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Symptomatic and asymptomatic abnormalities in patients with lumbosacral radicular syndrome: Clinical examination compared with MRI

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Abstract

Objective: To determine the frequency of symptomatic and asymptomatic herniated discs and root compression in patients with lumbosacral radicular syndrome (LRS) and to correlate clinical localization with MRI findings.

Methods: Fifty-seven patients with unilateral LRS were included in the study. Using the visual analogue scale, two physicians independently localized the most likely lumbar level of complaints. These clinical predictions of localizations were correlated with the MRI findings.

Results: MRI showed abnormalities on the symptomatic side in 42 of 57 patients (74%). In 30% of the patients, MRI confirmed an abnormality at the exact same level as determined after clinical examination. On the asymptomatic side, MRI showed abnormalities in 19 of 57 patients (33%), 13 (23%) of these patients had asymptomatic root compression.

Conclusions: In more than two-thirds of the patients with unilateral LRS there was no exact match between the level predicted by clinical examination and MRI findings. These discrepancies complicate the decision whether or not to operate.

Keywords: Herniated disc; Magnetic resonance imaging; Neurologic examination

1. Introduction

The most frequent cause of lumbosacral radicular syndrome (LRS) is nerve root compression by a herniated disc [1]. Root compression can also be caused by surrounding structures (e.g. degenerative stenosis of root canal or spinal canal, spondylolisthesis) or other less frequent pathological conditions (malignancies, infections or chemical irritation) [2–4]. To evaluate the lumbar region, MRI is the investigation of choice [5–7].

The back, however, is notorious for a high prevalence of asymptomatic abnormalities. Asymptomatic herniated discs are a common finding in the normal population (25%) and therefore it is assumed that within symptomatic patients a substantial number of herniated discs are asymptomatic too [8,9]. Besides herniated discs, other abnormalities in the back detected by MRI may also be asymptomatic [4,10–12].

To facilitate the distinction between symptomatic and asymptomatic lesions, the ability of current MRI to visualize the nerve root is considered helpful. However, MRI alone is not enough to retrieve the cause of LRS. Comparing clinical signs and symptoms with MRI-findings remains essential to determine which of the MRI-detected abnormalities are symptomatic and thus, to determine whether patients are eligible for surgical intervention [11,13].

A complicating factor within the diagnostic work-up of patients with back pain is the reliability of clinical examina-

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tion [14–16]. Previous myelography-based studies on clinical localization of herniated discs concluded that – especially in the lower lumbar levels – clinical localization is not reliable [17–19]. In 1999, a large systematic review on the value of individual items of clinical examination showed that no item of history or physical examination is highly accurate by itself [20]. It was suggested that a combination of items of history and physical examination could improve the reliability of clinical examination, but currently there are no studies supporting this conclusion. The relevance of the available evidence is also limited because of heterogeneous patient selection methods and the use of outdated imaging techniques.

The purpose of this study was to determine the frequency of symptomatic and asymptomatic herniated discs and root compression in a prospective cohort of patients with unilateral lumbosacral radicular syndrome. We also evaluated the reliability of clinical localization by comparing it with MRI findings. Clinical localization was based on a summary measure (visual analogue scale) in which all items of history and physical examination were combined. We performed an inter-observer analysis to validate this summary measure.

2. Materials and methods

We performed a prospective study between June 1999 and June 2000 as part of a larger project on the diagnostic process of patients with lumbosacral radicular pain at the Academic Medical Center, Amsterdam University.

Patients were recruited from the neurology outpatient department. Eligible were patients referred by their general practitioner with lumbosacral radicular syndrome (LRS) with suspected disc herniation at the levels L3-L4, L4-L5 or L5-S1 in whom conservative treatment was unsuccessful. LRS was defined according to the national general practitioner's guideline and the consensus statement on diagnostics and treatment of LRS defined by the Dutch Neurological Society [21]. The hallmark of this definition is continuous mono- or multiradicular pain below the knee with a primary suspicion of disc herniation. After unsuccessful conservative treatment for at least four weeks, patients are considered potential candidates for surgery.

