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DISTRIBUTION OF MODIC CHANGES IN MAGNETIC RESONANCE IMAGING OF LUMBAR SPINE

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ABSTRACT

Objective: To determine the frequency and distribution of endplate modic changes in lumbar spine on Magnetic Resonance Imaging (MRI) of lumbar spine of patients with low back pain.

Methodology: This cross sectional study was conducted in department of radiology, Hayatabad Medical Complex, Peshawar from January to June 2020. A total 500 patients of both genders were included. MRI films were evaluated by Radiologist with 5 years' experience. Endplate modic changes were classified according to definition by Modic et al. Frequency and distribution of modic changes were assessed at L1-L2, L2-L3, L3-L4, L4-L5 and L5-S1 levels.

Results: In our study, a total of 386 patients showed endplate modic changes. The mean age of the sample was 41.0±15.16 years. There were 190 (47.4%) males and 196 (52.6%) females. Type 2 modic changes were found in 192 (49.7%) patients while 161 (41.7%) had type 3 modic changes and 33 (8.5%) had type 1 modic changes.

Conclusion: Endplate modic changes occur with greater frequency at L5-S1. Modic type 2 changes are most common. Positive correlation exists between degenerative disk disease and modic changes.

Key Words: Modic; Magnetic Resonance Imaging; Back pain; Disc degeneration.

INTRODUCTION

Pain in lower back is common problem encountered in adult population.[1] A very important cause of low back ache is degenerative disease of lumbar spine. Endplates are thin structures located between vertebra and disc. It is intimately connected to the disc.[2]

Studies have been done to assess association of clinical symptoms with findings on magnetic resonance imaging (MRI). This has resulted in many authors reporting a relation between low back ache and modic changes, particularly modic 1.[3] Lumbar spondylosis is assessed radiologically by changes in signal intensity of endplates of vertebral body.

Modic changes are alteration in the signal intensity of marrow near endplate of vertebral body. They are frequently recognized by Magnetic Resonance Imaging in patients with back ache.[4-6] Modic et al has categorized these endplate changes into three types: type 1 represents vascularized fibrous tissue and appears hypo intense on T1WI and hyper intense on T2WI; type 2 represents replacement of marrow by fat and appear hyper intense on T1WI and hyper intense on T2WI; type 3 represents sclerosis of endplates and appear hypo intense on T1WI and T2WI.[7]

The prevalence of modic changes in patients with degenerative disc disease is between 19 and 59%.[8,9] Several studies reveal type 2 changes to be most common modic change.[10, 11] Several risk factors have been identified for modic changes. Hu et al described association between disc degeneration and modic changes.[12] Genetic factors have been proposed to affect severity of disc degeneration and distribution of modic changes in different races.[13] Type 2 modic changes represent fatty replacement of marrow, therefore some study suggests the possibility of association with obesity.[14] Other studies regard smoking,[15,16] heavy load bearing,[17] intervertebral disc herniation[18] etc. as possible risk factors. Studies have been conducted revealing close association between modic changes and grade of disc degeneration.[19] Strong correlation is also found between endplate modic changes and disc tear in lumbar spine.[20]

With advancement in MRI association of vertebral degenerative changes and modic changes with lower back ache has been extensively studied.[21] Till date very few local studies are performed. The aim of our study is to determine the frequency and distribution of endplate modic changes in lumbar spine in MRI of lumbar spine in patients with low back pain. By doing so, valuable information can be provided about degenerative diseases of lumbar spine which is major cause of low back ache.

METHODOLOGY

This cross sectional study was conducted in the department of radiology, Hayatabad Medical Complex - Peshawar from January to June 2020. A total of 500 patients with low back pain were included in the study. Approval for the study was taken from ethical committee. Both male and female patients with complete record and complete and clear imaging data were included in study. Patients with compressive fracture, spondylolisthesis, tuberculosis and back surgery were excluded from study.

