Original article:

MR Imaging of Modic Changes in Lumbar Disc Degeneration

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Abstract

Background: The association of Modic changes in patients with degenerative disc disease of the lumbar spine is well known. However there is disagreement as to which type of Modic changes are most prevalent .This difference can be purely due to selection and sampling errors or may point towards additional significance towards etiopathogenesis of degenerative disc disease. Our study was done on 50 patients with lumbar degenerative disc disease and associated Modic changes to find the relative frequency of each type of Modic change with degenerative disc.

Material and Methods : 50 patients including 32 males and 18 females who underwent MRI Spine examination on 1.5 Tesla Magnetom machine from July 2011 to June 2012 for low backache and related complaints and were found to have lumbar degenerative disc on imaging were evaluated for associated Modic endplate changes and frequency of each type studied .Observation : Out of 50 cases of degenerative disc disease,associated Modic Changes were seen in 40(80%) cases.Type 2 Change was the most frequent seen in 28(56%) cases,followed by type 1- 6(12%) cases and type 3 was least common seen in only 2(4%) cases. Mixed changes type 1&2 and 2&3 were seen in 4(8%) cases.

Conclusion: The prevalence of Modic changes among patients of degenerative disc varies with type 2 changes being the most common and type 3 and mixed-type changes being relatively rare. Study of prevalance and correlation of association of different types of Modic changes and disc degeneration may provide further insight into the pathological process of disk degeneration and factors contributing to degenerative disc disease.

Key-Words: Modic Changes, degenerative disc disease, MRI

Introduction

Modic changes were described initially in 1988 by the American radiologist, Michael Modic et al [1]. He described, three types of signal changes in endplates and adjoining marrow on MRI scans of lumbar vertebrae.Type 1 appears as low signal on T1-weighted images and high signal changes on T2-weighted images with vascular and inflammatory contents on histopathology .Type 2 is characterized by high signal changes on both T1-and T2-weighted images with fatty change and Type 3 Modic end plate changes appear low signal on both T1 and T2 and represent subchondral bony sclerosis [1, 2]. The association of Modic endplate changes with disc degeneration and low back pain has been described by several studies and our paper aims to study the prevalance and relative frequency of each type of Modic change with degenerative disc disease.

Material and Methods

Fifty patients more than 30 years of age who underwent MRI Spine examination on 1.5 Tesla Magnetom machine from July 2011 to June 2012 for low backache and related complaints and were diagnosed to have lumbar degenerative disc disease on imaging were evaluated for associated Modic endplate changes and study

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the relative frequency of each type of change. The imaging protocol consisted of localizer and imaging sequences in axial, sagittal and coronal planes; Sagittal Fast spin echo T1 weighted image: TR-500-900 msec,TE -10-20 msecs,FOV-370x370 mm2 ,slice thickness- 4 mm,intersection gap-1 mm ,matrix -270 x 384; Sagittal Fast spin echo T2 weighted image: TR-3000-5000 msec,TE -90-150 msecs,FOV-370x370 mm2 ,slice thickness- 4 mm,intersection gap-1 mm ,matrix -270 x 448; STIR coronal sequence: TI-160 msecs ,TR-2000-3000 msec,TE -20-40 msecs,FOV- 360x360 mm2 ,slice thickness- 4 mm,intersection gap-1.2 mm ,matrix -384x512; T1 weighted axial image: TR-500-900 msec,TE -10-20 msecs,FOV-220x220 mm2 ,slice thickness- 4 mm,intersection gap-1 mm ,matrix -256x256; T2 weighted axial image: TR-3000-5000 msec,TE -90-150 msecs,FOV-220x220 mm2 ,slice thickness- 4 mm,intersection gap-0.8 mm, matrix -230x384. The data was tabulated and analyzed.

Observation

Our study was done on 50 patients more than 30 years of age and included 32 males (64%) and 18 females (36%).Presenting complaints were low back pain in 30(60%), sciatica in 15(30%), weakness in legs 5(10%), Sensory loss/altered sensation of pins and needles 8 (16%) and bowel/bladder complaints in 2(4%) [Table 1].

Table 1: Presenting complaints in lumbar degenerative disc disease.

Presenting complaints	No.of patients
Low back pain	30
Sciatica	15
Weakness in legs	5
Sensory loss/altered sensation	8
Bowel/bladder complaints	2

MRI evaluation revealed that 7 of these patients had early disc bulge (No tear of annulus fibrosus) while remaining 43 had various grades of disc herniation –protrusion, extrusion and sequestration (with tear in annulus fibrosus). Evaluation for Modic changes revealed, associated end plate Changes in 40(80%) cases.Type 2 Change was the most frequent, seen in 28(56%) cases, followed by type 1 in 6(12%) cases and type 3 was least common seen in only 2(4%) cases. Mixed changes type 1&2 and 2&3 were seen in 3 and 1 case respectively (8%) cases **(Table 2).**

Table 2: Relative frequency of each type of Modic change

Type of Modic Change	Percentage
No Modic Change	20%
Type 1	12%
Type 2	56%
Type 3	4%
Mixed Type 1 and 2	6%
Mixed Type 2 and 3	2%

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All patients with low backpain as the presenting complaint were found to have associated Modic Changes particularly Type 1 in whom lowbackache was the presenting complaint in 100% cases.

