Research Article

Spectrum of magnetic resonance imaging findings in patients of low back pain at a tertiary care institute of West Bengal

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ABSTRACT

Background: Several diagnostic modalities are being used for evaluation of low back pain (LBP) such as conventional radiography, computed tomography scan, bone scan, and ultrasonography. Magnetic resonance imaging (MRI) can give different and improved information about structures in the body. Through MRI, an attempt was made to identify the structural abnormalities at the lumbosacral region. **Objectives:** The objective of this study is to evaluate the causes of LBP with MRI scan as imaging modality in the adult age group. **Materials and Methods:** It was a hospital-based, cross-sectional study. This study was done from May 2014 to April 2015 in the Department of Radiodiagnosis at a tertiary institute of West Bengal. The study population included all the patients above 18 years of age presenting with LBP in the hospital during the study period. During the study period, 158 patients were found eligible. **Results:** Majority (86.4%) of patients of LBP were aged below 60 years. Majority (88.3%) of the patients had lumbar spine degenerative disease, which was the most common pattern. Among lumbar degenerative findings, disc degeneration being the most frequent finding seen in 113 (83%) patients, followed by disc bulge 107 (78.6%), nerve root compression 103 (75.7%), disc herniation 59 (43.3%), and central canal stenosis 63 (46.3%). Odds ratio for disc degeneration was 2.6 (95% confidence interval: 1.2-5.5) times in age ≥40 years in comparison to age <40 years. There was no significant difference in the prevalence of various degenerative imaging findings between male and female. **Conclusion:** MRI is a useful and safe modality for the evaluation of pathologies of the lumbar spine in patients with LBP. Degenerative disc disease is the most common cause of LBP. Early diagnosis of degenerative changes in patients with LBP may enable physicians to plan preventive strategies.

KEY WORDS: Low Back Pain; Magnetic Resonance Imaging; Disc Degeneration

INTRODUCTION

Low back pain (LBP) is one of the most common problems affecting the adult population. Back pain is one of the leading causes of disability. Most LBP is caused by degenerative conditions followed by injury or trauma, infections, or congenital abnormalities in the spine. A few recent studies have shown the potential benefits of magnetic resonance imaging (MRI) as a diagnostic modality in LBP. MRI has been recommended as an essential diagnostic modality in post-HIV patients with LBP.[1] The safety and potential benefits of MRI-based diagnosis owing to precise location and excellent soft-tissue resolution to demonstrate pathology in cases of lumbar disc degeneration were reported by Suthar et al.[2] Ghaly et al.[3] reported MRI as a useful modality for the identification of degenerative disc disease (DDD), which is the single most common category for LBP and which can contribute significantly to drafting a preventive strategy. MRI is the established diagnostic modality of choice for specific diagnosis in patients with potentially severe underlying conditions (The Red Flags) which include malignancy, vertebral infection, severe/progressive neurological deficits,

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and other serious conditions as recommended in Guidelines, 2007 American College of Physicians and the American Pain Society, Diagnosis, and Treatment of LBP.[4-7]

Several diagnostic modalities are being used for evaluation of LBP such as conventional radiography, computed tomography (CT) scan, bone scan, and ultrasonography. As per the FDA guidelines, MRI can give different and improved information about structures in the body than can be obtained using a standard X-ray, ultrasound, or CT. MRI does not involve the use of ionizing radiation, that is, high-energy radiation that can lead to potential damage to DNA such as X-rays and CT scans. McNally et al.[8] in his study has established the superiority of MRI over conventional radiography in LBP. Therefore, in the present study, MRI is selected as the diagnostic modality for the evaluation of the possible causes of LBP arising due to conformational/structural abnormalities of the spine. By this modality, an attempt will be made to identify the structural abnormalities at the lumbosacral region such as bone degeneration and injury, pathologies of nerves, muscles, ligaments, paravertebral tissues, and blood vessels.

