



MODIC CHANGES AND END PLATE INVOLVEMENT ASSESSMENT BY MRI AND RADIOGRAPHY.

Radiology

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ABSTRACT

Back ground: Diagnosing low back pain clinically is difficult in certain situations; in such cases identifying the cause can be done by radiological investigations such as plain radiography, MRI. The main factors responsible for low back ache include degenerative disc disease, infective, congenital, neoplastic and non traumatic spondylolisthesis.

Aim: The aim of this study is to study the MODIC changes among patients presenting with low back pain and end plate involvement assessment by MRI and radiography.

Materials and Methods: Data from all the patients was collected pertaining to age, sex, socioeconomic status, relevant personal history, family history, history of trauma. These patients were advised to undergo Plain radiography and MRI to identify exact cause of low back ache. Results of MODIC changes, anteroposterior, lateral view radiography findings and MRI end plate changes in sagittal T1W, T2W and STIR sequences was entered into spread excel sheet and evaluated.

Results: Out of 120 patients with low back ache, 44 (36.6%) patients were noted with MODIC changes by radiography and MRI. Out of 44 patients with MODIC changes, 17 (38.6%) patients who had type II/III and 12 (27.2%) patients who had type II were observed in majority, followed by 7 (15.9%) patients with type I/II, 6 (13.6%) patients with type III and 2 (4.5%) patients with type I.

Conclusion: Now-a-days, most number of patients unable to bear pain anymore, so advancement is going more towards accurate diagnosis and early management. In such cases MRI is an ultimate to diagnose the pathology behind Low Back Pain and Plain radiography is readily available in any nearby accessible health care settings.

KEYWORDS

Low Back Pain, MODIC Changes.

INTRODUCTION

Worldwide, the most common musculoskeletal clinical feature affecting adults is low back ache, which is influenced by various socioeconomic considerations. Prevalence of low back pain among adults worldwide is up to 84% [1].

The main factors responsible for low back ache include degenerative disc disease, infective, congenital, neoplastic and non traumatic spondylolisthesis. Disc degenerative disease can present in various ways includes disc bulging, disc protrusion, disc extrusions, nerve root compression and annular tears as the cause of back ache [2]. Among this commonest cause for low back ache is disc degenerative disease.

Diagnosing low back pain clinically is difficult in certain situations; in such cases identifying the cause can be done by radiological investigations such as plain radiography, MRI. Plain radiography is the most preferable investigation by many clinicians in early stage, as it is low cost and easy availability in all health care settings. Plain radiography helps to identify bone deformities, but it has got its own limitations [3]. MRI is the ultimate gold standard investigation which can diagnose all possible causes, even dynamic markers in vertebral endplate can be visualized by MRI [4]. In detecting bone marrow diseases, MRI is superior when compared to other imaging modalities due to lack of ionizing radiation and multiplanar imaging capability.

Modic changes are a term which is used to describe the changes of the vertebral endplate which are related to spinal degeneration. On MRI demonstrates signal intensity changes during the degeneration process, whether it is fat, oedema or sclerosis. Modic changes are thought to be a dynamic process which can change and progress, but no cases have been reported where Modic changes have gone away [5].

On MRI, Modic changes will look like signal alteration in the endplates parallel to the disc. They are most common in the lumbar spine, and whilst they can occur at any level, they are most commonly observed at L4/5 and L5/S1. Where the changes occur is variable too. Commonly they occur anteriorly, but there are also cases where there is near-complete vertebral.

There are three types of MODIC changes [5,6] Type I - Represents fibrovascular changes in the subchondral bone marrow such as oedema and inflammation. Type 2 - Represents replacement of bone with fatty yellow marrow. It can be distinguished with increased signal intensity in both T1 and T2 images. Type 3 - Represents the replacement of bone with bony sclerosis where there is little residual marrow.

The etiology of MODIC changes is unknown. However, there are three possible hypothesis for the pathogenesis of MODIC changes: a biomechanical, biochemical (these two may be interrelated) and infective hypothesis.

Risk factors for MODIC changes can be classified into disc/endplate damage (DD, disc herniation, endplate defects), systemic factors (smoking, ageing, male gender, genetics), and hyperloading (obesity, spinal deformities, high occupational load) [7,8]. The unidentified and multifactorial nature of MC is especially true for MC1; conversely, MC2 mainly associates with hyperloading and systemic factors [9,10].

