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Original Article

Nerve Root Sedimentation Sign: A Potential Diagnosis of Symptomatic Lumbar Spinal Stenosis

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Abstract

Introduction: Nerve root sedimentation sign is natural sedimentation of lumbar nerve roots to the dorsal part of the dural sac seen on transverse MRI scans. This phenomenon can be taken advantage of to distinguish symptomatic lumbar spinal stenosis from nonspecific low back pain. We aimed to evaluate the clinical validity of the nerve root sedimentation sign to diagnose patients with symptomatic lumbar spinal stenosis who need surgical intervention.

Methods: In this study, 100 patients were surveyed referring to an Orthopedic Clinic with a chief complaint of chronic low back pain (LBP) for three months or more. Demographic information, physical examination, and lumbar MRI scans were obtained, then the patients were assigned to two groups of 50 patients in each namely Lumbar spinal stenosis (LSS) and LBP groups. The frequency of a positive sedimentation sign was compared between the two groups.

Results: The mean age of patients was 57.95±9.81 years, 61 of them were male, and the rest of the 39 subjects were female. Nerve root sedimentation sign was positive in 48 pts of the LSS group (96% Sensitivity) but none in the LBP group (100% specificity).

Conclusion: A positive sedimentation sign exclusively and reliably occurs in patients with lumbar spinal stenosis, suggesting its usefulness in clinical practice. Future studies are needed to address its sensitivity and specificity.

Keywords: Sedimentation sign, Lumbar spinal stenosis, Low back pain.

Introduction

Lumbar spinal stenosis (LSS) is one of the most common spine diseases among elders. Patients with LSS suffer from severe and increasing pain in the muscles of their hip and leg (one side or both) when standing or walking. This pain symptom is referred to as lumbar spinal stenosis that could be local or systemic and involve single or multiple areas of the spine [1]. This disorder can be classified anatomically and pathologically. The anatomical classification consists of various cervical, pectoral and lumbar disorders. The most prevalent area for spinal stenosis is the lumbar, followed by the cervical. LSS involves central, lateral Recess, foraminal and extraforaminal areas. Pathological arrangement includes traumatic, congenital, inflammatory, and metabolic types [2].

The most prevalent cause of the LSS is degenerative arthrosis that occurs due to variable difficulties such as Ankilozan Spondilit, intervertebral disc herniation, or primary osteoarthritis. Also, other reasons can be mentioned, including Achondroplasia, breakage associating lumbar stenosis, Kyphosis, Scoliosis, and Spondylolisthesis [3]. LSS indication occurs slowly and cryptically and intensive activities are aggravating. Approximately one-third of the patients complain about leg pain (radicular pain) while walking. Neurologic claudication of this type occurs fast and become worse by walking and does not go away by standing, but vascular claudication usually indicates after walking a distance and vanishes by standing. The clinical background of

the patients is beneficial for diagnosis. Mostly the patient is a middle-aged individual who suffers from severe and vague pain in one or both lower limbs after walking for 10-15 minutes. The pain increases continually and makes the patient sit in the end. To prevent the patient from sitting leads to walking in a bent position of the body. The relief would be obtained only when the patient sits or lies down. While sitting in the squatting or walking in a bent position, due to spine flexion, lumbar spinal diameter spreads lead to rebating or reclaiming the indications [3].

For LSS diagnosis, radiologic signs are not always accompanied by clinical indications. For instance, in some cases, radiologic signs are intensive, but the patient has a few or even without clinical symptoms. It seems another criterion is needed for diagnosis. Recently a remarkable indication was introduced to recognize the symptomatic LSS for surgical interventions. In this method, a cross-section transverse MRI scan in the supine position is taken naturally lumbar nerve roots in the dorsal part of the dural sac are sediment as a result of gravity, which is called the "Nerve root sedimentation sign." Not sediment lumbar nerve roots in the dorsal part are considered as "Positive sedimentation sign" [4]. This situation is only observed in the severe LSS and could serve as a crucial point for distinguishing symptomatic LSS from nonspecific LBP.