MATERIALS AND METHODS

It was a hospital-based, cross-sectional study. The study was done from May 2014 to April 2015 in the Department of Radiodiagnosis at a tertiary institute of West Bengal. The study population included all the patients above 18 years of age presenting with LBP in the hospital during the study period. Among these, those who were referred for lumbar spine MRI to the Department of Radiodiagnosis were our study sample. Sample size was calculated based on equation $N = \frac{Z\alpha / 2 * p(p-1)}{MOE}$. $Z_{\alpha/2}$ is the critical value of the normal distribution at α/2 (for a confidence level of 95%, α is 0.05, and the critical value is 1.96), MOE is the margin of error, and p is the sample proportion. A finite population correction has been applied to the sample size formula. Earlier study reported the prevalence of degenerative spinal cord stenosis among patients with LBP as 11%. Based on this prevalence, sample size was calculated to be 150. Non-probability consecutive sampling was applied to select individual samples. Patients referred for LBP in adult age group of both sexes with or without radiculopathy as the primary and only diagnosis or in association with other pre-existing conditions were included in this study. Patients with MR unsafe devices or with ferromagnetic foreign bodies or having claustrophobia were excluded. During the study period, 158 patients were found eligible. Out of which, 4 were excluded. Hence, the final sample was 154 patients. Written informed consent was obtained followed by counseling. A pre-designed questionnaire was used to collect data. MRI was done using Siemen Magnetom-C 0.35 Tesla. A trained radiographer performed imaging. The scan consisted of sagittal, axial, and coronal T1-weighted, T2-weighted spin echo, and short tau inversion recovery sequences. Data entered and analyzed using Microsoft Excel student's edition 2016. Percentage and frequency were calculated. Odds ratio (OR) was calculated using Medical online calculator. Ethical approval was obtained from the Institute Ethical Committee.

RESULTS

As depicted in Table 1, majority (86.4%) of patients of LBP were aged below 60 years. Males and females were almost equally affected (50.6 vs. 49.4). There was urban predominance (61.9%) among patients. 84.5% patients were literate, whereas 76.8% were employed.

A review of 154 MRIs of patients presented with LBP in this study revealed (Table 2) that majority of the patients had lumbar spine degenerative disease 88.3% (n = 136) which was the most common pattern. Among other patterns observed were trauma 6.5% (n = 10), infections 5.2% (n = 8), neoplasms 4.5% (n = 7), other causes 2.6% (n = 4), whereas 6.5% (n = 10) were normal and free from any such changes.

Table 1: Sociodemographic profile of patients (n=154)

Variables	Category	*n* (%)
Age group	18-39 years	53 (34.5)
	40-59 years	80 (51.9)
	60-82 years	21 (13.6)
Sex	Male	78 (50.6)
	Female	76 (49.4)
Residence	Urban	95 (61.9)
	Rural	59 (38.1)
Education	Illiterate	24 (15.5)
	Primary + middle	68 (44.3)
	High school and above	62 (40.2)
Occupation	Employed	118 (76.8)
	Unemployed	36 (23.2)
Socioeconomic status	Lower	50 (32.6)
	Middle	59 (38.0)
	Upper	45 (29.4)

Table 2: Distribution of low back patients according to their MRI findings (n=154)*

MRI finding	Frequency (%)
Lumbar degenerative disease	136 (83.3)
Trauma	10 (6.5)
Infection	08 (5.2)
Neoplasm	07 (4.5)
Others	04 (2.6)
Normal	10 (6.5)

*In some patients, more than one finding reported. MRI: Magnetic resonance imaging

On lumbar MRI, overall prevalence of lumbar degenerative findings, disc degeneration (sign of reduced disc signal intensity) being the most frequent finding seen in 113 (83%) patients, followed disc bulge 107 (78.6%), nerve root compression 103 (75.7%), disc herniation 59 (43.3%), and central canal stenosis 63 (46.3%). The less common findings were Modic changes which were seen in 26 patients (19.11%), facet arthropathy seen in 5 patients (3.6%), and ligamentum flavum hypertrophy 5 (3.65%) (Table 3).

The prevalence of lumbar degenerative changes was found to be increasing significantly with age. OR for disc degeneration was 2.6 (1.2-5.5) times in age ≥40 years in comparison to age <40 years. This was also true for Modic changes, disc bulge, and nerve root compression where OR was significantly higher in age ≥40 years. Type II Modic changes were more common than Type I. However, the prevalence of spinal canal stenosis and herniation did not differ significantly with age (Table 4).

There was no significant difference in the prevalence of various degenerative imaging findings between male and female except disc bulge which was significantly less prevalent in male (OR = 0.11; 0.05-0.27) (Table 5).

