

Lumbar Nerve Root Anomalies are Still a Diagnostic and Therapeutic Challenge. Case Report and Review of Literature

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Abstract

Even in the MRI era lumbar nerve root anomalies in patients with lumbar radiculopathies are still frequently un- or misdiagnosed and usually discovered during spine surgery only. The existing literature suggests that patients with lumbar nerve root anomalies are especially prone to develop radiculopathies and suffering operative complications. Therefore, preoperative diagnosis is imperative to enable appropriate surgery and avoid complications. We describe a case of a patient with unilateral lumbar radiculopathy misdiagnosed with a lumbosacral disc herniation on magnetic resonance imaging. During surgery a Neidre/MacNab type 2b lumbar nerve root anomaly rather than a disc herniation was verified, which required a wide decompression of the involved neural structures. The literature is reviewed and the clinical and radiological features of lumbar nerve root anomalies are discussed from a neurosurgical perspective.

Introduction

Lumbosacral Nerve Root Anomalies (LNRA) is congenital anomalies that may consist of bifid, conjoined, of a transverse course or of anastomosed nerve roots. It is believed that the development of an anomalous nerve root is secondary to aberrant migration of the involved roots during embryologic development [1]. Firstly, encountered as incidental findings during autopsies they are more frequently described in the last years due to the advances in radiological imaging, especially magnetic resonance imaging (MRI) [2,3]. Nevertheless, most of LNRA cases are still diagnosed during spinal surgery for degenerative spinal lesions only [1,4-6]. The literature demonstrates that LNRA are frequently un- or misdiagnosed when relying on standard spinal imaging. In the present report we describe a case of a patient with unilateral lumbar radiculopathy misdiagnosed with a lumbosacral disc herniation on magnetic resonance imaging. During surgery a rare Neidre/MacNab type 2b lumbar nerve root anomaly rather than a disc herniation was verified, which required a wide decompression of the involved neural structures, instead of a microdiscectomy. In an attempt to enhance the awareness of LNRA, the literature is carefully reviewed and the clinical relevance and radiological features of LNRA are discussed from a neurosurgical perspective.

Case Report

Initial presentation

The patient was an 82-year-old woman with a 6-months history of neurogenic claudication involving the left lower extremity. Oral and intravenous analgesics provided no long-lasting benefit. Neurological examination revealed the absence of any sensory or motor deficit and a left-sided positive straight leg raising sign at 30°. A standard MRI of the lumbar spine (Figure 1B-D) demonstrated a cranially migrated lumbosacral disc herniation with signs of a left-sided L5 nerve root compression. The MRI was reviewed by a neuroradiologist and two neurosurgeons. No suspicion of a LNRA was raised. Due to these radiological findings and the corresponding therapy-refractory radicular pain a lumbosacral microdiscectomy was indicated.

Operation

The patient was positioned prone in general anesthesia and the lumbosacral level was marked after fluoroscopic level identification. After midline skin incision a small left-sided interlaminar fenestration was performed. The yellow ligament was removed and the thecal sac and the left S1 nerve root were identified mobilized and carefully retracted medially slightly cranial to the level of the lumbosacral intervertebral disc. The posterior longitudinal ligament was identified but no subligamentous or epidural herniated disc could be found. Correct level of surgery was checked at this stage using fluoroscopy. Inspection of the thecal sac above the level of the lumbosacral intervertebral disc revealed a nerve root in an anatomically abnormal location exiting the thecal sac at its ventral aspect. This accessory nerve root was thinner in diameter compared to a normal lumbar nerve root and had a nodular shape. Therefore, a left-sided hemilaminectomy L5 was performed

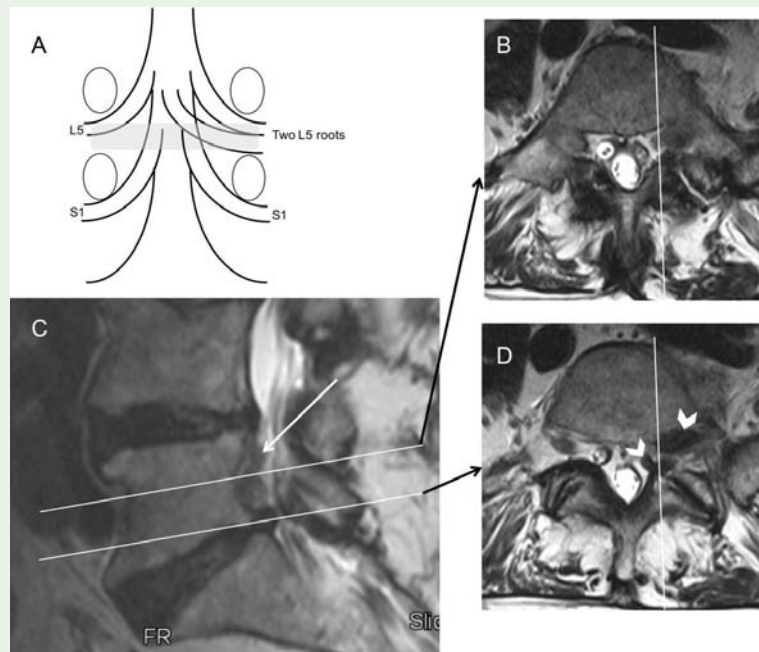


Figure 1: Illustration of a lumbar nerve root anomaly mimicking a lumbar disc herniation on magnetic resonance imaging (MRI).

