.

Some patients report that certain parts of the leg are numb or that certain parts of the leg or foot have a feeling of "needles and pins." An observing patient may describe his sensory involvement so accurately that a localizing diagnosis may be made. The pain is usually burning, stinging, or prickling, and, in some instances, there is tingling and a feeling of electric shock. For an accurate description of the dermatomes of the 5th lumbar and the 1st and 2d sacral nerves, an anatomical textbook should be
consulted. As a rough working basis it may be stated that the 5th lumbar dermatome is represented on the top and mesial side of the great toe and a small strip extending up the shinbone. The 1st sacral dermatome includes the dorsum of the foot, the four lateral toes and a band about two inches wide extending up the lateral aspect of the leg to the knee. The 2d sacral dermatome extends posteriorly over the calf and the lateral aspect of the ankle and foot (figure 1).

![Figure 1. Approximate sensory distribution of L-5, S-1, and S-2.](image)

A herniated nucleus pulposus at the 4th lumbar interspace, i.e. between the 4th and 5th lumbar vertebrae, causes sensory disturbances primarily in the 5th lumbar dermatome. The same lesion at the lumbosacral disc causes sensory disturbances in the 1st sacral and perhaps the 2d sacral dermatomes. A large lesion at either level may involve one, two, or three dermatomes.

No "low back" history is complete without a thorough general medical history, particularly with respect to symptoms of rheumatoid arthritis, acute and chronic systemic infections.

EXAMINATION

The examination should be made with the patient disrobed. Observations with respect to the posture, gait, general alignment of the legs with the trunk, position of the feet, and the motion of the small joints should be made. A careful evaluation of the patient as an individual (i.e., his general appearance, his mental attitude, and his over-all personality) is of prime importance, particularly if operation is contemplated.

Most patients with a herniated nucleus pulposus have a straight lumbar spine with obliteration or reversal of the normal lumbar lordosis. Some of them, in addition, show listing away
from the side of the sciatic pain (figure 2). In almost every instance the pelvis on the affected side is higher than on the unaffected side. Movements of the lumbar spine are usually limited, especially in flexion. Extension of the spine is often painful. The erector spinae muscles may be spastic, and the spasm may be greatest on the side opposite the lesion. Light percussion or pressure at the level of the lesion will usually demonstrate an area of localized tenderness. Deeper percussion just to the side of this tender area may cause radiating pain into the gluteal region or leg. Radiating percussion pains thus produced are caused probably by waves of force transmitted through the ligamentum flavum to the affected nerve roots at the site of the lesion. When positive, this sign is almost pathognomonic of a herniation of the nucleus pulposus (figure 3).

Lateral bending is often restricted, particularly toward the painful side. Bending forcibly toward the painful side for thirty seconds normally intensifies the back pain and may reproduce the whole pattern of leg pain, even the sensory disturbances (figure 4). Bending away from the painful side usually gives
relief (figure 5). Occasionally a patient is observed who obtains relief by bending toward the painful side or who has alternating scoliosis. A herniation of the nucleus pulposus presenting near the midline should be suspected in such cases.

In testing for sensory changes, the patient must be relaxed and fully cooperative. Two forms of stimuli are sufficient to demonstrate gross sensory involvement—light touch with the finger tips and painful sensation with pin prick. In mapping out areas of sensory loss it is desirable to compare the normal with the abnormal side. In many instances the only sign of sensory disturbance will be the patient’s statement that the skin of the involved area feels thicker than normal. In questionable cases, testing with heat and cold will demonstrate sensory loss when other tests are equivocal.

Paresthesias may be described as peculiar sensations (electric shocks) spreading from the point of stimulation into the remainder of the involved dermatome. They are best reproduced by lightly stroking the skin with the finger tips.

Patients in great pain can not exert maximum muscular effort. For this reason weakness of the gluteal and hamstring muscles is difficult to demonstrate. Some muscular weakness is probably present when the 4th or 5th and 1st or 2d sacral nerve roots are compressed to any degree by a herniated nucleus pulposus. The anterior tibial, peroneal, and the long digital extensor muscles are involved most frequently. Atrophy occurs both from disuse and from focal paralysis of nerves, particularly in cases of long standing. Filbrillation of the regional muscles occurs in certain cases. Gross paralysis is rare, and, when it occurs, the lesion is more likely to be a neoplasm of the cauda equina.