Consecutive non-probability sampling was performed. Both male and female patients from 20 to 90 years were included in study. MRI was performed using 1.5 Tesla Philips scanner. T1W and T2W fast spin echo axial and sagittal images were performed. All MRI images were evaluated by consultant Radiologist having at least 5 years' experience.

Frequency and distribution of modic changes were localized to disc level from L1-L2 to L5-S1. Correlation was assessed between modic change, age, disc bulge, disc protrusion, disc extrusion and disc sequestration using Pearson correlation. Data analysis was performed using SPSS version 20.0.

Endplate modic changes were classified into 3 types specified by Modic et al[7]. Type 1: low signal intensity on T1-weighted images and high signal intensity on T2-weighted image. Type 2: high signal intensities on T1-weighted images and isointense or slightly hyperintense signals on T2-weighted images. Type 3: low signal intensities on both T1- and T2-weighted images.

Disc bulge was defined when herniation is 180 to 360 degrees beyond the edges of the ring apophyses. Disc protrusion was defined when the distance between the edges of the disc herniation is less than the distance between the edges of the base. When the distance between the edges of the disc material is greater than the distance at the base, it was defined as disc extrusion. When the displaced disc has lost continuity with the parent disc it was defined as sequestered disc.

RESULTS

In our study, out of 500 patients, 386 endplate modic changes were included. 183 patients were male and 203 were female. The mean age of the sample was 41.0±15.16 years. Only 3 patients were less than 30 (0.7%) years of age, 74 (19.2%) were between 31-40 years, 100 (25.9%) patients were between 41-50 years, 111 (28.7%) patients were between 51-60 years, 64 (16.6%) patients were in the age range of 61-70 years, 25 (6.5%) patients were in the age range of 71-80 years and 6 (1.5%) patients were >81 years (1.5%).

Positive Pearson correlation has been observed between modic change and age (r=.295, p=0.01), suggesting increasing incidence with increasing age. Type 1 modic changes were observed in 33 (8.5%) patients, 192 (49.7%) patients had modic 2 changes and modic 3 changes were seen in 161 (41.7%) patients.

Modic changes were most common at L5-S1 (n=213, 55.1%) levels. This was followed by L4-L5 (n=89, 23.1%), L3-L4 (n=47, 12.1%), L2-L3 (n=28, 7.2%) and L1-L2 (n=10, 2.5%). Table 1 shows distribution of modic changes at different levels of lumbar spine.

Positive Pearson correlation (r=.552, p<0.01) was found between modic changes and lumbar disc bulges at L1-L2, L2-L3, L4-L5, L5-S1 levels. Positive correlation between modic changes and disc protrusion (r=.248, p<0.01) was only found at L1-L2 level. Table 2 shows types of spinal disk herniation in various modic changes.

DISCUSSION

Modic changes are signal changes in vertebral endplates on MRI. Our cross sectional study demonstrated that modic type 2 change is by far most prevalent modic change, followed by modic type 3 change. It is associated with diffuse disc bulge and disc protrusion. There is increased incidence of modic changes with increasing age.

The incidence of endplate modic changes increase with increasing age. It is found in 20-50% of patients with low back pain.[22] Several studies have been conducted showing correlation of modic changes with clinical outcome. MRI is an effective modality in providing information about disc degeneration. Modic type 1 endplate change occurs early and is active stage. In a study by Weishaupt et al, modic changes can cause lower back pain. However, modic 2 changes can produce relatively less pain as compared to modic 1.[23]

In our study majority of patients with modic changes were between 51-60 years with percentage of 28.8%; and 25.9% in age range of 41- 50 years. These findings are in agreement with other studies.[24, 25] In a study conducted by OI et al, patients between 40- 60 years had increased incidence of modic changes.[26] Our study showed the

Table 1: Distribution and percentage of modic changes lumbar spine levels (n=386)