A: Scheme of a nerve root anomaly at the lumbosacral level encountered during microsurgery for a supposed left-sided lumbosacral disc herniation. Contrary to a disc herniation an accessory L5 nerve root originating caudo-ventrally from an anatomically normal L5 nerve root was found. Both nerve roots exited the spinal canal through the left lumbosacral neuroforamen C: Sagittal T2-weighted MRI of the lower lumbar spine suggesting a cranially migrated lumbar disc herniation (white arrow) at the lumbosacral level. B,D: Corresponding transversal T2-weighted MRI also suggesting a disc herniation compressing the left nerve roots L5 and S1 (white arrow heads).

to gain a more extensive vision of the thecal sac and the normal left nerve root L5, which exited the thecal sac at a normal anatomical site and angle. The intraoperative findings are illustrated in the scheme of (Figure 1A). The thecal sac and both L5 nerve roots were carefully unroofed along their entire course through the spinal canal to the foramen. Both L5 nerve roots exited the spinal canal through the left-sided lumbosacral foramen. At the end of the decompression there were no signs of remnant spinal canal stenosis. The operation was completed without any complications.

Postoperative Course

In the postoperative course the left-sided radicular pain subsided immediately and the patient was able to walk normally again without any neurologic deficits. On the fifth postoperative day the patient developed a symptomatic deep venous thrombosis in both shanks which required anticoagulation. There were no further postoperative complications or complaints in a 6-months follow-up period. The patient has given her informed consent to publication of her case.

Discussion

Given that the current knowledge about LNRA is derived from diverse small surgical series on the one hand, and comparably large radiological cohorts on the other hand, the frequency of LNRA between the different reports varies significantly. In a retrospective analysis of 376 patients who underwent lumbar spine MRI for low back pain and/or radicular pain, LNRA were found in 17.3% of the cases [7]. Conversely, a LNRA frequency of only 2% was found in a series of 2123 patients undergoing lumbar myelography in the pre MRI era [8]. 35 of 5000 consecutive patients (0.7%) exhibited

LNRA in a large surgical series that was evaluated retrospectively [9]. In a more recent report of a patient cohort undergoing lumbar microdiscectomy conjoined nerve roots were encountered in 5.8%, mainly involving the S1 nerve root (69%), followed by the L5 nerve root (31%) [10]. another surgical series demonstrated a similar conjoined nerve root frequency in 5% of the cases [1]. Given that, it is commonly agreed upon that LNRA are frequently under recognized regardless of the advances in imaging studies and that they are also underappreciated and underreported when encountered surgically [3,11].

Most commonly, LNRA are classified with the Neidre/MacNab classification first published in 1983 [12]. They divided LNRA in three main types and subtypes according to the way the nerve roots exit the dura and the spinal canal. This is illustrated in Figure 2. Figure 2 also shows a fourth type of LNRA (four in brackets), that was not described in the original publication by Neidre et al., but was more recently suggested as a fourth LNRA entity by Burke et al [13] where a confluent nerve root exits the foramen with 2 contributions from two adjacent nerve roots arising from the thecal sac separately. In our case we have incidentally found a very rare Neidre/MacNab 2b anomaly with two separate left L5 nerve roots exiting the left lumbosacral neuroforamen. Further intraoperative inspection revealed that all foramen were occupied with nerve roots, which excluded a more common Neidre/MacNab 2a anomaly.

Due to their unusual anatomical course, accessory nerve roots in LNRA can be damaged during lumbar disc surgery and lead to neuropathic pain due to excessive retraction. In our case we incidentally encountered a more medially located double root which

