Original Article

Magnetic Resonance Image Findings in Radicular Low Back Pain

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Abstract

Introduction: Low back pain (LBP) is the most common symptom associated with degenerative disc disease. Common causes of radicular low back pain are narrowing of the space where nerve roots exit the spine, which can be result of stenosis or disc herniation. Magnetic Resonance Imaging (MRI) is the key investigation for diagnosis of radicular LBP.

Objective: To find the association between radicular low back pain and MRI findings of degenerative disc disease.

Materials & Methods: This cross-sectional study was conducted in the Combined Military Hospital (CMH), Dhaka, from January to June 2018. A total of 128 patients with LBP with or without radiculopathy were included in the study. Lumbosacral MRI was carried out in all patients.

Results: One third (34.4%) of the patients had LBP with radiculopathy. A substantial proportion (68%) of patients had history of trauma to back-bone. Majority (97.7%) of the patients had disc degeneration. Approximately 72% had nerve-root compression and over three-quarters (76.6%) had spinal canal stenosis. Radiculopathy was significantly associated with past history of trauma to the back-bone ($p < 0.01$) and history of load-bearing ($p < 0.001$). Signs of degenerative disease were evident as Modic changes in 80.5%, disc displacement in 100% and disc herniation in 75%. All degenerative lesions were predominantly found at L4/L5. Highly significant ($p < 0.001$) association of radiculopathy with Modic changes, disc herniation, nerve root compression and spinal canal stenosis was found.

Conclusion: Signs of degenerative disc disease are significantly associated with radicular low back pain.

Key-words: Radicular low-back pain, MRI, Disc degenerative disease.

Introduction

Low back pain is very common now-a-days. Studies in developed countries[1] found point prevalences of 12-33%, one-year prevalence of 22-65% and for lifetime it is about 11-84%. Low back pain results from many causes, such as lumbosacral disc prolapse, spine degeneration due to age-related changes, stenosis of the spinal canal, trauma, tumour, infections and arthritic issues. Lumbar disk herniation is typical in these etiologies which cause low back pain[2]. In some patients, the same extension of lumbar disc herniation may be asymptomatic but may cause severe involvement of the spinal nerve root in others. The final diagnosis of disc herniation can, therefore, be challenging, because it is necessary to identify the exact structures that cause pain and disability in the patients[3].

Plain radiography hardly can directly visualize intervertebral discs and that is why insensitive for diagnosis of disc herniation. It is also unable to detect compromise of the vertebral canal caused by soft tissue. The accuracy of CT and MRI for diagnosis of herniated disc and spinal stenosis is similar[4,5]. However, as MRI is not associated with ionizing radiation and provides better visualization of soft tissues, vertebral marrow, and the spinal canal, it is considered as the choice of investigation for lumbo-sacral disk diseases. MRI delineates changes in the anatomy and tissue properties of the lumbosacral disc, which must then be viewed in the clinical context[6].

There's a controversial relationship between the clinical history, the findings of MRI imaging, and the final outcome of lumbosacral disc disease patients. It is therefore, of utmost importance to identify anatomic variations in MRI to find the association between low back pain with radiculopathy and MRI findings[7]. This study was, therefore, undertaken to find the association between the clinical features of disc prolapse (radiculopathy) in order to determine the clinical significance of anatomical abnormalities identified by MRI.

Materials and Methods

This cross-sectional study was conducted in Combined Military Hospital (CMH), Dhaka from January to June 2018. A total of 128 patients aged 22 years to 78 years with low back pain with or without radiculopathy were included in the study. However, patients with past history of spinal infection, tumour, lumbar canal stenosis, spondylolisthesis, cauda equine syndrome, myelopathy, metabolic spinal disease, radiological multiple level

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of disc involvement and history of spinal surgeries were excluded. Lumbosacral MRI was carried out and MRI parameters at six levels (D12-L1 to L5-S1) were noted. The MRI was done by using 1.5 tesla machine (GE medical system, Wisconsin, USA). Sagittal images were obtained in both T1 FSE (TE 20-40 TR 400-600) and T2 FSE (TE-96, TR 4000, Flip angle 25) sequence. Axial images were acquired in T2 sequence parallel to intervertebral disc. Sagittal images were attained at 4 mm slice thickness with 0.3 mm interslice gap. Coronal STIR images were used for the evaluation of sacroiliac joints. Six vertebral segments including D12-L1 to L5-S1 were evaluated for documenting the 20 parameters of anterior and posterior elements according to Milette et al[8]. Data were analyzed with the help of SPSS version 25 and the test statistics used to analyze the data were descriptive statistics and Chi-square (χ^2) Test. The level of significance was set at 5% and p value < 0.05 was considered significant.

