



Research Article

Redundant Nerve Root Syndrome of Cauda Equina

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Summary

Objective: Recognizing cauda equina redundant nerve root syndrome is crucial before surgery. Magnetic resonance imaging (MRI) findings of this condition are demonstrated. The aim of this study is to identify patients with redundant nerve root syndrome (RNS), well demonstrate (MRI) findings, notify the surgeon before the surgery and therefore to prevent a potential catastrophe.

Methods: Ten patients (age range 59-87; mean age 74; 5 males and 5 females) with clinical symptoms of back pain, progressive leg numbness, pain and paresthesia on lower sensory dermatomes were diagnosed as redundant nerve root syndrome of cauda equina by MRI and clinical findings in our institution in two years prospective evaluation. In the same time period, 575 lumbar MRI was performed for patients who presented with low back pain in our clinic.

Results: Magnetic resonance imaging findings revealed severe extradural lumbar spinal canal stenosis and tortuous, elongated, enlarged nerve roots in all ten patients with redundant nerve root syndrome of cauda equina.

Conclusions: Severe extradural lumbar spinal stenosis may represent itself with large, elongated and tortuous nerve roots. This is probably secondary to acquired elongation of nerve roots due to mechanical trapping at the level of lumbar spinal stenosis. Cause is possibly a squeezing force due to chronic compression. Magnetic resonance imaging and MR myelography findings of several redundant nerve root syndrome of cauda equina cases are presented with clinical impression in this study.

Key words: Nerve root, spinal stenosis, magnetic resonance imaging

Kauda Equina Redundant Sinir Kökü Sendromu

Özet

Amaç: Kauda equina redundant sinir kökü sendromunu cerrahiyi yapmadan önce tanımak ve cerrahiyi önceden planlamak son derece önemlidir. On vakalık serimizde bu sendromun önemi ve manyetik rezonans görüntüleme bulguları sunulmuştur.

Yöntem: Bel ağrısı, ilerleyici bacak hissizliği, alt duyu dermatomlarında parestezi ve ağrı şikayetleri olan, kauda equina redundant sinir kökü sendromu klinik ve görüntüleme bulguları ile incelenen 10 hasta (yaş aralığı 59-87, ortalama yaş 74, 5 erkek, 5 bayan) hastanemizde 2 sene prospektif çalışma sonucunda değerlendirildi. Aynı zaman diliminde hastanemize bel ağrısı ile başvuran hastalara 575 lumbar MR yapıldı.

Bulgular: Manyetik rezonans görüntüleme sonuçları, ciddi ekstradural lumbar spinal kanal stenozu, gevşek, sarkık sinir kökleriyle karakterize olarak 10 hastanın hepsinde redundant sinir kökü kauda equina sendromu bulgularını gösterdi.

Sonuç: Ciddi ekstradural lumbar spinal stenozu geniş, uzamış, sarkık ve gevşek sinir kökleri şeklinde kendini gösterebilir. Bu muhtemelen sonradan edinilmiş olarak sinir köklerinin lumbar spinal kanal stenozu seviyesinde uzun süreli mekanik basıya uğrayıp sıkışmaları

sonucunda oluşur. Araştırmamızda redundant sinir kökü kauda equina sendromunun klinik önemi, manyetik rezonans görüntüleme ve MR myelografi bulguları sunuldu.

Anahtar Kelimeler: Sinir koku, spinal daralma, manyetik rezonans görüntüleme

INTRODUCTION

Redundant nerve root syndrome of cauda equina is not as rare as it is thought or mentioned in the literature^(2,4). Recognition of this entity is important because redundant and tortuous nerves may cause unpleasant surprise for the surgeon if not well prepared for the condition. During the operation, pieces of thick and elongated nerves suddenly may herniate through a small dural tear and replacement may not be possible.

Duraplasty might be necessary for repair. Patients recover faster if this situation is well known and the operation team is prepared previously⁽²⁾. The aim of this study is to identify the patients with redundant nerve root syndrome (RNS), well demonstrate magnetic resonance imaging (MRI) findings, notify the surgeon and make it possible for him/her to prepare the surgery team before the intervention. If surgeon operates the patient with this condition without recognizing it, he or she may face with a catastrophic situation during the surgery. In patients with lumbar stenosis, iatrogenic dural tear is a potential complication. If dural tear occurs and if RNS is present tortuous, elongated and enlarged nerve roots exit through the defect. Replacement of the nerve roots back through the defect could not be possible. Wide duraplasty may be necessary. Materials for this kind of unexpected situation should be prepared beforehand. Therefore understanding the redundant nerve root syndrome and preparing the team for a potential situation are essential.

Magnetic resonance imaging of the lumbar spine is useful for demonstrating degenerative high grade spinal stenosis of redundant nerve roots as thick, elongated, long and tortuous signals similar to that of

nerve roots in the cauda equina. MR imaging demonstration of redundant nerve root syndrome is important since it reveals clinical significance. MR myelography images are also well demonstrated in our study. MR myelography is a noninvasive technique that can be performed with lack of ionizing radiation and lack of need for intrathecal contrast material and providing anatomic information about the subarachnoid space. Literature rarely discusses redundant nerve root syndrome of cauda equina. Invasive myelography images are well shown in previous articles^(1,3) however depending to our research it is found that MR myelography of this syndrome is not studied in detail.