If it is possible to determine that this sign during LSS has a proper sensitivity and specificity, it could be beneficial as an appropriate indicator together with other diagnostic criteria for LSS. Thus, in this study, it was tried to evaluate the validity of the nerve root sedimentation sign to detect patients with symptomatic lumbar spinal stenosis who needed surgical intervention.

Methods

This study was an analytical cross-sectional survey applied on 100 patients in Baqiyatallah hospital in 2019 with the chief complaint of chronic low back pain for three months and more, also lacking spine MRI history in the past six months. After achieving demographic information, physical examination, and lumbar MRI scan, the patients were assigned to two groups with 50 patients. Based on the agenda's inclusion criteria, the first group were with LSS and the second group were with LBP. Inclusion criteria were as follows: elder than 40 years' patients, chronic backache history for more than six months, not taking spine MRI during the recent six months, filling consent form. Excluding criteria were as follows: neurologic claudication occurrence in the distances of 200 to 1000 meters, the indication of stenosis in the S1-L5 areas via MRI, history of spine surgery operation, history of spine disorders, history of claustrophobia, and also the history of confounder diseases of this study such as Osteoarthritis of lower limbs joints, vascular disorders, diabetes and rheumatoid arthritis.

Clinical examinations of the patients were approached, and the questionnaire consisted of age, gender, history of spine surgery operation, history of spine disorders and history of underlying diseases (Osteoarthritis, vascular diseases, diabetes, and rheumatoid arthritis) was provided. Restrictions of the patient activities due to the backache and their backache severity in accordance with patients' answers were evaluated via disability Oswestry index (DOI) and visual analog scale (VAS) respectively. The evaluated variables in this study were: sex, age, nerve root sedimentation sign, LSS, the location of LSS, ODI, and VAS. Lumbosacral spine MIR was applied for every patient after an hour of being in the supine position. Patients were walked in the presence of the researcher as far as they could for a maximum of 35 minutes (more than 1000 meters walking distance) until they revealed body bent and neurologic claudication. The distance of every patient passed on the treadmill was recorded in the prepared questionnaire.

Fifty patients indicating neurologic claudication in less than 200 meters with stenosis in the MRI images were considered, as LSS group, and 50 subjects of those who didn't reveal stenosis in the MRI images and were able to walk more than 1000

meters without neurologic claudication indication were considered as LBP group. Positive sedimentation signs in the cross-section spine MRI scans, as well as adjacent areas to the stenosis, were evaluated by the researchers.

The obtained data were analyzed by SPSS v 20, and means and standard deviations were calculated for the quantitative variables. For the qualitative variables, frequency and percentage were utilized. To compare qualitative and quantitative variables Chi-square and Independent T-test were applied respectively.

Ethics: all of the information of the patients was classified, and a consent indication form was provided, primarily. This study was approached based on the deceleration of Helsinki principles.

Results

One hundred patients were evaluated in this study. The mean age of the patients was 57.95 years (the range of 41 to 83 years) with a standard deviation of 9.8, 61 of those were male, and the rest of 39 subjects were female. Seventeen patients in the LBP group were women (34%), and 33 patients (66%) were men. In the LSS group, 28 women (56%) and 22 men (44%) were located. Chart 1 presents sex distribution among the groups which weren't statistically significant (P=0.41).

The mean age of the LBP group was 54.64 years, with a standard deviation of 8.04. The mean age of men and women in this group were 56.9 and 53.4 in the range of 41 to 80 years. The LSS group had a mean age of 61.26 years with a standard deviation of 10.37. Men and women's mean ages in this group were 59.5 and 62.6 in order in the age range of 42 to 83 years (Chart 2). Thus LSS group was 6.62 years older than the LBP group, and this difference was significant (P=0.001).