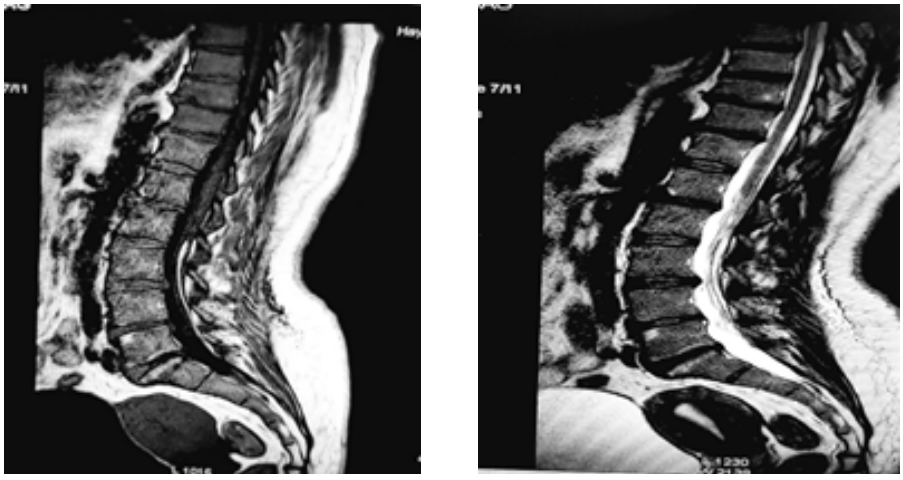
Modic changes	L1-L2	L2-L3	L3-L4	L4-L5	L5-S1	Total
1	1	2	1	4	25	33
2	9	26	44	84	30	192
3	-	-	2	1	158	161

Table 2: Types of spinal disk herniation in various modic changes (n=386)

Spinal disk herniation	Modic 1	Modic 2	Modic 3
Bulge	24	149	132
Protrusion	6	40	26
Extrusion	2	1	2
Sequestrated	1	2	1

Figure 1: T2W and T1W images showing grade 1 endplate modic changes at L4-L5 level.

Figure 2: T1W and T2W images showing grade 2 modic changes at adjacent endplates at L5-S1 level.



incidence of modic changes to be higher in female (52.6%) than males (47.4%), similar to study by Hans et al which reveal strong association of female, heavy weight lifting and increased weight with modic changes.[27] A study by Chen et al showed that gender is related to different types of modic changes.[21] Male were associated with type 1 change and females were associated with type 2. Since workload of men is more, this results in less repair of micro fracture and hence increase prevalence of modic 1 change.[28]

Our study results showed modic 2 changes to be most common with percentage of 49.7%. This finding is consistent with another study.[29] We found modic changes to be more common at L4-L5 (23%) and L5-S1 (58.6%) which are similar to study by Xu et al.[30] The main reasons appear to be maximum stress suffered at these levels. Chen et al showed statistical correlation between disc protrusion, extrusion, sequestration and modic changes. Nasir et al[24] and Zhang et al[31] also in their study revealed the presence of disc degenerative disease in association to modic changes. Our study showed significant correlation between disc bulge and protrusion with modic changes.

This was a retrospective study carried out in a single hospital. The patients were not followed after treatment to assess the prognosis. Thus, to confirm our results and to assess prognosis, a prospective study or a randomized control trial should be carried out on patients from different hospitals in future.

CONCLUSION

Endplate modic changes are frequent finding in MRI of lumbar spine of patients with degenerative disease of lumbar spine. These are markers of degenerative process occurring with increasing age. Type 2 modic changes are most common. L5-S1 disc levels are most commonly involved. By determining the distribution of modic changes in lumbar spine, we have conducted a preliminary analysis. Further investigations need to be done to assess its clinical efficacy.

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Author's Contribution

MS conceived the idea, and did literature review. MRK planned the study, and drafted the manuscript. MRK did the statistical analysis. NT critically reviewed the manuscript. AS and KR critically reviewed the manuscript. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest

Authors declared no conflict of interest

Grant Support and Financial Disclosure

None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.