Clinical symptoms are usually low back pain, progressive leg numbness, pain and paresthesia on lower sensory dermatomes. Treatment is decompressive laminectomy.

MATERIAL AND METHODS

Ten patients (age range 59-87; mean age 74; 5 males and 5 females) with clinical symptoms of back pain, progressive leg numbness, pain and paresthesia on lower sensory dermatomes were diagnosed as redundant nerve root syndrome of cauda equina by MRI and clinical findings in our institution in two years prospective evaluation. None of the patients had urinary incontinence. All of these patients had degenerative lumbar spinal canal stenosis, concomitant disk disease and most of them had grade 1 degenerative spondylolisthesis. In the same time period 575 lumbar MRI examinations were performed for patients who presented with low back pain in our clinic. Mean duration of neurological symptoms was 20 months (from 5 to 44 months). Patients were evaluated for low back pain, leg pain or tingling, ability to walk, capability for walking distance, straight leg raising test, sensory and motor disturbance, restriction

of daily activities and urinary bladder function.

We did not perform conventional fluoroscopic myelography. Instead MR myelogram with heavily T2 weighted images was performed. MR imaging of the lumbar spine was performed with a 1.5 Tesla imager (Avanto, Siemens Medical Solutions, Erlangen, Germany). Imaging protocol included sagittal T1, sagittal T2, coronal T2, axial T1 and T2.

RESULTS

Magnetic resonance imaging findings revealed severe extradural lumbar spinal

canal stenosis and tortuous nerve roots in all ten patients. Most patients (60%) also had degenerative grade1 spondylolisthesis.

Sagittal, particularly T2 weighted MR images are found characteristic to demonstrate findings.

Figure 1a. Sagittal T2 weighted image

Figure 1b. Coronal T2 weighted image

Figure 1c. Axial T2 weighted image

Figure 2a. Single slice MR myelography

Figure 2b. Multislice MR myelogram

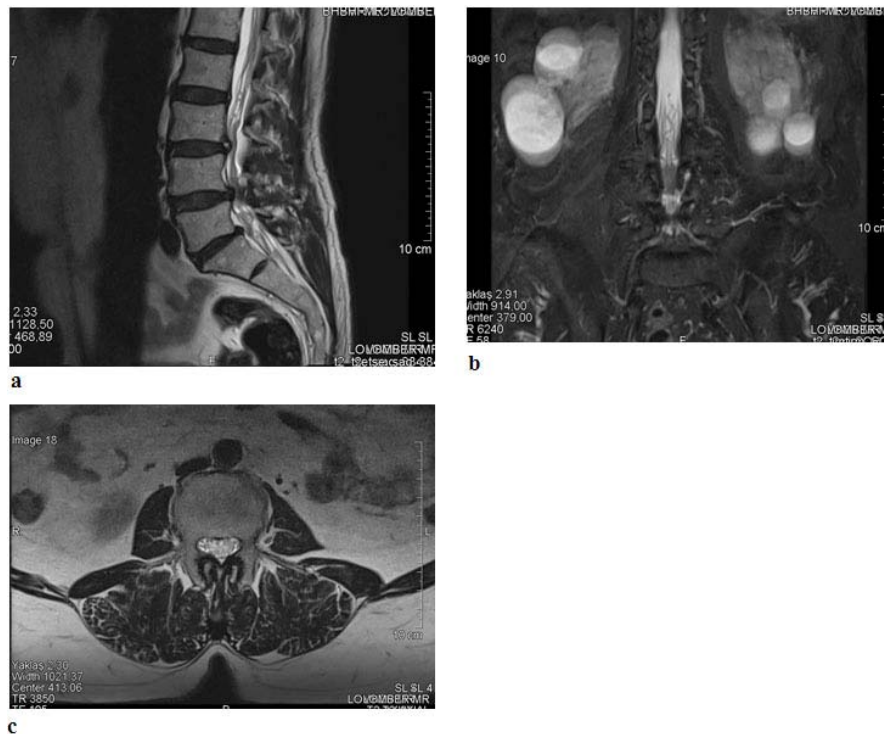


Figure 1a: Sagittal T2, **Figure 1b.** Coronal T2, **Figure 1c.** Axial T2 weighted images. Lumbar spinal levels for the lesion are between L2 through L5 in our series. Wave like deformity with diffuse stenosis of thecal sac and band like filling defects, tortuous, enlarged, elongated, coiled nerve roots indicating redundant nerve roots of cauda equina.