According to chart 3, the frequency of L2 and L3 is more than others which are 14 subjects among 50 patients (28%).

As is presented in table 1, the correlation between the frequency of the stenosis level and nerve sedimentation sign was not significant (P=0.75).

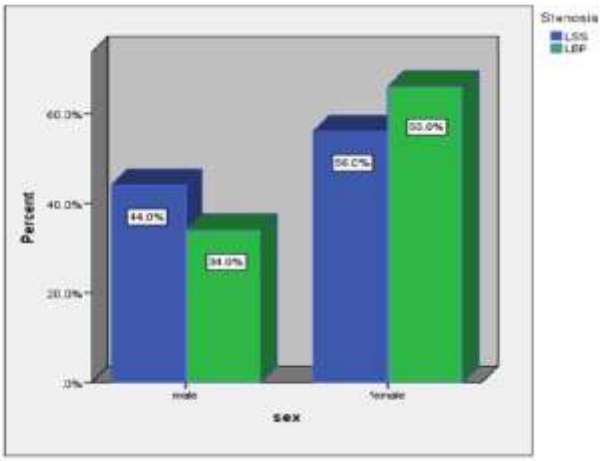

Chart 1: Sex distribution among LSS and LBP groups.

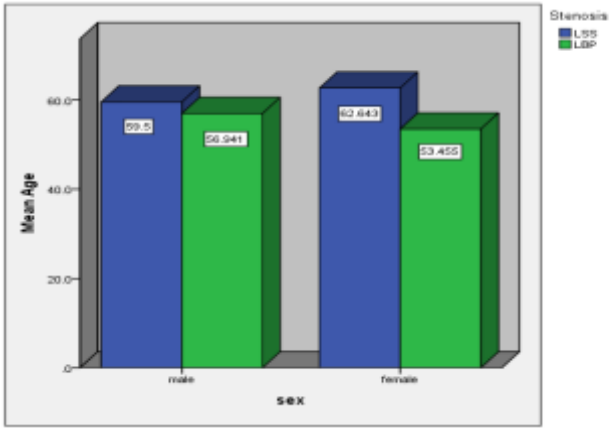

Chart 2: The mean age of LBP and LSS groups considering two sexes.

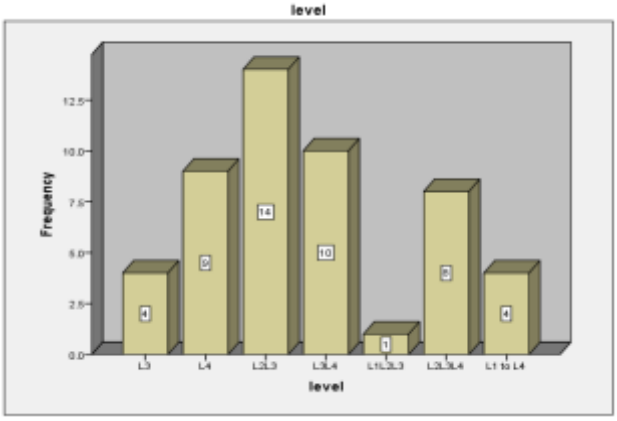

Chart 3: The frequency of the stenosis level among LSS group.

Table 1. The correlation between the frequency of the stenosis level and nerve sedimentation sign

Criterion **Stenosis level**	**Nerve sedimentation sign among LSS group**	
	Negative	**Positive**
L3	0	4
L4	1	8
L2L3	0	14
L3L4	1	9
L1L2L3	0	1
L2L3L4	0	8
L1toL4	0	4
P- value	0.75	

According to table 2, among the LSS group, 21 males and 27 females had positive sedimentation signs while only one male and one female had negative sedimentation signs, which were not statistically significant (P=0.69).

