

The diagnostic value of nerve root sheath infiltration

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As early as 1891 Gowers (2) stated that "narrowing of the foramina may damage the nerve roots and radiating pains are produced, sometimes even a descending neuritis." By describing that this was observed at post-mortem examination without being suspected during life he originated without realizing it the concept of asymptomatic pathology. In the twenties, Putti (7) wrote extensively in Italian about nerve root compression caused by degenerative changes of the lumbar facet joints. He described the pathological changes, the clinical symptomatology and the surgical therapy recommending laminectomy with total facetectomy. In the majority of cases, a neurological deficit caused by radiculopathy due to entrapment was observed.

Particularly in patients without neurological localizing signs, the question of symptomatic versus asymptomatic pathology is of significance. Indeed, people without any symptoms at all may have radiological signs of lumbar nerve root entrapment on caudography (3), CT (10) or MRI. This so called asymptomatic nerve root entrapment is possible, as Sunderland states, "because a nerve will tolerate remarkable degrees of deformation providing this occurs sufficiently slowly and does not impair the blood supply of the nerve." These studies show that asymptomatic entrapment is increasing with age.

Diagnosis

In a prospective longitudinal study (9) of nine years on diagnosis and surgical management of patients with lumbar lateral stenosis, it has been demonstrated that the patient may present with neurogenic intermittent claudication, canal stenosis being absent. Furthermore, with radiculopathy, nerve root compression syndrome, atypical leg pain or a combination of these.

In patients with atypical leg pain no neurological signs are present. In view of the possibility of asymptomatic entrapment, the question arises whether the radiologically observed entrapment is symptomatic and explaining that atypical leg pain. In the majority of these patients neurophysiologic examinations are of no help.

In his well known paper on the negative disc exploration, Macnab (5) briefly mentioned the use of nerve root sheath infiltrations in patients with a radicular syndrome having had an operation before. He did not report the diagnostic value of the test but only described the results in six patients.

Technique

Lumbar nerve root sheath infiltration is performed as an outpatient procedure without premedication. Image intensification is used and radiographs are made in anteroposterior and lateral views. The patient is lying prone on his healthy side supported by pillows to facilitate an approach of the nerve root canal in a plane 45° off the midsagittal plane. A six-inches long, 21-gauge needle is introduced in a vertical direction aimed at the pedicle. The approach is similar to the lateral route for discography as described by McCulloch (6). When accidentally the pedicle is hit the needle is withdrawn 1 or 2 cm and subsequently aimed slightly more distal and again advanced.

The needle point has to be located just caudal to the pedicle and just lateral to the line connecting the centers of the pedicles (Figure 1). Particularly in patients with a deep seated L5 vertebra it may not be possible to use this approach but instead approaches as described by Krempen (4) and Tajima (8) are utilized. For the S1 nerve root the technique is different: the patient is lying completely prone and the roentgen tube is tilted in the direction of the sacral foramina. The needle is introduced in the first sacral foramen until the point of the needle is about halfway of the anterior cortex as to ensure its closeness to the S1 nerve root (Figure 2).

As the needle touches the nerve root sheath the patient experiences pins and needles in his foot and a sharp stabbing pain in his leg. This is not a reliable sign of a correct location of the needle point: joint capsule, periosteum and anulus fibrosis are very sensitive structures and irritation of these structures may also cause referred pain down the leg. After a radiographic check of the position of the needle point a maximum

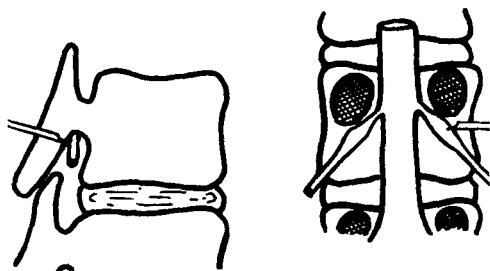


Figure 1. Schematic representation of correct location of needle tip: in the lateral view just distal to the pedicle, in the A-P view just touching the imaginary line between the centers of the proximal and distal pedicle.

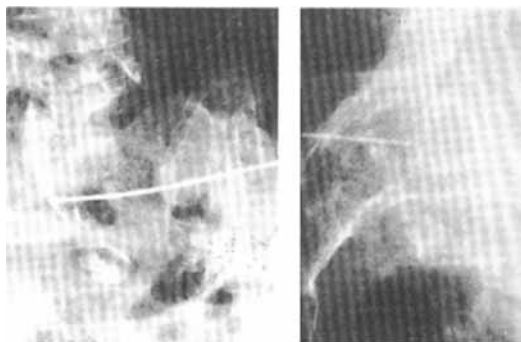


Figure 2. A-P and lateral radiographs of an S1 nerve root sheath infiltration. Note the location of the needle tip.