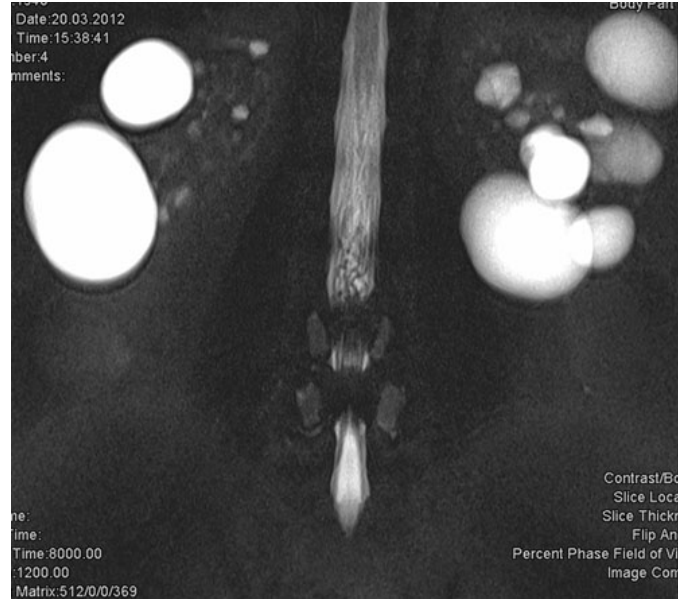


Figure 2a: Single slice MR myelogram. MR myelography shows loop shaped redundant nerve roots by which a sign for intensity of the severe degenerative spinal stenosis is seen. Redundant nerve roots are well demonstrated on the cephalic side of the block.



Figure 2b: Multislice MR myelogram. Single slice image shows band like filling defects or wave like deformity on the thecal sac by extrinsic compression better than the multislice MR myelogram.

Single thick slice MR myelography takes a few seconds and provides a projection image with excellent suppression of background signal. Single shot turbo spin echo sequence with extremely long effective TE is used. An inversion pulse is applied to completely suppress the fat signal.

Single slice MR myelogram provided better signal contrast, high spatial resolution, less artifact arising from CSF than seen on multislice MR myelography. We chose to place single slice MR myelogram images in this study although we performed both methods. Complete or partial block and spinal stenosis are well demonstrated. Redundant nerve roots were well seen on the cephalic side of the block⁽³⁾.

Multi slice technique takes approximately 6 minutes to scan the patient. Since multislice technique is relatively long, image quality is degraded by artifacts arising from cerebrospinal fluid pulsatile flow and background signal contributed by fat or paravertebral veins. On the other hand degree of the spinal stenosis can be overestimated on single slice MR myelography because of relatively low signal to noise ratio.

DISCUSSION

Redundant nerve root syndrome of cauda equina is associated with severe extradural lumbar stenosis^(3,4,5,6,7). It represents itself with thickened, large, tortuous and elongated nerve roots. This syndrome is possibly secondary to continuous pressure on the nerve roots at the site of lumbar spinal canal stenosis. In our ten-case-study patients' symptoms such as low back pain, progressive leg numbness, pain and paresthesia on lower sensory dermatomes were secondary to high grade lumbar spinal stenosis and lumbar disc herniation.

All of our ten patients were older than 59 years with mean age 74. In the literature it is mentioned that the disorder is usually

found in older patients. This suggests that redundant nerve root configuration requires a long disease time to form degenerative spinal stenosis. Long duration of spinal lumbar spondylosis and degenerative spinal canal stenosis are the primary issues for the configuration of elongated and tortuous, redundant nerve roots. 575 lumbar MRI examination was performed and ten cases of redundant nerve root syndrome of cauda equina were prospectively detected in two years in our institution. This is somewhat close to findings (2%) of the literature⁽¹⁾. Literature also suggests that heavy laboring is related with this disease. In our ten-patient-study all patients were exposed to heavy laboring either professionally or as a result of their hobbies.

Myelographic features were defined as severe extradural blocks associated with lumbar spinal stenosis and multiple filling defects above the block due to serpiginous elongated nerve roots^(3,4). Myelographic appearance is not specific and might be confusing since these filling defects might suggest the possibility of tumor, an arteriovenous malformation or dilated tortuous veins due to other causes^(2,3).

MR imaging and MR myelography have the capability to well demonstrate the cauda equina nerve roots. Redundant nerve root syndrome of cauda equina can be correctly diagnosed by MRI examinations which represent important clinical findings preoperatively⁽⁶⁾. Characteristic MR imaging and MR myelography findings of this syndrome rather than fluoroscopic myelography are only a few in the literature. Emphasizing clinical significance and raising consciousness for a possible catastrophe during the operation of RNR syndrome if surgeon is unaware of the condition before the intervention are of great importance. Min⁽⁴⁾ and Ono⁽⁶⁾ claim that the results of the operations of lumbar canal stenosis with cauda equina redundant nerve root syndrome are slightly worse

compared to the operative results of lumbar canal stenosis without redundant nerves. Planning of surgery and preparation for potential duraplasty are extremely critical. Lumbar canal stenosis itself is a possible risk for dura tear. If there is redundant nerve root syndrome enlarged, tortuous, elongated nerve roots may exit through the defect and replacement could not be possible. In this case surgery regimen will be different. Recognizing of cauda equina redundant nerve root syndrome, preparing the team, materials for this possible unpleasant and surgically difficult situation are therefore crucial.

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