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Original Article

Radiology Section

Correlation between Pain, Disability and Levels of Disc Herniation in Michigan State University Grade-3 Disc Prolapsed Patients using Magnetic Resonance Imaging: A Cross-sectional Study

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ABSTRACT

Introduction: Sciatica is considered as a pain with radiation from the back to the dermatome of the nerve root which gets compressed. Clinical decision making for the diagnosis and treatment of the patients with sciatica need the support from the imaging of the spine. Magnetic Resonance Imaging (MRI) is the best modality for screening the spine.

Aim: To identify the relationship between pain, disability and levels of disc herniation in grade-3 disc prolapsed patients.

Materials and Methods: The present study was a cross-sectional study, which was conducted in the King Khalid Hospital, Hail, Saudi Arabia from November 2019 to May 2020. In this study, 57 patients were included and their consent was obtained. Patients reported their intensity of back and leg pain in Visual Analogue Scale (VAS) and recorded their disability in the Roland Morris Disability Questionnaire (RMDQ-Arabic version). Clinical examination of the spine and the lower extremity was done, followed by MRI for all the patients. The degree of the disc displacement and nerve root compression was graded according to the Michigan State University (MSU) classification of disc herniation. Documented data was statistically analysed using Statistical Package for the Social Sciences (SPSS) 20.0 version with the Pearson's correlation.

Results: Correlation between the pain intensity (VAS), Functional Disability (RMDQ) and grade-3 disc herniation in MRI were measured with Pearson correlation coefficient. Grade-3 disc herniation had weak correlation with pain intensity (r=-0.147) and also with functional disability (r=0.155). In these patients, pain intensity and functional disability also showed weak correlation disability (r=0.293).

Conclusion: Level of the disc herniation shows weak correlation with both intensity of pain and functional disability; thus, it is advisable to correlate the clinical symptom of the patients with MRI to decide the therapeutic intervention.

Keywords: Dysfunction, Impairment, Intervertebral disc prolapse, Low back pain, Radiodiagnosis

INTRODUCTION

Low back pain affects approximately 80% of the population once in their lifetime and around 80% of the reason for this back pain is due to the structural changes due to intervertebral disc [1]. Disc herniation or Intervertebral Disc Prolapse (IVDP) is usually considered as a multifactorial mechanical derangement often related to the degeneration of the disc and may be due to poor posture or by external trauma of the spine especially during spinal flexion or rotation exercise and stretching of the back [2]. Throughout the world, degenerative disc disease is the most frequently known cause for low back pain [3]. Normally, negative pressure increases the hydration of the intervertebral disc and decreases pressure on the nerve root by removing the compression on the vertebral pulp [4]. Neuromuscular system plays a vital role in maintaining the stability of the spine as well as for the normal biomechanics of the lumbar spine [5,6]. In low back pain, weakness and fatigue of the back muscle as well as decreased mobility of the spine leads to pain and disability [7,8]. Thus, for the normal function of the spine, adequate contraction of the trunk muscle, balance between agonist and antagonist muscles and coordination of the structures around the spine is important [8,9]. Alteration in the muscular stabilisation ends in reduction of force to support the spine thus increases the risk of further injury to the spinal structures [6]. In IVDP, sciatic pain is responsible for the dysfunction in the lumbar spine, as these pain delays the onset of back muscle contraction [9].

MRI is one of the gold standard tools to evaluate the disc degeneration and intervertebral disc pathologies especially in dehydration, herniation, Schmorl's nodes and inflammatory changes in the endplates [10-12]. MRI is the excellent radiodiagnostic machine to assess the relationship of intervertebral disc with the surrounding soft tissues and neural structures [13]. Though, it is usually done to identify the pathology in the soft tissues around the spine, it is also helpful to detect the pathologies in the spinal canal and cord [14]. In IVDP patients, to have a complete evaluation of the problem and to judge the appropriate treatment, a valid objective measure as well as a standard scale is needed to grade the disc herniation [15]. MRI data specifies the shape, size, extent and location of the disc and the outcome of the IVDP patients and mostly depends on the size and location of the prolapsed disc within the spinal canal. It is documented that central disc extrusion and protrusion are less symptomatic than centrolateral or lateral lesions [16]. Herniated disc of same size may be symptomatic in some patients whereas asymptomatic in some other [17]. Thus, to avoid the misinterpretation of the abnormal MRI images in asymptomatic patients, clinical correlation is always essential before treating them [18].

