Prevalence and Factors Associated with Modic Changes of Lumbosacral Spine in Nepalese Patients with Chronic Low Back Pain

Pankaj R Nepal, Suman Rijal

ABSTRACT

Aim: To determine prevalence and factors affecting modic changes (MC) of vertebral endplate in patients with chronic low back pain Nepalese patients coming to a neurosurgical–tertiary care center in Nepal.

Materials and methods
Study design: Prospective analytical study
Sample size: 194 cases
Sampling technique: Nonprobability consecutive sampling

Data collection and analysis: Patients clinical data like age, gender, occupation, body mass index, smoking habit, and history of diabetes mellitus (DM) were noted and status of Modic changes were noted from the MRI. The analysis was done using SPSS-20. Mean and standard deviation (SD) were calculated for quantitative variables. Frequency and percentage were calculated for qualitative variables. Effect modifier has been controlled through stratification and post-stratification Chi-square test was applied with P≤0.05 was taken significantly.

Results: Overall prevalence of the Modic changes was 50.5% where MC II was the commonest of all the types. Prevalence of MC was significantly higher in patients who are elderly, obese, had severe pain on presentation, and had a habit of smoking.

Conclusion: Modic change occurring at the vertebral endplate is a common phenomenon with significant association with the age, severity of pain, smoking, and Body Mass Index (BMI).

Clinical significance: Modic changes (MC) are the pathological changes of the vertebral body and endplate of the vertebra. Its prevalence in the general population is about 6% and is present in about 35% of patients with low back pain (LBP). Since Modic et al. first described these changes, there have been various researches conducted to see its association with back pain; however, controversies still persist. MC Type I (MC-I) has a poor outcome in the patient with persistent LBP and has less improvement of back pain following microdiscectomy if they have Type I changes preoperatively. These vertebral endplate changes are also the essential features of associated disease progression.

Despite all these facts, controversies still persists. Hutton et al. claimed that these vertebral endplate changes are reversible. Similarly, Keller et al. stated that they do not influence the clinical course of back pain, and Jensen et al. showed their association with LBP are not constant.

INTRODUCTION

Modic change (MC) was first described in MRI by de Roos et al. in 1987 as pathological changes of the vertebral body and endplate of the vertebra. In 1986 its classification was formulated by Modic et al., into three types secondary to marrow edema, fatty degeneration and bony sclerosis (Table 1).

<table>
<thead>
<tr>
<th>Types</th>
<th>Underlying Pathology</th>
<th>TI</th>
<th>T2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC- I</td>
<td>Marrow edema</td>
<td>Hypointense</td>
<td>Hyperintense</td>
</tr>
<tr>
<td>MC- II</td>
<td>Fatty degeneration</td>
<td>Hyperintense</td>
<td>iso-hyperintense</td>
</tr>
<tr>
<td>MC- III</td>
<td>Bony sclerosis</td>
<td>Hypointense</td>
<td>Hypointense</td>
</tr>
</tbody>
</table>

Keywords: Low backache, Lower back pain, Modic changes, Herniated lumbar disc

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INTRODUCTION

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As MC is primarily diagnosed by MRI, its actual prevalence in general population is difficult to calculate; however, is quoted around 6% and is present in about 35% of patients with low back pain (LBP). Since Modic et al. first described these changes, there have been various researches conducted to see its association with back pain; however, controversies still persist. MC Type I (MC-I) has a poor outcome in the patient with persistent LBP and has less improvement of back pain following microdiscectomy if they have Type I changes preoperatively. These vertebral endplate changes are also the essential features of associated disease progression.

Despite all these facts, controversies still persist. Hutton et al. claimed that these vertebral endplate changes are reversible. Similarly, Keller et al. stated that they do not influence the clinical course of back pain, and Jensen et al. showed their association with LBP are not constant.
With the objective to determine prevalence and factors affecting Modic changes of lumbosacral vertebral endplate in patients with chronic low back pain, this study was conducted in a neurosurgical tertiary care center in Nepal.

**MATERIALS AND METHODS**

*Study design:* Prospective analytical study  
*Sample size:* 194 cases  
*Sampling technique:* Non-probability consecutive sampling  
*Duration:* 3 months  
*Inclusion criteria:* All male and female patients of 30–70 years of age, presented with moderate to severe pain, visual analogue scale (VAS) >3, for more than 3 months duration in this institute.

**Exclusion Criteria**

- Patients presented with recent trauma
- Obvious vertebral body injury or spinal injury
- Obvious vertebral body or disc lesions like metastasis or tuberculosis
- Obvious spinal deformity like scoliosis.