The aim of this study is to study the MODIC changes among patients presenting with low back pain and end plate involvement assessment by MRI and radiography.

MATERIALS AND METHODS

This is a prospective study was carried out from October 2018 to February 2019 at Government General Hospital, Anantapuramu. A total of 120 patients presented with low back pain and referred to Department of Radiology were included in this study.

Inclusion criteria:

Both sexes of age group between 21-70 years.
Those who are willing to undergo radiography and MRI.

Exclusion criteria:

Pregnant women
Patients with Fracture vertebrae, infective pathology and spinal tumors
Patients with implants
Previously operated patients for spinal surgery.

Data from all the patients was collected pertaining to age, sex, socioeconomic status, relevant personal history, family history, history of trauma. These patients were advised to undergo Plain radiography and MRI to identify exact cause of low back ache. Radiograph of the spine is performed with a 500 mAs Alengers machine using a 14 x 17 inch cassette with 70-100 kV and 15-50 mAs. MRI lumbosacral spine is taken using a 1.5Tesla Philips 16 channel. Different sequences that performed were T1-sag, T2-sag, T2-axial and STIR – sag.

Results of MODIC changes, anteroposterior, lateral view radiography findings and MRI end plate changes in sagittal T1W, T2W and STIR sequences was entered into spread excel sheet and evaluated.

RESULTS

Out of 120 patients presented with low back pain, 74 (61.6%) were males and remaining 46 (38.3%) were females. Most of the patients were presented with low back ache in the age group of 31-60 years, i.e., 91 (75.8%) patients out of 120. 17.5% (21 out of 120 patients) of patients were observed in the age group of 21-30 years (Table 1).

Table 1. Age and Sex distribution

Age in years	Male	Percentage	Female	Percentage	Total	Percentage
21-30	12	10%	7	5.8%	21	17.5%
31-40	18	15%	12	10%	30	25%
41-50	19	15.8%	14	11.6%	33	27.5%
51-60	15	12.5%	11	9.1%	28	23.3%
61-70	10	8.3%	2	1.6%	8	6.6%
Total	74	61.6%	46	38.3%	120	100%

Out of 120 patients with low back ache, 44 (36.6%) patients were noted with MODIC changes by radiography and MRI. Among different types of MODIC changes, type II, type II/III was noted predominantly. Out of 44 patients with MODIC changes, 17 (38.6%) patients who had type II/III and 12 (27.2%) patients who had type II were observed in majority, followed by 7 (15.9%) patients with type I/II, 6 (13.6%) patients with type III and 2 (4.5%) patients with type I (Fig 1).

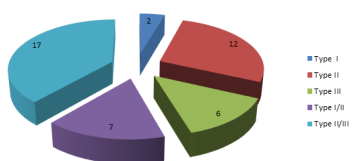


Fig 1. Prevalence of various types of MODIC changes

MODIC type I was noted in the age group of 21-40 years, MODIC type II & I/II observed in patients under 41-50 years predominantly, majority of MODIC type III & II/III was observed in the age group of 41-60 years (Table 2).

Table 2. MODIC changes in relation to age

Age in years	No. of patients	I	II	III	I/II	II/III	Total
21-30	21	1 (4.7)	1 (4.7)	0	0	1 (4.7)	3
31-40	30	1 (3.3)	2 (6.6)	0	1 (3.3)	2 (6.6)	6
41-50	33	0	5 (15.1)	3 (9.0)	4 (12.1)	6 (18.1)	18
51-60	28	0	3 (10.7)	3 (10.7)	2 (7.1)	7 (25)	15
61-70	8	0	1 (12.5)	0	0	1 (12.5)	2
Total	120	2	12	6	7	17	44

All the positive cases of MODIC changes were evaluated for their endplate distribution according to each subtype. 68.1% of the patients showed endplate involvement at L5-S1 level, followed by 38.6% at L4-L5 level (Table 3).

Table 3. Endplate distribution of MODIC changes

MODIC type	S1-sup erior	L5-infer ior	L5-sup erior	L4-infer ior	L4-sup erior	L3-infer ior	L3-sup erior	L2-infe rior	L2-sup erior
I	2	2	0	0	0	0	0	0	0
II	8	12	8	2	1	1	0	0	0
III	4	0	3	1	0	1	0	0	0
I/II	5	4	5	1	0	0	0	0	0
II/III	11	8	1	1	0	1	1	1	1

DISCUSSION

MRI of the spine is a commonly used diagnostic tool in patients with back pain and requires an understanding of not only the findings of common degenerative changes but also of the normal appearance of bone marrow and common benign lesions.