Results

Age distribution showed that 55% of the patients were 30 – 50 years old (20-40 years 27.3% and 40-50 years 27.3%) with mean age of the patients being 48 years (range: 22- 78 years). A male preponderance (69.5%) was observed with male to female ratio being 2.3:1 (Table-I). Over two-thirds (68%) of the patients gave history of past trauma to back-bone, 17.2% had load bearing history on the back and 14.8% had no history of clinical significance (Figure-1). Over one-third 44(34.4%) of the patients had low-back pain with radiculopathy and the rest 84(64.6%) had pain without radiculopathy. Radiation of pain to one thigh alone was in 31(24.2%) patients and to both thighs was in 13(10.2%) patients (Figure-2). MRI examination revealed that most of the patients (97.7%) had disc degeneration; Grade I, II, III, IV and V degenerations were 19(14.9%), 41(32%), 36(28.1%), 19(14.9%) and 10(7.8%) respectively. More than 80% of the patients exhibited Modic changes in the intervertebral disc with type II changes being predominant (57.9%); Type I, II and III changes were 14(10.9%), 74(57.8%) and 15(11.7%) respectively. Disc herniation was found in 98(76.6%) patients–postero-lateral was found in 44(34.4%), postero-central in 40(31.3%) and foraminal in 14(10.9%) patients. Nerve root compression was found in 92(71.9%) patients and spinal canal stenosis was in 98(76.6%) patients (Table-II). More than two-thirds (68%) of the patients gave history of past trauma to back-bone, 17.2% had load bearing history on the back and 14.8% had no history of clinical significance (Figure-1). Approximately 72% of the patients exhibited nerve-root compression and over three-quarters (76.6%) exhibited spinal canal stenosis. All degenerative lesions revealed by MRI were predominantly found at L4/L5 followed by L5/S1, L3/L4, L2/L3 and L1/L2.

The presence of radiculopathy was significantly associated with past history of load-bearing ($p < 0.01$). Majority (88.6%) of the patients with radiculopathy had significant association ($p < 0.001$) with past history of trauma to the back-bone (Table-III). Radiculopathy was not found to be significantly associated with disc degeneration ($p > 0.05$) but had highly significant association with modic changes ($p < 0.01$), disc herniation ($p < 0.001$), nerve root compression ($p < 0.001$) and spinal canal stenosis ($p < 0.001$) (Table-IV).

Table-I: Distribution of patients by their age and sex (n=128)

Characteristics		Frequency	Percentage
Age (years)	< 30	10	7.8
	30-40	35	27.3
	40-50	35	27.3
	50-60	26	20.3
	≥ 70	22	17.3
	Mean ± SD = 48.0 ± 13.2; Range = 22-78		
Sex	Male	89	69.5
	Female	39	30.5

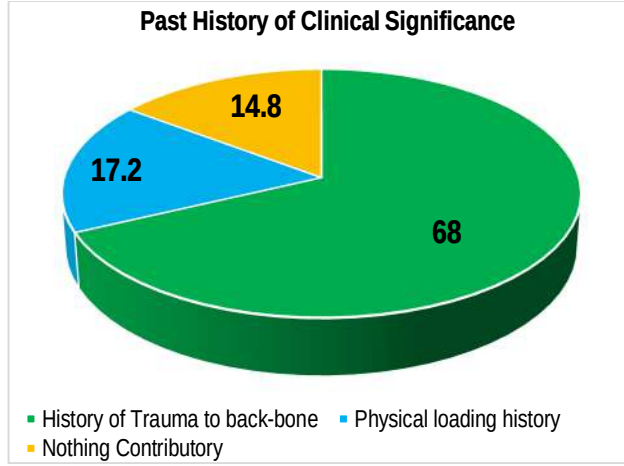

Figure-1: Distribution of patients by history of clinical significance (n = 128)