*Data collection:* All patients meeting the inclusion criteria were enrolled in the study. Patients' clinical data like age, gender, occupation, body mass index, smoking habit, and history of diabetes mellitus (DM) were noted, and status of modic changes was noted from the MRI of the patient (Figs 1 to 3) based on its classification (Table 1).

**Data Analysis**

Analysis has been done through SPSS software; version 20. Mean, standard deviation has been calculated for age, duration of pain, BMI, and VAS. Frequency and percentage have been calculated for gender, smoking status, diabetes mellitus, and MC in the vertebral endplate. Effect modifier has been controlled through the stratification of age, gender, duration of LBP, BMI, VAS, diabetes mellitus, and smoking status to see the effect of these factors on MC. Post-stratification chi-square test was used, and p-value of ≤0.05 was considered significant.

**RESULTS**

There were a total of 194 patients enrolled in the study, where 58.2% were females, and 41.8% were males. The age of the patients ranged from 30 to 70 years old. Age groups of 30–40 years and 60-70 years were more common, i.e., 27.8% and 29.9% respectively (Graph 1) with the mean age being 50.36 (SD: 13.22) years (Graph 2).

Among the enrolled patients, the highest frequency of the patients were farmers (46.4%) followed by 23.7% labors (Graph 3). The criteria “other” invariably involved the elderly (60–70 years of age), and they were retired office worker, army personnel, or not involved in any activities besides daily chores (Graph 4).

In this study, 11.3% of the total sampled patients had a previous history of diabetes mellitus, and 42.8% had a habit of smoking (Table 2).

Only those patients with low back pain of more than three months duration were considered in this study.
Among them, the most extended period of low back pain was 19 months, with mean duration being 9.64 (SD 2.76) months.

Mean BMI of the patients was 22.50 (SD 2.7) kg/m$^2$. Of all the patients, 70.6% of the patients had a healthy weight, and 20.6 % of them were overweighted (Table 3).

Table 2: Demographical data of diabetes and smoking

<table>
<thead>
<tr>
<th>Categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes mellitus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>172</td>
<td>88.7</td>
</tr>
<tr>
<td>yes</td>
<td>22</td>
<td>11.3</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>no</td>
<td>111</td>
<td>57.2</td>
</tr>
<tr>
<td>yes</td>
<td>83</td>
<td>42.8</td>
</tr>
</tbody>
</table>

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Mean BMI of the patients was 22.50 (SD 2.7) kg/m$^2$. Of all the patients, 70.6% of the patients had a healthy weight, and 20.6 % of them were overweighted (Table 3).

Table 3: Distribution of patients in different body mass index categories

<table>
<thead>
<tr>
<th>BMI categories</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (&lt;18.5)</td>
<td>17</td>
<td>8.8</td>
</tr>
<tr>
<td>Healthy weight (between 18.5 and 25)</td>
<td>137</td>
<td>70.6</td>
</tr>
<tr>
<td>Overweight (between 25 to 30)</td>
<td>40</td>
<td>20.6</td>
</tr>
</tbody>
</table>

VAS ranged from 4 to 9 with mean being 6.46 (SD 1.45). Among all the patients, the majority of patients (67.5%) had a moderate degree of pain (Table 4).

Table 4: Presentation of patients with different severity of pain

<table>
<thead>
<tr>
<th>Visual analogue scale categories (VAS)</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate pain (VAS 4-7)</td>
<td>131</td>
<td>67.5</td>
</tr>
<tr>
<td>Severe pain (VAS&gt;7)</td>
<td>63</td>
<td>32.5</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Prevalence and Association of Factors Affecting Modic Changes

The overall prevalence of MC was 50.6% (Table 5) with MC I being 9.3%, MC II being 35.6 % and MC III being 5.7% (Table 6).

Modic change (MC) had no significant gender preponderance (Table7); however, was significantly associated with age. With advancing age the prevalence of MC was increasing, until the highest prevalence (66.66%) at 61-70 years of age.
Prevalence of MC was highest in patients who have a sedentary lifestyle like office worker (17/24, 70.83%) and retired personnel (15/26, 57.26%); compared to other active groups like farmer and labor. However, the relation was not statistically significant (Table 7).

Prevalence of MC was common if the patient presented with severe pain (39/63, 57.14%) and the value was statistically significant. However, there was no significant association with the duration of pain (Table 7).