Table 3: Distribution of lumbosacral degenerative changes (*n*=136)*

MRI finding	Frequency (%)
Disc desiccation	113 (83)
Modic changes	26 (19.1)
Disc bulge	107 (78.6)
Disc herniation	59 (43.3)
Spinal canal stenosis	63 (46.3)
Neural foraminal/lateral recess narrowing/nerve root compression	103 (75.7)
Facet joint arthropathy	5 (3.6)
Ligamentum flavum hypertrophy	5 (3.6)

*In some patients, more than one finding reported. MRI: Magnetic resonance imaging

DISCUSSION

The main objective of the current study was to identify the different MRI patterns of LBP. The mean age of the participants was 43.5 years and the median was 46 years, which indicates that condition is a major cause of morbidity among the working age group of our country. The results of this study corroborate with previous reports from Kenya[9] and Ethiopia[10] showing mean age group affected with LBP as 40.9 ± 13.2 and 42.4 ± 13.22, respectively. In the present study, the author sought to evaluate the gender difference in the incidence of LBP in the population under consideration. This study results show a slightly higher incidence of LBP in males (56.5%) versus females (43.5%). However, several previous studies have reported higher incidence of LBP in females,[11-13] the difference in the findings can be attributed to number and the type of population sampled.

The results of this study showed that the severity of degenerative changes was significantly enhanced with increased duration of pain. This finding agrees with a study by Yong et al.[14] where 56.0% presented with chronic LBP

Table 4: Distribution of MRI imaging findings of lumbosacral degenerative patients according to age

MRI findings	Below 40 years *n*=53	≥40 years *n*=101	OR (95% CI)
Disc degeneration	32 (60.3)	81 (80.1)	2.6 (1.2-5.5)
Modic changes	0 (0)	26 (25.7)	18.7 (2.4-142.2)*
Disc bulge	28 (52.8)	79 (78.2)	3.2 (1.5-6.5)
Disc herniation	15 (28.3)	44 (43.3)	1.9 (0.9-3.9)
Spinal canal stenosis	20 (37.7)	43 (42.5)	1.1 (0.57-2.2)
Neural foraminal/lateral recess narrowing/nerve root compression	25 (47.1)	78 (77.2)	3.7 (1.8-7.7)

*Haldane–Anscombe correction: Adding 0.5 to each of the cells and then calculate the OR over these adjusted cell counts. OR: Odds ratio, CI: Confidence interval, MRI: Magnetic resonance imaging

Table 5: Distribution of MRI imaging findings of lumbosacral degenerative patients according to gender

MRI findings	Male (*n*=78)	Female (*n*=76)	OR (95% CI)
Disc degeneration	53 (67.9)	60 (78.9)	0.56 (0.27-1.1)
Modic changes	15 (19.2)	11 (14.4)	1.4 (0.60-3.2)
Disc bulge	39 (50.0)	68 (89.4)	0.11 (0.05-0.27)
Disc herniation	31 (39.7)	28 (36.8)	1.1 (0.59-2.1)
Spinal canal stenosis	32 (41.0)	31 (40.7)	1.0 (0.57-1.9)
Neural foraminal/lateral recess narrowing/nerve root compression	52 (66.6)	51 (67.1)	0.98 (0.5-1.9)

OR: Odds ratio, CI: Confidence interval, MRI: Magnetic resonance imaging

of more than 3 months. Pain associated with DDD can be inflammatory and/or mechanical. Inflammatory pain is caused by the release of chemicals in the nucleus that irritate nerve endings in the annulus fibrosus. Mechanical pain is due to the physical compression of a nerve root because of herniation or disc space compression. Therefore, LBP can be an indicator for persisting mechanical injury or inflammatory change leading to aggravation of degenerative changes in the disc, and MRI as a modality for early degenerative changes associated with LBP can help plan an appropriate preventive strategy from further progression of the unwanted changes. Our study reported lumbar spine degenerative disease (88.3%) as the most common cause of LBP. Similar findings have been reported from several studies.[15-17] Other less frequently encountered but contributing MRI patterns for LBP include infections 5.2%, neoplasms 4.5%, trauma 6.4%, and other causes such as referred pain from other organs 2.6%, normal findings were found in 6.5% cases. Other studies have also reported the detection of similar MRI patterns in DDD.[15] While most of the findings in the studies mentioned focus only on DDD excluding infections, neoplasms, and congenital anomalies. This study however shows that MRI has a high sensitivity for the detection of infections and neoplasm alongside lumbar spine degenerative disease.