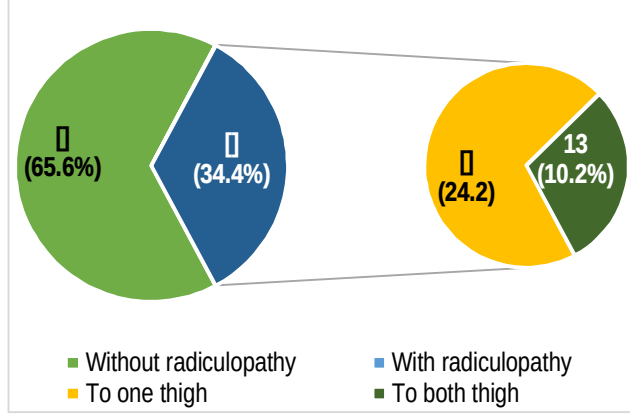

Figure-2: Distribution of patients by characteristics of low-back pain (n = 128)

Table-II: Distribution of patients by MRI findings (n = 128)

Characteristics			Frequency	Percentage
Disc degeneration	**Yes**	Grade I	19	14.9
		Grade II	41	32.0
		Grade III	36	28.1
		Grade IV	19	14.9
		Grade V	10	7.8
		Total	125	97.7
	No		3	2.3
Modic changes	**Yes**	Type-I	14	10.9
		Type-II	74	57.9
		Type-III	15	11.7
		Total	103	80.5
	No		25	19.5
Disc displacement			128	100
Disc herniation	**Yes**	Posterolateral	44	34.4
		Poster central	40	31.3
		Foraminal	14	10.9
		Total	98	76.6
	No		30	23.4
Nerve root compression	**Yes**		92	71.9
	No		36	28.1
Spinal canal stenosis	**Yes**		98	76.6
	No		30	23.4

Table-III: Association between radiculopathy and pertinent past history

Past history of clinical significance		Low-back pain with radiculopathy		p-value
		Yes (n = 44)	No (n = 84)	
History of load-bearing	Yes	13(29.5)	9(10.7)	<0.01
	No	31(71.5)	75(89.3)	
History of trauma	Yes	39(88.6)	48(57.1)	< 0.001
	No	5(11.4)	36(42.9)	

** Chi-squared test was done * Percentage in parentheses*

Table-IV: Association between MRI findings of disc and radiculopathy

MRI findings of intervertebral disc		Low-back pain with radiculopathy		p-value
		Yes (n = 44)	No (n = 84)	
Disc degeneration	Yes	44(100)	81(96.4)	0.279
	No	0(0)	3(3.6)	
Modic changes	Yes	41(93.2)	62(73.8)	0.009
	No	3(6.8)	22(26.2)	
Disc Herniation	Yes	44(100)	52(61.9)	<0.001
	No	0(0)	32(38.1)	
Nerve Root Compression	Yes	44(100)	48(57.1)	<0.001
	No	0(0)	36(42.9)	
Spinal canal stenosis	Yes	44(100)	54(64.3)	<0.001
	No	0(0)	30(35.7)	
Location of herniation	Posterolateral	27(61.4)	17(20.2)	<0.001
	Posterocentral	6(13.6)	34(40.5)	
	Foraminal	11(25.0)	03(1.2)	
	No herniation	0(0)	30(38.1)	