Patients younger than 18 years or older than 70 years, pregnant women, patients with a previous history of lumbosacral herniation or lumbosacral surgery, as well as patients with contraindication for MRI were excluded.

After the neurologist had confirmed the diagnosis of LRS, patients were subjected to MR imaging within one week and no specific treatment was given within this period. The Institutional Review Board approved the study protocol and written informed consent was obtained from all patients.

2.1. Imaging technique

Lumbar MR examinations were performed with a 1.5 T Signa LX Scanner (General Electric Medical Systems, Milwaukee, USA) using a dedicated lumbar spine surface coil. The protocol included sagittal spin-echo T1-weighted (TR 500 ms, TE 14 ms) and proton density/T2-weighted (TR 3500, TE 120-20) fast spin-echo images with 4 mm slice thickness, 0.5 mm intersection gap, 200×512 matrix and $29\,cm \times 29\,cm$ field of view. In addition, axial spin-echo T1-weighted (TR520 TE 12) and fast spin-echo T2-weighted (TR 4500, TE 120) images were obtained from the level of L3 to the bottom of S1 with 4 mm slice thickness, 0.5 mm intersection gap, 200×256 matrix and $15\,cm \times 15\,cm$ field of view. Axial images were obtained without angulation. Finally, heavily T2-weighted (TR 5000, TE 252) spin-echo oblique MR myelography was performed with two slices of 20 mm thickness, 250×220 matrix and $16\,cm \times 16\,cm$ field of view.

2.2. Data collection

Patients were examined at the outpatient department of Neurology. Attending physicians collected their findings of history and physical examination on a standard form before MRI was performed. A research fellow (N.K.) extracted a case report from each standard form. Two experienced clinicians, a neurologist (J.S., observer1) and a neurosurgeon (W.C.P., observer2), independently reviewed the case reports without knowledge of the MRI results.

They estimated the probability of a disc herniation based on these case reports using a visual analogue scale (VAS). This VAS score could range from 0, indicating 'no herniated disc' to 10, indicating a herniated disc [22]. The lumbar levels L3-L4, L4-L5 and L5-S1 were evaluated on both sides, resulting into six VAS-predictions per patient.

2.3. Image evaluation

Two experienced neuroradiologists (C.B.L.M.M. and F.J.H.) independently evaluated all MR images blinded for clinical information. The radiologists made no use of the MR myelography results. The images were presented per patient in a random order. Each disc was scored for the presence of a herniation and root compression. Discrepancies between the two readers were re-evaluated by a panel (G.J.dH., C.B.L.M.M.) to determine the final MRI-diagnosis.

2.4. Data analysis

In the analysis, we differentiated between lesions detected on the symptomatic side and lesions detected on the asymptomatic side.

The level with the highest VAS-score within each patient was selected as the predicted clinical level. Observer variability in clinical localization was assessed by calculating the proportion of full agreement and the kappa-statistic. To evaluate the reliability of clinical localization, we calculated the proportion of patients in whom a lesion was detected by MRI at the predicted clinical level.

In addition, we examined whether the quality of clinical localization was different between herniated discs, root compression and herniated discs with compression of the accompanying nerve root. Differences in the proportion correctly localized lesions were tested using the chi-square statistic. P-values < 0.05 were considered statistically significant.

3. Results

Sixty-four consecutive eligible patients with lumbosacral radicular syndrome (LRS) were identified within the study period. Three patients could not undergo MRI because of claustrophobia. Two more patients were excluded because their data were incomplete, leaving 59 patients with complete records. Two patients had bilateral LRS. In the remaining 57 patients, both clinicians agreed that symptoms were unilateral (mono- or multiradicular) as signified by VAS scores of zero on all three contralateral lumbar levels. We limited our analysis to this group. Thirty-four patients had left-sided LRS and 23 had right-sided LRS.

MRI detected a total of 113 lesions consisting of 57 herniated discs and 56 compressed roots in 50 of 57 patients (88%). Seven patients had no lesions on the symptomatic side nor on the asymptomatic side.