Among all the lumbar spine degenerative diseases identified as cause of LBP, disc degeneration was the most frequent finding observed in 113 (83%) patients in this study. The prevalence was observed to increase with age (the incidence in the various range of age groups were 60-82 years of age 100%, between 40 and 59 years and in the range 18-39 years was 75% and 60%, respectively). The difference observed between the age groups was significant ($P < 0.05$) and compares well to the findings of other previous studies.[18-21] The difference in the prevalence among young and aged individual could be contributed by aging process. Degenerative spine disease onsets when the normally rubbery discs lose integrity during the normal process of aging and as the disc deteriorate, they lose their protective ability. In support of this finding, our study also shows that incidence of DDD is highest in the aging population. Disc degeneration was slightly more frequent among females (78.9%) as compared to males (67.9%), and the variation observed was statistically significant, similar outcome was also reported by Irurhe et al.[22]

Proportion of degenerated discs (reduction in disc signal intensity) progressively increases with lower the spine level and the most common spine levels identified in this study were between L4/L5, which corroborates with previous studies.[11,14,19] The possible explanation of this finding can be attributed to the fact that mechanical characteristics of the discs are greater in those that are close to fused lumbar vertebrae therefore favors degeneration and with increased aging there is loss of proteoglycans from the lumbar disc that may culminate into disc degeneration. The observation that in some cases disc degeneration was not associated with LBP is like the findings from the previous report by Sivas Acar et al.[23]

The prevalence of Modic changes (19%) was lower compared to 43% and 23% reported in previous studies,[24] changes in this study increased with age, in the age group of 20-39 years, 40-59 years and 60-80 years, respectively, and this finding was statistically significant ($P < 0.05$), and this is similar to the findings by Kuisma et al.[25] This variation can be due to normal aging process in older individuals. In young individuals, Modic changes are common, this as observed by Takatalo et al.[26] and Sivas Acar et al.[23] to be 1.4% and 3.7%, respectively, in patients below 30 years. Type II Modic changes were more common than Type I as was found by Kuisma et al.[25] In this study, it was observed that Modic changes progressively increased with the lower spine level, and the most common location were L3-L4, L4/L5, and L5/S1. This observation is consistent with previous studies by Takatalo et al., Grainger and Allison.[26,27] Recent studies indicate modic changes as a heritable factor associated with disc degeneration.[28]

Disc displacement is also a common finding in lumbar spine degenerative disease. The displaced disc can be a bulge or herniation; herniated discs can be protrusion, extrusion, or sequestration. In this study, disc bulges were more common than herniation, and disc bulges were predominantly observed in women and older age group, that is, above 60 years, on the other hand, disc herniation was a significant finding in the lower age group. Other studies have also reported similar findings.[11,29] The common location/position of disc herniation, that is, at L4/L5 and L5/S1 and incidence of canal stenosis observed in our study corroborates with previous reports.[11,13,18,30-32] The structural changes with aging and type of job involvement may contribute to the higher incidence of disc bulge among women and in the older age group. Taken together, the results of this study identifies lumbar DDD as the major factor responsible for LB, and our findings are supported by a plethora of similar reports from various global studies.[14,17,33-35]

Degenerative changes are most common in the lower lumbar region as it is the area of heaviest mechanical stressors, most profoundly affecting L4-5 level as foreboded by the presence of bulges (37.5%) and herniations (24.6%) followed by a lower incidence at L5-S1 level. Therefore, his implies that the region L4/L5 is susceptible to injury and degeneration, appropriate precautions, and preventive measures need to be devised to curb the degenerative changes. Most common contour abnormalities in patient with LBP were disc bulges followed by herniations as reported in previous studies.[15-16]

CONCLUSION

MRI is a useful and safe modality for the evaluation of pathologies of the lumbar spine in patients with LBP. DDD is the most common cause of LBP. Early diagnosis of degenerative changes in patients with LBP may enable physicians to plan preventive strategies.

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