**Data were analyzed by Chi-squared test * Percentage in parenthesis*

Discussion

Changes in disc degeneration are associated with the aging process, with higher and increased prevalence found in older age groups of the population[9], although 75% of the patients in the present study were in the range of 30–60 years. The aging process creates aggrecan (Chondroitin sulfate proteoglycan-1) deprivation and fragmentation, increased amount of keratan sulfate and type 1 collagen in nucleus, with changes in extracellular matrix structure and composition. Besides this, the hydration and structural framework of the disc are distorted and further alter disc behavior and function, making the disc more susceptible to injury. In the present study over one-third (34.4%) of the patients had LBP with radiculopathy and the rest had pain without radiculopathy. A substantial proportion (68%) of patients gave history of past trauma to back-bone. The presence of radiculopathy was significantly associated with past history of trauma to the back-bone or load-bearing ($p = 0.007$ and $p < 0.001$ respectively) indicating that past history of trauma to the back is of utmost clinical significance to LBP. MRI examination demonstrated that majority (97.7%) of the patients had disc degeneration with Grade II & III degeneration formed > 60% of the cases. LBP cases with radiculopathy was significantly associated with modic changes ($p = 0.009$). Modic changes in the disc were evident in > 80% of the cases with type II changes being predominant (57.9%). This sharply contrasts with the findings of another study where Modic type 1 change showed an acknowledged predictive value for the presence of pain. A study on 2,457 symptomatic individuals showed a positive predictive value (PPV) of 81% and a specificity of 98% with Modic type 1 change[10]. This change was more commonly found in symptomatic subjects[11] aged < 50 years (19–50%), although > 60% of our patients were below 50 years old and type II Modic changes were more prevalent.

Disc displacement was invariably present with L4/L5 being the predominant level of disc displacement. Disc herniation comprised 76.6% and simple disc bulging formed 23.4% of the cases. However, disc degeneration was not found to be associated with radicular pain. All degenerative lesions [high intensity zones (HIZ), disc degeneration, disc herniation, and nerve root compression] revealed by MRI were predominantly found at L4/L5 followed by L5/S1, L3/L4, L2/L3 and L1/L2. Shambrook et al[12] found 354 individuals with LBP who had already undergone lumbosacral MRI examination. One or more MRI changes were reported in 86.4% individuals, while 17.8% had all four signs of MRI changes. In the present study all cases demonstrated disc herniation as opposed to 61.9% of the controls ($p < 0.001$). Approximately 72% of the patients exhibited nerve-root compression with right-sided compression being more common (57.6%) than left-sided ones (42.4%). Nerve root compression and spinal canal stenosis were generally associated with low-back pain with radiculopathy ($p < 0.001$). Disc herniation, spinal ligaments thickening and articular processes hypertrophy may be linked with progressive narrowing of the spinal canal and further result in back pain related to the compression of neurovascular structures[13,14].

LBP is strongly associated with intervertebral disc degeneration. Above all it is correlated with the disruption of the complex anatomy of nucleus pulposus, annulus fibrosus and adjacent supporting structures of the spine. Changes in the shape and intensity of nucleus pulposus, decreased disc height, disc herniation, vertebral endplate changes, presence of osteophyte and posterior HIZ are degenerative changes found in imaging studies. We considered every feature for grading the severity score. Modic changes, DEBIT (disc extension beyond interspace) score and Pfirrmann criteria are some of the scoring criteria mainly used for assessing disc degeneration severity[15]. Disc herniation is the most common cause and inflammation of the affected nerve rather than its compression is the most common pathophysiological process. Radicular pain differs from radiculopathy in several aspects. Radiculopathy impairs conduction down a spinal nerve or its roots. Although radiculopathy and radicular pain often accompany one another, radiculopathy has been observed in the absence of pain and radicular pain may happen in the absence of radiculopathy[16].

Clinical examination aims to clarify whether there is mechanical impingement of a nerve root[17]. An incorrect clinical diagnosis may expedite to unnecessary imaging and healthcare expenditure and suffering for patients[18,19]. The object of imaging is to certify or disprove a clinical suspicion and to provide a roadmap for planning of surgical or other intervention procedures, if indicated. Mechanical nerve root impingements demonstrated with MRI or CT is an accepted reference standard[20].

Conclusion

All the signs of disc degenerative disease (disc degeneration, disc herniation, and nerve root compression and spinal canal stenosis) revealed by MRI demonstrate their significant association with radicular low back pain. So, if a patient's history and physical examination findings indicate lumbar disc herniation with radiculopathy, the most suitable noninvasive test to confirm this could be an MRI, unless it is contraindicated to the patient.

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