3.1. Symptomatic side

Forty-nine patients (86%) presented with complaints attributable to 2 or 3 lumbar levels: 31 (54%) had signs and symptoms of 2 and 18 (32%) of 3 lumbar levels. In 8 out of 57 patients (14%) the clinicians agreed that the complaints were attributable to a single lumbar level.

The inter-observer agreement of the prediction of the most likely level of herniation (based on the highest VAS-score within each patient) was good. The two observers agreed on the same level in 86% (49/57) of the patients, leading to a kappa of 0.78 (95% confidence interval: 0.64–0.92). Table 1 shows the cross-classification of the predicted lumbar levels in each patient from both observers.

Table 2
Proportions of MRI lesions at the symptomatic side in which the level was correctly predicted by clinical examination

	HNP ($N=42$)	RC ($N=42$)	HNP + RC ($N=32$)
Observer1	38[a] (16)	33[a] (14)	38[a] (12)
Observer2	43[a] (18)	33[a] (14)	38[a] (12)

Note: HNP, hernia nuclei pulposi; RC, root compression HNP + RC, herniated disc with root compression of the accompanying nerve root. The quality of prediction did not differ between groups (Chi-square: all P-values $\gg 0.05$). Results stratified by type of MRI abnormality.

[a] Values are percentages.

MRI identified 84 lesions consisting of 42 herniated discs and 42 compressed nerve roots on the symptomatic side in 42 of 57 patients (74%) Correlating the clinical localization with the level of MRI-findings revealed that the prediction of both clinicians was exactly right in only 30% of the patients (fourth column of Table 1). In the remaining patients, either no MRI abnormality was found ($N=15$) at the predicted level or an abnormality was identified at a level higher or lower than predicted ($N=22$ for observer1 and $N=24$ for observer2).

We found no evidence that the quality of clinical prediction varied between the different types of abnormalities. Table 2 shows the MRI results stratified by type of lesion. The percentages represent the proportion correctly predicted lesions by the observers. The differences between the proportions were not statistically significant for both observers (observer1: herniated discs (HNP) versus root compression (RC) $p=0.66$ and HNP versus HNP + RC $p=0.96$; observer2: HNP versus RC $p=0.37$ and HNP versus HNP + RC $p=0.64$).

3.2. Asymptomatic side

We found asymptomatic herniated discs in 26% (15/57) of our patients. A total of 13 patients (23%) had signs of root compression on the MRI at the asymptomatic side. Of these 13 patients, the root compression was caused by spondylolisthesis in two cases and one patient had degenerative stenosis of the root canal of L4 and L5 on the asymptomatic side. In the remaining 10 cases, a herniated disc caused root compression.

Table 1
Inter-observer agreement of clinical level localization in 57 patients with unilateral LRS

	Observer1				
	L3-L4[a]	L4-L5[a]	L5-S1[a]	Total[a]	Confirmed by MRI[b]
Observer2					
L3-L4	9	2	0	11	1 (9)
L4-L5	1	16	2	19	3 (16)
L5-S1	0	3	24	27	14 (52)
Total	10	21	26	57	18 (32)
Confirmed by MRI[b]	1 (10)	3 (14)	12 (46)	16 (28)	

Note: Full agreement on the predicted level was 86% (49/57); Kappa = 0.78. Values in parentheses are percentages.

[a] Perdicted clinical level.

[b] Proportion of cases in which MRI detected a herniated disc or root compression on the exact same level as predicted after clinical examination.

Four of these patients also had a second herniated disc with root compression on the symptomatic side. In three patients, a relatively large herniated disc compressed both the right-sided and the left-sided nerve root, but causing symptoms only on one side. There were four patients with a herniated disc with root compression on the asymptomatic side without additional anatomical or systemic pathology.