Based on table 3, the frequency of positive nerve sedimentation signs among the LBP group, was zero, and among the LSS group was 47 subjects. Thus there were two false-negative cases and none false-positive cases. Therefore, diagnostic indicators value was as follow: negative predictive value (NPV) = 96.1%, positive predictive value (PPV) = 100%, SP= 100% and SEN= 96%. There was also a significant correlation between stenosis level and nerve sedimentation sign in the X2 test (P=0.0001).

Table 2. The correlation between the sex frequency and nerve sedimentation sign

Criteria	nerve sedimentation sign						Total
Group	LSS		LBP		Total		
Sex	Negative	Positive	Negative	Positive	Negative	Positive	
Male	1	21	17	0	18	21	39
Female	1	27	33	0	34	27	61
Total	2	48	50	0	52	48	100
P-value	0.69		---		0.41		

Table 3. Adaptive nerve sedimentation sign prevalence among two groups.

Group Nerve sedimentation	LSS	LBP	Total
Positive	48	0	48
Negative	2	50	52
Total	50	50	100
P-value	0.0001		

Discussion

It revealed that the mean age of the LSS group was 6.7 years older than the LBP group, and this difference was significant (P=0.001). Among both groups, the VAS difference was not significant (P=0.350). It indicated that there was an insignificant correlation between patients' complaints about pain and stenosis level. Shapiro et al. reported a similar result in a previous study in 2003 [5]. However, Igarashi et al. believed that there was a correlation between stenosis level and pain of leg in their research in 2004 [6]. Nevertheless, the DOI indicator was higher in the LBP group (P=0.01), which demonstrated that activities restrictions among the LBP group are more intensive, probably because of adaptive reactions occurrence among LSS group due to the slower trend of the disease (Mueller). In the following study, there wasn't a significant correlation between positive sedimentation signs and stenosis levels among the LSS group (P=0.75). The most prevalent stenosis level was observed for simultaneous involvement of L3 and L4 discs (28%). On the other hand, in this study, there wasn't a significant correlation between the prevalence of nerve sedimentation signs and the prevalence among each sex in the LSS group (P=0.61). Whereas Kim et al. claimed that because of pain sensitivity difference role among two sexes; there is a significant correlation between LSS indications and gender [7]. The following study revealed that for patients with symptomatic LSS at the higher level of L5 disc, the nerve sedimentation sign was positive in 96% of cases, while this sign was negative for all patients with the LBP lacking stenosis. Thus, in this study sensitivity of positive nerve sedimentation sign was 96% with a specificity of 100%, PPV of 100%, and NPV of 96.1%. Subsequently, the patient with a positive nerve sedimentation sign suffers from symptomatic central lumbar spinal stenosis and needs surgical intervention with approximately 100% of certainty, also a negative nerve sedimentation sign disproves symptomatic central lumbar spinal stenosis with 96% confidence. A significant correlation was also determined between spinal stenosis and positive nerve sedimentation signs (P=0.0001).

The most beneficial nerve sedimentation sign is that it can be discovered easily in spine cross-section MRI images. This study demonstrated that this method had high clinical reliability too. However, in this research, the evaluation of nerve sedimentation signs in stenosis of S1-L5 levels was impossible due to close roots exiting sites from the anterior sacrum section. It is also probable that diagnostic values of this sign for non-central stenosis decline, which needs more investigations.

Conclusion

A positive sedimentation sign exclusively and reliably occurs in patients with LSS, suggesting its usefulness in clinical practice. Future accuracy studies will address its sensitivity and specificity. If they confirm the sign's high specificity, a positive sedimentation sign can rule in LSS, and, with high sensitivity, a negative sedimentation sign can rule out LSS.

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Conflict of Interest Disclosures

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Authors' Contributions

All authors pass the four criteria for authorship contribution based on the international committee of medical journal editors (ICMJE) recommendations.

Ethical Statement

This study was approved by ethical committee of Baqiyatallah University of Medical Sciences, Tehran, Iran.

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