DM does not have a significant association with MC. But, the patient having a habit of smoking possessed higher prevalence of MC (67/83, 80.72%) with the high level of significance (Table 7).

The higher the BMI category, the higher was the prevalence of MC. The overweighted patients had 75% prevalence of MC which was statistically significant (Table 7).

**DISCUSSION**

**Prevalence of Modic Changes**

The overall prevalence of MC ranged from 16-25% in a different study population. However, in patients with chronic LBP the prevalence was as high as 62%. In this study, 98 out of 194 patients with chronic LBP, who had a history of back pain for more than 3 months, had MC which accounted for 50.5%.

**Modic Changes and Gender**

Females seem to have a higher prevalence of MC in most of the studies, which ranged between 52.5 to 70%, but statistic does not have a significant association in most of them. Similarly, our study also showed a higher prevalence of MC in female although it was statistically not significant.

**Modic Changes and Age**

Various studies have included the age from 18 to 80 years in the study population. And, some of those studies have shown significant association of MC with age. In this study, there was a similar finding of increasing prevalence of MC with increasing age groups, and the values were statistically significant.

**Modic Changes and Occupation**

Nepal is an agricultural country, 80% of the population survives as a farmer. This evidence was reflected in this study with the maximum number of patients being farmer (90, 46.39%), and followed by labor (35, 19.4%). Kjaer et al. in their study also showed a relationship between heavy physical work and modic changes; however, the prevalence of MC was more common in patients who lived a sedentary lifestyle like office worker (70.83%) and retired personnel (57.26%), but the association was not statistically significant.

**Modic Changes and VAS, Duration of Pain**

This study enrolled the patients with moderate (VAS 4–7) and severe (VAS >7) pain. The prevalence of MC seems

<table>
<thead>
<tr>
<th>Modic changes</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>96</td>
<td>49.5</td>
</tr>
<tr>
<td>Yes</td>
<td>98</td>
<td>50.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Categories</th>
<th>Modic changes</th>
<th>Frequency</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>No modic changes</td>
<td>96</td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td>Modic I</td>
<td>18</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>Modic II</td>
<td>69</td>
<td>35.6</td>
<td></td>
</tr>
<tr>
<td>Modic III</td>
<td>11</td>
<td>5.7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

Table 7: Association of different factors with modic changes

<table>
<thead>
<tr>
<th>Categories</th>
<th>No modic change</th>
<th>Modic change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>60/36</td>
<td>53/45</td>
<td>0.248</td>
</tr>
<tr>
<td>Age</td>
<td>40/40</td>
<td>14/25</td>
<td>0.000*</td>
</tr>
<tr>
<td>Occupation</td>
<td>24/48</td>
<td>22/42</td>
<td>0.123</td>
</tr>
<tr>
<td>VAS</td>
<td>72/11</td>
<td>59/11</td>
<td>0.032*</td>
</tr>
<tr>
<td>Duration of Pain</td>
<td>24/9</td>
<td>39/11</td>
<td>0.06</td>
</tr>
<tr>
<td>DM</td>
<td>86/10</td>
<td>86/12</td>
<td>0.822</td>
</tr>
<tr>
<td>Smoking</td>
<td>80/16</td>
<td>31/67</td>
<td>0.000*</td>
</tr>
<tr>
<td>BMI categories</td>
<td>12/12</td>
<td>5/56</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*means p-value <0.05.
to be significantly associated with severity of pain at presentation, 61.9% of MC was noted in the patient who presented with severe pain; however, the prevalence of MC was not associated with the duration of pain.

**Modic Changes and Diabetes, Smoking**

Kjaer et al. in their study also showed the positive association of smoking with modic changes.24 Similarly, in our study, there was a significant association of smoking with MC in vertebral endplates. The prevalence was 80.7% in patients who had the habit of smoking compared to 27.9% in the non-smoker.

**Modic Changes and BMI**

In previous studies, overweight in combination with laborious physical activity was significantly associated with the prevalence of modic changes.25 Similar findings were also note in the study of Karchevsky et al. where it showed there was the significant association between prevalence of MC with increasing weight but not with BMI. In this study, the prevalence of MC seems to be increasing from 29.4% among underweighted patients to 75% among overweighted patients with a high level of statistical significance (Table 7).

**CONCLUSION**

Modic change occurring at the vertebral endplate is a common phenomenon with the prevalence of 50.5% in patients presented with chronic low back pain, with Type II MC having the highest prevalence of all the subtypes. These changes have a significant association with the age, habit of smoking, the severity of pain at presentation, and BMI.

**REFERENCES**