4. Discussion

In this study, we matched signs and symptoms of clinical examination with MRI findings in patients with lumbosacral radicular syndrome (LRS). The frequency of symptomatic findings was high, but in more than two-thirds of the patients the level of signs and symptoms did not exactly correlate with the MRI-results. We also observed a high frequency of asymptomatic herniated discs with root compression.

All patients in our study were included as potential candidates for surgery. In line with the recommendation from the multidisciplinary guideline for the management of LRS, all patients underwent MR imaging [23]. However, in only one-third of the patients there was an exact match between the predicted level after clinical examination and the MRI findings. In these 'straightforward cases' referral to a neurosurgeon seems appropriate.

This means that in the majority of cases, there was a discrepancy between the clinical predictions and the MRI results indicating that no MRI abnormality was found at the level with the highest VAS-score. In most of these patients, an abnormality was detected by MRI at another lumbar level with a lower clinical VAS-score, indicating less severe signs and symptoms. In these patients, the decision on whether to surgically intervene becomes complicated because there is less certainty with respect to the clinical significance of the MRI abnormalities.

The available studies on the value of clinical examination in patients suspected of herniated discs agreed that no symptom or sign from either history or physical examination is highly accurate in isolation. A combination of individual items from history and physical examination, however, might lead to better discrimination between patients with and without herniation [16,20,24]. An advantage of using the VAS-score was that the clinicians were allowed to incorporate all items of history and physical examination in their prediction. Using this method, the inter-observer agreement for clinical localization was good. Still, there were eight cases in which the observers disagreed on the most likely lumbar level of a possible symptomatic herniated disc. In these cases, the MRI showed no lesion in four cases. In the remaining four cases, both observers correctly predicted the level of a herniated disc once in two separate cases. In patients in whom experienced physicians disagree on the significance of an MRI-confirmed herniated disc, the possible causes of the discordance should be evaluated before the patient can be considered a candidate for surgery.

We used the VAS-score not only to determine the predicted level of an abnormality, but also to allow the observers to express their uncertainty. In previous studies on level localization, uncertainty about the lumbar level of LRS was not an issue because patients with multiradicular symptoms were excluded. [17–19]. In our prospective clinical cohort, all patients with signs and symptoms of LRS were included. Because the majority of patients with LRS have complaints attributable to more than one lumbar level, there was considerable uncertainty about the most likely level of a herniated disc in our study. This did, however, not explain the poor correlation with MRI because in the cases in which the observers indicated to be very certain about the clinical level, the correlation with MRI was as poor as in the other cases.

The use of MR-myelography and neurophysiological examinations was beyond the scope of our study. More prospective studies are needed to evaluate the value of additional diagnostic techniques and to clarify and standardize the full diagnostic work-up and surgical triage of patients with radicular pain. With respect to MRI, the focus should also be on alternative parameters to objectify signs and symptoms, like atrophy or edema of muscles or fatty degeneration in the symptomatic region.

4.1. Recommendations

When comparing clinical examination with the MRI results in patient with LRS, physicians should be aware that not only herniated discs but also root compression indicated by MRI might be asymptomatic.

Determining the clinical relevance of MRI-confirmed lesions on the symptomatic side is susceptible to miss-interpretation because clinical localization does not correlate with the imaging results in a substantial number of patients. As long as the neurological examination is unreliable and the clinical significance of MRI-detected abnormalities is not thoroughly investigated, physicians will not be able to get to a clear-cut diagnosis in many patients with radicular symptoms. We believe that patients in whom the signs and symptoms do not exactly match the MRI-results should be re-evaluated before considering surgery.

References

[1] Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. Ann Intern Med 2002;137:586–97.
[2] Pfirmann CWA, Dora C, Schmid MR, Zanetti M, Hodler J, Boos N. MR image-based grading of lumbar nerve root compromise due to disk herniation: reliability study with surgical correlation. Radiology 2004;230(2):583–8.
[3] Resnick D. Degenerative diseases of the vertebral column. Radiology 1985;156:3–14.
[4] Jinkins JR, Rauch A. Magnetic resonance imaging of entrapment of lumbar nerve roots in spondylolytic Spondylolisthesis. J Bone Joint Surg 1994;76-A(11):1643–8.
[5] Patel N. Surgical disorders of the thoracic and lumbar spine: a guide for neurologists. J Neurol Neurosurg Psychiatry 2002;73(Suppl 1):i42–8.