Diminution or absence of the ankle jerk on the affected side occurs in at least 80 percent of herniations at the lumbosacral disc, but in only 25 percent of herniations at the 4th lumbar disc (figure 6). These changes in the ankle jerks coupled with maximal sensory findings are valuable in localization of the lesion. The knee jerks are seldom involved with herniations at the 4th or the 5th lumbar discs. However, with herniations at the 3d
lumbar disc, diminution or absence of the knee jerk is to be expected due to involvement, primarily, of the 4th lumbar nerve root.

The straight leg raising test is a valuable index of the degree of sciatic pain (figure 7). The angle at which pain appears may also be used as a reliable index for judging the progress of the case. The Lasègue's test is a valuable refinement in equivocal cases (figure 8). These two tests are almost always positive in
lumbar herniation of the nucleus pulposus producing sciatic pain.

Hyperextension of the lumbar spine usually greatly exaggerates the back and leg pain (figure 9). In this position, not only may the pain be exaggerated but the whole pattern of sensory disturbances in the leg may appear. When the nonpainful thigh is flexed upon the abdomen, relief of pain in the affected leg is experienced (figure 10). This test, when positive, is valuable confirmatory evidence of a lumbar herniation of the nucleus pulposus.

The jugular compression test is performed by impeding the venous return from the internal and external jugular veins with digital compression or with the cuff of a sphygmomanometer placed around the patient's neck. By increasing the intracranial pressure and consequently increasing the intraspinal pressure, the radicular pain in the affected leg is aggravated (figure 11). A positive jugular compression test is pathognomonic of an intraspinal lesion, and when the pattern of the patient's leg pain is reproduced accurately the test is of great value in localizing the lesion.
Many lumbar herniations of the nucleus pulposus can be accurately localized on the basis of clinical findings alone. All cases have in common: (1) low back disability; (2) pain in the distribution of the sciatic nerve.

The characteristic findings are as follows:

4th lumbar interspace:

1. Tenderness to percussion about the 4th spinous process.
2. Radiating percussion pain to the side of the 4th spinous process.
3. Positive jugular compression test with tingling into the great toe (the 5th lumbar dermatome).
4. Knee and ankle jerks normal.
5. Hypesthesis and/or paresthesia in the 5th lumbar and the 1st sacral dermatomes.
5th lumbar interspace:
(1) Tenderness to percussion about the 5th spinous process.
(2) Positive jugular compression test with tingling into the
top of the foot, sparing the great toe.
(3) Positive jugular compression test with tingling into
the top of the foot, sparing the great toe.
(4) Diminished or absent ankle jerks—knee jerks normal.
(5) Hypesthesia and/or paresthesia in the 1st sacral and
the 2d sacral dermatomes.

DIFFERENTIAL DIAGNOSIS

If an injury initiates the symptoms of low back and sciatic
pain, particularly if the injury has been a severe one, fracture of
the spine or pelvis must be ruled out by appropriate x-ray study.
If the symptoms develop insidiously, chronic conditions which
affect the spine should be considered and ruled out. These in­
clude tuberculosis, low grade osteomyelitis, Marie-Strümpell dis­
ease, rheumatoid and osteo-arthritis, myositis, fasciitis, and con­
genital anomalies, especially spina bifida occulta and spondylolis­
thesis. Chronic or subacute abdominal conditions must be taken
into consideration, although they rarely cause severe low back
pain. Similarly, lesions in the prostate, particularly carcinomata,
and metastatic tumors in the spine or pelvis from the breast,
thyroid, lungs, prostate, kidney, and gastro-intestinal tract must
always be considered.

Differentiation between these lesions in the spine and pelvis
is not, as a rule, difficult if the examination is carefully carried
out in an orderly manner. However, in approaching the problem
of low back disability, one frequently must exhaust his diagnostic
acumen to arrive at a logical explanation for the pain, and not
infrequently even the most careful consideration leaves the ques­
tion unanswered. The appreciation of the fact that there is a
definite clinical picture associated with rupture of the inter­
vertebral disc with herniation of the nucleus pulposus will con­
siderably reduce the number of cases formerly classified as low
back pain of undetermined etiology.

MYELOGRAPHY

Abundant clinical experience has indicated that in 60 per­
cent of lumbar herniations of the nucleus pulposus the diagnosis
can be established accurately upon clinical findings alone. The
remaining 40 percent can be demonstrated only by exploratory
operation or by satisfactory myelography. While an exploratory
operation may be a justifiable procedure, particularly if the operator is skilled in this type of surgery, one would prefer to use a simple and more precise method.

Myelography has, for the most part, been performed by three methods: (1) lipiodol; (2) thorotrast; (3) air (or gases).