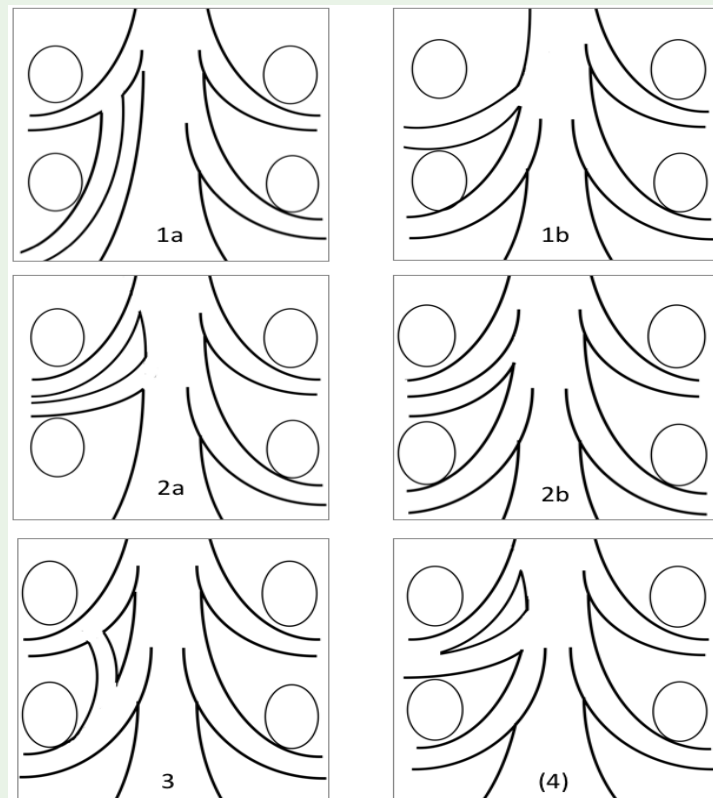


Figure 2: Classification of lumbar nerve root anomalies (LNRA) by Neidre and MacNab including a fourth type of LNRA described by Burke et al. Congenital nerve anomalies were divided into three types and then subdivided according to the manner in which they exited the dura. In type 1a, the two nerve roots arise from a common dural sheath. The cranial nerve root component departs the conjoined nerve root at an acute angle and passes below its respective pedicle. The inferior nerve root component travels inferiorly within the canal and exists below the caudal pedicle. In type 1B, the cranial nerve root exits at a 90° angle from the conjoined nerve root. In type 2 anomalies, two separate nerve roots exit through one foramen. This leaves one foramen unoccupied in type 2a anomalies or all foramina occupied by exiting nerve roots as it is the case in type 2b anomalies. In the type 3 anomaly adjacent nerve roots are connected by a vertical connecting anastomotic segment. In a more recently reported fourth LNRA published by Burke et al. a confluent nerve root with 2 contributions from two adjacent nerve roots arising from the thecal sac coalescing to form a single nerve root that exits the foramen.

was obviously thinner in diameter than a normal nerve root and exited the thecal sac in a sharper angle than normally. These findings are in concordance with a recent publication by Halil et al. [5]. They identified 21 patients harboring conjoined nerve roots in a series of 612 lumbar disc cases. They found that more medially located roots were significantly thinner and exited at a smaller angle than laterally located nerve roots. They concluded that the presence of a more medially located or thinner root during surgical exploration and the absence of the fragment in the axilla in extruded or sequestered discs usually indicate a conjoined nerve root closer to the pedicle. In the above reported case we have found a similar situation with no disc fragments at all. Forced manipulation at the ventral aspect of the thecal sac could have caused severe injury to the accessory nerve root in this situation. Due to the unusual size at attachment of nerve roots involved in LNRA the effects of compression and entrapment are amplified in the presence of even mild forms of stenosis or disc herniation [4]. LNRA may even producesymptoms of a radiculopathy in the absence of mechanical impingement as it was the case in the present report [1]. This leads to significantly higher frequencies of unfavorable postoperative outcomes. White et al. [14] found only 30% good results in 63 cases of surgically confirmed conjoined nerve roots following hemilaminectomy, pediculectomy, and discectomy in

patients with lumbar disc disease. Interestingly, another study [15] showed that postoperative outcome can be significantly improved when the LNRA is known preoperatively. In their cohort they found a success rate of 65%. Outcome was further improved with an 80% success rate in cases of concurrent disc herniations.

Preoperative clinical diagnosis of LNRA seems hardly possible due to the absence of distinct pathognomonic signs. Taghipour et al. [16] studied the clinical signs and symptoms of patients harboring conjoined nerve roots. They found that 15 of 22 patients (68%) exhibited signs and symptoms incompatible with the underlying pathology found in MRI. They concluded that in these cases the conjoined roots have probably contributed to the incompatible signs and symptoms and argue that twin dermatomal involvements in addition to a negative Lasegue sign are clues to the diagnosis of a conjoined nerve root anomaly. In the presented case we did not identify incompatible clinical signs and found a positive Lasegue sign.

MRI represents the current gold standard for the diagnosis of LNRA. T2-weighted coronal MRI is the best method for tracking the course of an abnormal nerve roots similar to myelography [3,11]. Unfortunately, coronal lumbar spine studies are not performed on a routine basis. Song et al. [17] performed a thorough retrospective

analysis of the MRI of three patients harboring lumbar conjoined nerve roots. They identified three radiological signs (corner, fat crescent and parallel sign) suggestive for conjoined nerve roots and tested these signs in a prospective cohort. They found the signs in 50% to 100% of conjoined nerve root cases and concluded that the signs found on routine lumbar spine MRI are suggestive and assist in the recognition of conjoined nerve roots.

Conclusion

LNRA are still frequently under recognized regardless of the advances in imaging studies and they are also underappreciated when encountered surgically. Preoperative diagnosis of LNRA significantly improves postoperative outcome. Therefore, future studies are warranted to drive further advances in radiological imaging and enhance the preoperative diagnosis of LNRA.

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