[6] Milette PC. Classification, diagnostic imaging, and imaging characterization of a lumbar herniated disk. Radiol Clin North Am 2000;38(6):1267–92.
[7] Herzog RJ. The radiologic assessment for a lumbar disc herniation. Spine 1996;21(24):19–38.
[8] Jensen MC, Brant-Zawadski MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic resonance imaging of the lumbar spine in people without back pain. NEJM 1994;331(2):69–73.
[9] Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic resonance scans of the lumbar spine in asymptomatic subjects. J Bone Joint Surg [Am] 1990;72:403–8.
[10] Humphreys SC, Hodges SD, Patwardhan A, Eck JC, Covington LA, Sartori M. The natural History of the cervical foramen in symptomatic and asymptomatic individuals aged 20–60 years as measured by magnetic resonance imaging. Spine 1998;23(20):2180–4.
[11] Borenstein DG, O'Mara JW, Boden SD, Lauerman WC, Jacobson A, Platenberg C, et al. The value of magnetic resonance imaging of the Lumbar Spine to predict low-back pain in asymptomatic subjects. J Bone Joint Surg 2001;83-A(9):1306–11.
[12] Nygaard O, Jacobsen EA, Solberg T, Kloster R, Dullerud R. Nerve root signs on postoperative Lumbar MR imaging. A prospective cohort study with contrast enhanced MRI in symptomatic and asymptomatic patients one year after microdiscectomy. Acta Neurochir (Wien) 1999;141:619–23.
[13] Herzog RJ, Ghanayem AJ, Guyer RD, Graham-Smith A, Simmons ED. Magnetic resonance imaging: use in patients with low back pain or radicular pain. Spine J 2003;3:6–10.
[14] Vroomen PC, De Krom MC, Wilmink JT, Kester AD, Knottnerus JA. Diagnostic value of history and physical examination in patients suspected of lumbosacral nerve root compression. JNNP 2002;72:630–4.
[15] Deyo RA, Rainville J, Kent DL. What can history and physical examination tell us about low back pain? JAMA 1992;268(6):760–5.
[16] Andersson GBJ, Deyo RA. History and physical examination in patients with herniated lumbar discs. SPINE 1996;21(24s):10s–8s.
[17] Kortelainen P, Puranen J, Koivisto E, Lahde S. Symptoms and signs of sciatica and their relation to the localization of the lumbar disc herniation. Spine 1985;10(1):88–92.
[18] Jensen OH. The level-diagnosis of alower lumbar disc herniation: the value of sensibility and motor testing. Clin Rheumatol 1987;6(4):564–9.
[19] Jensen OH. The medial hamstring reflex in the level-diagnosis of a lumbar disc herniation. Clin Rheumatol 1987;6(4):570–4.
[20] Vroomen PCAJ, De Krom MCTFM, Knottnerus JA. Diagnostic value of history and physical examination in patients suspected of sciatica due to disc herniation: a systematic review. J Neurol 1999;246:899–906.
[21] Stam J. Consensus on diagnosis and treatment of lumbosacral root entrapment syndromes. Ned Tijdschr Geneeskd 1996;140:52.
[22] Streiner DL, Norman GR. Health measurement scales. 3rd ed. Oxford University Press; 2003. p. 32–4.
[23] Luijsterburg PA, Verhagen AP, Braak S, Avezaat CJ, Koes BW. Do neurosurgeons subscribe to the guideline lumbosacral radicular syndrome? Clin Neurol Neurosurg 2004;106:313–7.
[24] Hoogen HM, Koes BW, van Eijk JT, Bouter LM. On the accuracy of history, physical examination, and erythrocyte sedimentation rate in diagnosing low back pain in general practice. A criteria-based review of the literature. Spine 1995;20(3):318–27.