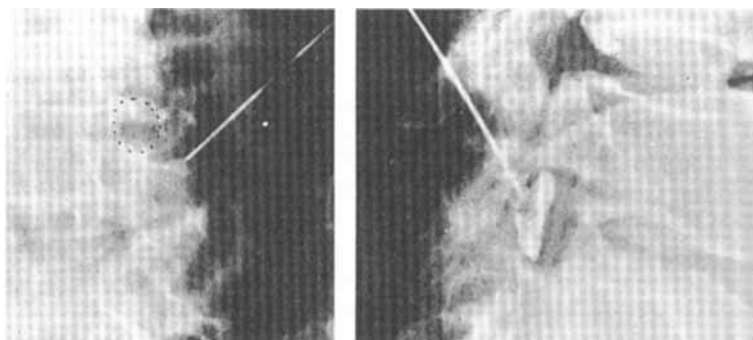


Figure 3. A-P and lateral radiographs of a L5 nerve root sheath infiltration. Note that the location of the needle tip is just outside the foramen intervertebrale. The radiographic image and the clinical observations confirmed a correct technique.

of 1.0 mL of contrast medium is slowly injected (Figure 3). High injection pressure has to be avoided. The injection is performed under image intensification.

When the needle point is placed to far laterally, the image is striated, indicating contrast between the fibres of the psoas muscle. By a too far medially placed needle the risk of epidural anesthesia is present. Although Tajima (8) claims that the image of the spinal nerve surrounded by contrast has diagnostic significance regarding the site of entrapment this has not been confirmed (9). The symptoms provoked at injection of contrast are noted and in particular whether the provoked pain is similar to the usual pain. Subsequently a small amount of marcain 0.5% (0.2–0.5 mL) is injected. When no neural deficit is occurring the test may still be valid: the location of the needle tip and the radiographic image may define the test technically correct.

The result is interpreted as *positive* when the patient's usual leg pain has been provoked and disappeared after injection of marcain. The patient has to be pain free for at least one hour, and be able to stand and walk without pain.

The test result is interpreted as *negative* when the pain in the affected leg is not influenced at all.

The test result is *equivocal* when the response of the patient is unclear, often because the leg pain is only partially relieved. To optimize selectivity it is important to use a very small amount of marcain. By spreading of marcain in the surrounding tissue a second spinal nerve only 1 to 2 cm proximally may be blocked.

Errors of technique and interpretation include incorrect level and needle placement too far laterally. Furthermore, a distally located lesion, for example of the lumbar plexus or of a peripheral nerve, may result in a false positive interpretation. The same applies for an intraneural lesion, in particularly in a "battered" nerve root causing deafferentation pain. Although the nerve root sheath infiltration test will be positive, surgical therapy is ineffective.

Complications: persisting structural damage has not been encountered.

Diagnostic value

The reliability of the test has been assessed by applying the test in patients with nerve root entrapment due to lumbar disc protrusions or malignant disease, usually metastases, to treat these patients symptomati-

cally: in 37 patients with disc protrusions and 9 patients with metastases, the blocks were repeatedly done by two radiologists. In all the cases the test was positive indicating a high reliability in experienced hands.

To define the *sensitivity* of the test, patients with a proven lumbar radicular syndrome were chosen as a model: complete relief of symptoms is expected in these patients after injection of marcaïn around the affected nerve root. A positive test result was defined as truly positive. The clinical and radiological diagnosis was confirmed at surgery. The sensitivity was reported as 100% (88–100% with a 95% confidence limit; 1, 9).

The *specificity* was defined by studying the results of the test being done at a level different from the symptomatic entrapment. At that level radiological signs of nerve root entrapment were not observed. A negative test result was defined as true negative. In 23 patients the test result was negative, thus no false positive were observed: indicating a specificity of around 90% (9).

Finally the *predictive value* was tested on a group of patients with radiological signs of nerve root entrapment due to degenerative changes without neurological localizing signs. After the test the symptomatic nerve root was decompressed by a partial medial undermining facetectomy. When the outcome of the operation was good, the positive test result was considered as truly positive. In the case of a poor outcome, the positive test result was considered as false positive.

Because a number of patients refused operation regardless of the fact that the radiological observations were unequivocal and the test result was positive, two scenarios were reported:

- A worst scenario, including the ones who refused operation. The positive predictive value was 70% with a 95% confidence limit of 50–85%.
- A best scenario, excluding those patients. The positive predictive value was 95% with a 95% confidence limit of 77–100% (1, 9).

Conclusion

Nerve root sheath infiltration as a diagnostic test is a reliable test in experienced hands with a high specificity and sensitivity. The predictive value positive in patients with lumbar lateral stenosis is about 85%.

Indications

Nerve root sheath infiltration as a diagnostic test is in particular indicated in patients with possible radicular leg pain without localizing signs to indicate which nerve root is involved.

Furthermore, in a lumbar radicular syndrome with radiological signs of entrapment of two or more roots or a discrepancy between clinical and radiological signs.

Thirdly, in patients with canal and lateral stenosis combined, to see whether entrapment of the nerve root may explain the symptoms so that only a medial partial undermining facetectomy via an interlaminar approach is needed and a wide laminectomy can be avoided.

Finally, in patients with “atypical leg pain” and in patients with radiological signs of entrapment of more than one nerve root.

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