Morphologic changes to the endplates and subchondral bone occur with advancing age, but also in association with disc degeneration. It is difficult to differentiate changes that occur solely due to aging from those that are associated with degeneration. Interestingly, however, endplate changes have been observed to precede the intra discal changes [11,12]. During the first decade, vascular channels through the endplate diminish and the first endplate cracks are seen. Vascular channels disappear by the age of 20 and only the outer parts of the annular lamellae may contain tiny collateral vessels. At this stage, cartilage cracks and micro fractures of the adjacent subchondral bone

with new bone formation are frequently seen. From the third decade, abnormalities of the EP are very similar to those seen in younger groups, but in increasing numbers. Starting in the fourth decade, trabeculae in the vertebral body change in size and pattern resulting in decreased vertebral body strength and density [12,13].

In the fourth and fifth decades, advanced degeneration with structural disorganization of the EP is observed. During the sixth and seventh decades, tissue alterations become most severe, including micro fractures and bone sclerosis. After this stage, scar formation, large tissue defects and calcification of the endplates are seen [13].

whereas two studies have shown that type I may be more common [14,15]. Meanwhile, Kjaer et al [16] identified the prevalence of MC was only 0.5% in a study of 439 thirteen-year-old children.

MODIC changes are bone marrow sign all intensity changes adjacent to the endplates of the degenerated intervertebral discs in magnetic resonance imaging.

In studies by Modic et al [4], Kjaer et al [14] -The prevalence of Modic changes has been found to increase with age and they are uncommon in younger individuals. Since the working class in our country predominantly belongs to the age group of 31 to 50 and with other associated factors of increased degenerative processes MODIC changes are more prevalent in these groups.

Chung et al [17] investigated the frequency and distribution of MC in 59 asymptomatic subjects and found 11 MC type I and 38 MC type II in 590 lumbar vertebral endplates. In other study of 60 asymptomatic subjects by Weishaupt et al [15], one reader identified that the prevalence of MC on MRI only was 11% in the study population (type I, 2%; type II, 7% and type III, 2%).

First, Modic et al [18] observed that the distribution of MC at L4-L5 or L5-S1 were most common. These observations were confirmed by Kuisma et al [19]. Moreover, the depth and extent of MC were greatest at L4-L5 and L5-S1.

In a study by Karchevsky et al [20], prevalence of MODIC changes 77% of the males had MODIC changes.

In a study by Albert & Manniche, Karchevsky et al, the prevalence of Modic changes among patients with degenerative disc disease of the lumbar spine has been reported to vary between 19 and 59% [7,20].

Modic changes have been observed to be a more common MRI-finding in patients with LBA compared to non-clinical populations. Furthermore, Modic changes are uncommon in asymptomatic individuals without disc degeneration [4,12,18].

In several studies by Modic et al, Braithwaite et al. 1998, Schmid et al. 2004, Karchevsky et al. 2005), the predominance of type II has been observed to constitute up to 80% of Modic changes in the lumbar spine [4,18,20,21].

In studies by Karchevsky et al. 2005, Modic et al Changes occurred most commonly at L4-5 or L5 [4,20].

These findings may be related to the biomechanics of the lumbar spine. L5 is the largest of all movable vertebrae and it carries the weight of the upper body) and also as the L5-S1 vertebra being the transitional vertebra.

Also the prevalence of MODIC changes in younger age groups, asymptomatic population, specific occupational and lifestyle association needs to be studied.

Three hypotheses of the mechanism - biomechanical, biochemical and infective - have been proposed. To date, however, the evidence supporting these hypotheses or their possible interplay in the pathogenesis of MODIC changes is not clear.

Further studies with longer follow-up periods, more frequent MRI studies and larger sample sizes will be required.

CONCLUSION

Diagnosing Low back pain and treating patients accurately is sometimes a challenging aspect. Now-a-days, most number of patients unable to bear pain anymore, so advancement is going more towards accurate diagnosis and early management. In such cases MRI is an ultimate to diagnose the pathology behind Low Back Pain and Plain radiography is readily available in any nearby accessible health care settings. In certain situations, these two investigations play an important role, clinicians can choose based on requirement.

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