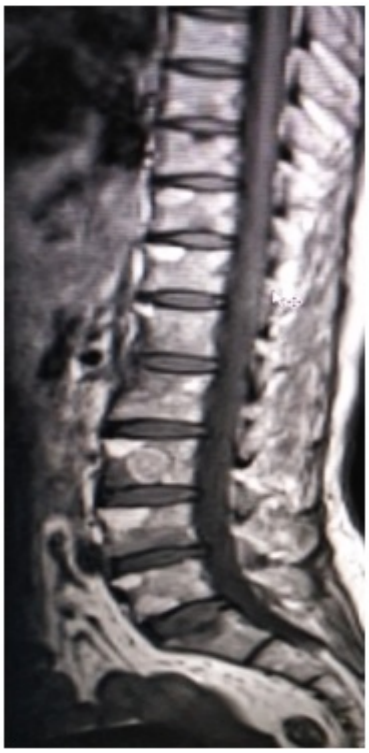

Figure 1: T1 weighted Image showing Type 2 Modic changes in all the lumbar vertebrae except L2 and S1vertebrae which are showing Type 1 Modic Change(Hypoinitensity in superior endplates) .

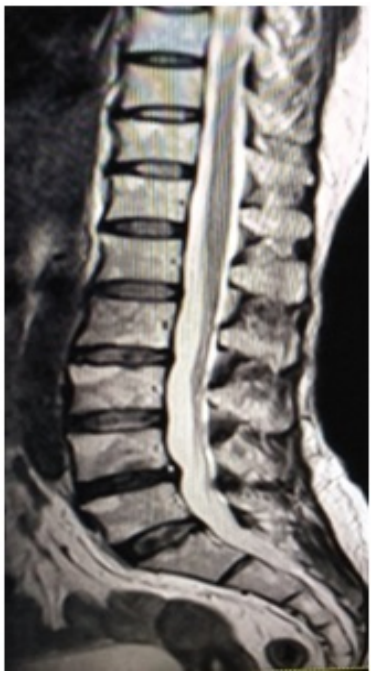

Figure 2: T2 weighted Image of the same patient confirming Type 2 Modic changes in all the lumbar vertebrae except L2 and S1vertebrae which are showing Type 1 Modic Change.

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Discussion:

In their original study, Modic et al examined histopathologic sections from patients with Modic changes and found that type 1 changes correspond to the inflammatory stage of degenerative disc while type 2 changes represent chronic granulomatous fatty stage progressing to sclerotic stage of subchondral bone in Type 3[1]. The higher prevalence and association of Modic changes with degenerative disc disease and backache has been well demonstrated by several authors. In the general population, Modic changes are found in 5–10% cases with prevalance rate increasing with age and it occurs most frequently in the L4-L5 and L5-S1 levels [3, 4]. It is supposed that Modic changes constitute a crucial step in the pathogenesis of degeneration of the disc and these changes with degenerative disc are much more frequently associated with clinical symptoms [5, 6].In our study we found Modic endplate changes in association with 80% of cases of disc degeneration and type 2 Modic change was the most common in our study group being found in 56% cases. The original study of Modic et al,has also shown that type 2 changes are the most frequent and account for up to 90% of these endplate changes[1]. Other studies have suggested that type 1 changes may be more common being seen in upto 68% cases [7].Such differences in prevalance frequency may be due to cohort size and sampling errors. However in middle aged and old patients with low backache prevalance rates of Modic changes particularly Type 1 change can be very high. The etiology suggested is that microfractures in endplates due to wear and tear or repeated trauma with age and herniation of the adjacent disc results in the production of inflammatory mediators and capillary ingrowth with increased blood flow resulting in low back pain[4,7,9]. Small Modic changes may disappear while larger ones persist and mixed type 1 and type 2 changes show that these can change and can convert from one type to another showing their dynamic or evolving character[9]. However Type 3 change have been shown to be irreversible.

Conclusion:

Modic changes represent dynamic markers of the age-related degenerative process affecting the spine and detailed studies of the prevalence and frequency of these types of endplate changes can provide valuable insight into the etiopathogenesis of degenerative disc disease as well as low backpain in this group of patients as well as the interplay of endplate, bone marrow and disc during the degenerative disc disease development process.

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