Lipiodol is in many respects a satisfactory medium for visualizing the spinal subarachnoid space. However, if the material is not removed, its tell-tale shadow persists more or less indefinitely. It can be removed, but the removal is attended with difficulties and at best is often incomplete.

Thorotrast gives excellent radiographic detail, and interpretations can be made with great accuracy. Thorotrast can be removed completely by continuous spinal drainage. However, there are many objections to its use, not the least of which is the time consuming procedure of continuous spinal drainage.

Air myelography is used more universally than any of the three, because air is absorbed and leaves no demonstrable x-ray evidence of its use. The headache for twenty-four hours is often
severe and incapacitating. The shadows cast by gases in the
spinal subarachnoid space are, with highly refined radiographic
technique, subject to fairly accurate interpretations. However,
in many instances the radiographic diagnosis is presumptive and
often equivocal.

A new myelographic medium is now available which com­
bines the desirable qualities of lipiodol and thorotrast and is more
easily removed by aspiration. If a few drops are left, they are
absorbed within four to six weeks. The material is Pantopaque
and is the contribution of Dr. Stafford L. Warren, Professor of
Roentgenology, University of Rochester (N.Y.) School of Medi­
cine, and Dr. William Strain of the Eastman Kodak Company.

The technique of Pantopaque myelography used at the
Walter Reed General Hospital is as follows:

The patient is placed prone on the tilting fluoroscopic table
with a small pillow beneath the abdomen. Lumbar puncture is done in this position, the needle being inserted distal to the 4th or the 5th lumbar spinous process. The puncture may be done below the 3d spinous process, but at this level subsequent removal of the Pantopaque is more difficult. Spinal puncture in the face down position is as simple when one is accustomed to it as in the conventional position. One must be careful to keep in the midline and to insert the needle millimeter by millimeter after the ligamentum flavum is encountered. As soon as spinal fluid is obtained, the needle is inserted further about two millimeters and three cubic centimeters of Pantopaque injected. A stylet is then placed in the needle and the whole field covered with a sterile towel. The patient is now ready for fluoroscopy.

Pantopaque, being of low viscosity, is easily balanced at the desired level in the spinal canal by tilting the fluoroscopic table. Pantopaque, being heavier than spinal fluid, always seeks a dependent position in the subarachnoid space. As the column passes each lumbar intervertebral disc, spot films are made. Where suspicious defects are encountered, oblique or lateral films (made with a portable unit) may be made. Once the lesion is demonstrated and spot films of all suspected areas recorded, the column of Pantopaque is balanced at the point of the needle by tilting the table to the desired position. The needle is introduced about two millimeters further in order that aspiration may be accomplished as close to the anterior wall of the spinal canal as possible. A syringe is then attached and gentle aspiration begun. If the column has been carefully placed at the point of the needle, pure Pantopaque will be obtained and almost the entire amount may be recovered before fluid begins to bubble through the oily mixture. When spinal fluid appears, the syringe should be detached, the stylet reinserted and again the patient fluorospected to collect what remains of the Pantopaque around the point of the needle.

The whole examination, when one is experienced, requires but fifteen to twenty minutes including the injection and removal of the drug.

Spot films made with a grid show remarkably accurate detail. The dural sleeves and the axillary pouches are accurately outlined in most instances, and not infrequently the whole course of the nerve root may be shown at each level.

Myelography with Pantopaque, like myelography with other media, should not be attempted soon after a diagnostic lumbar
puncture, certainly not until at least a week or ten days have elapsed. The continuous fluid drainage through the needle hole in the arachnoid often produces sufficient subdural fluid to make another subarachnoid puncture difficult or impossible. This is the most frequent cause of subdural and extra-arachnoid injections and, of course, when it occurs the myelograms are useless for interpretation. It is better practice to remove spinal fluid for examination at the completion of the myelogram rather than to do a routine diagnostic puncture during the preliminary study.

Experience with some two hundred Pantopaque myelograms indicates that interpretations can be made with remarkable accuracy. No untoward reactions are to be expected if the drug is removed immediately following the examination. Should for any reason removal not be complete, no greater reaction occurs than if lipiodol were used.

Pantopaque myelograms are made routinely on all disc patients at the Walter Reed General Hospital, where surgery is contemplated. Such routine is believed desirable on two accounts: first, that the clinical diagnosis of herniated nucleus pulposus may be verified preoperatively; second, that the lesion may be accurately localized, thus permitting removal with the least possible disturbance of the spinal weight bearing mechanism.

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