The aim of this study was to find the correlation between level of disc herniation with pain and disability amongst patients with severe disc prolapse.

MATERIALS AND METHODS

This was a cross-sectional study carried out in the Department of Radiology of King Khalid Hospital, Hail, Saudi Arabia from November 2019 to May 2020. The research protocol was submitted to the Institutional Ethical Committee (King Khalid Hospital, Hail) and the approval was obtained before starting the research (KKH-RAD-2019-017-80 dated 14.09.2019). Information about the nature, procedure, risks and benefits of the research was given and written consent was obtained from all the study participants.

Inclusion criteria: Only grade 3-disc herniation patients as described by the MSU classification were included [19]. Both sexes, aged between 20-50 years, with ability to participate in the study without cognitive impairments were included in the study.

Exclusion criteria: Patients with any aetiology for their low back pain such as spinal deformities: scoliosis, kyphosis, spondylolisthesis, cancer, spinal injuries, trauma, fracture in the spine, ankylosing spondylitis, visceral problems, pregnancy and myofascial pain were excluded from this research. Patients receiving corticosteroid treatment in the last six months were also excluded.

Sample size calculation: The sample size calculation for the correlation was performed using G power 3.1.9.7 software. Considering an alpha of 0.05, a power of 0.80, calculated effect size for the model was 0.43, with a required sample of 38 individuals. For this study, a total of 57 patients with low back pain referred for MRI scan of lower back were included.

Study Procedure

Participants were assessed at baseline by an investigator, the severity of pain, functional disability and the extent of disc herniation.

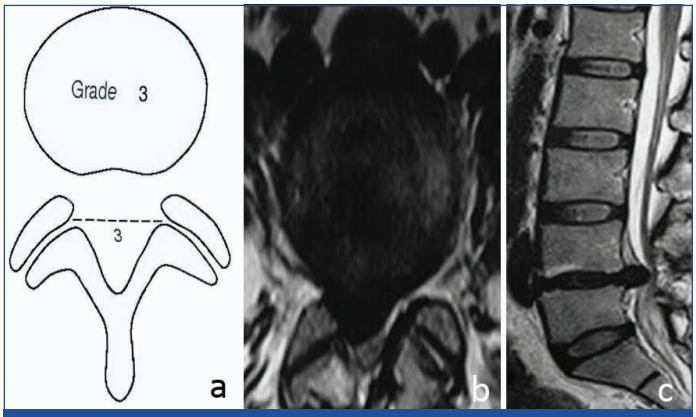
Pain: Pain was assessed using a VAS, consists of a 10 cm line, with the left extremity indicating "no pain" and the right extremity indicating "unbearable pain." Participants were asked to use the scale to indicate their current level of pain. Higher values suggest more intense pain [19].

Functional disability: Functional disability was estimated by the RMDQ, a functional scale to assess the impact of low back pain on daily activities. Though there are many functional questionnaires available for the measurement and evaluation of low back pain, RMDQ was appropriate for this study ([Valid Arabic version available for better understanding of the study population) [20]. The subjects were asked to tick a statement which suits their symptoms during a functional activity. The end score was calculated by just adding all the ticked boxes. The score ranges from 0 (no disability), 11 (mild), 18 (moderate) or 24 (severe).

Magnetic Resonance Imaging (MRI): All the patients underwent MRI diagnostic imaging in the supine lying using the 1.5 T MRI machine (Avanto; Siemens, Erlangen, Germany) with a 24-element body spine surface coil.

The MRI protocol consisted of sagittal and axial T1 and T2 weighted sequences with turbo spin echo. The procedure used as follows: T1-sagittal weighted sequences (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 320×320; field of view, 32×32 cm; TR/TE, 400/8 ms), T1- axial multistack and angle (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 320×320; field of view, 25×29 cm; TR/TE, 400/15 ms), T2- sagittal weighted sequences (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 320×320; field of view, 32×32 cm; TR/TE, 4700/100 ms), T2-axial weighted sequences (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 448×225; field of view, 25×19.5 cm; TR/TE, 4,600-5,150/100-110 ms), T2-STIR sagittal (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 320×320; field of view, 32×32 cm; TR/TE, 4000/110 ms), T2-axial multistack and angle (slice thickness, 3.0 mm; intersection gap, 1.0 mm; matrix size, 265×265; field of view, 25×290 cm; TR/TE, 3000/100 ms) [Table/Fig-1].

Evaluation and interpretation of the MRI changes (L1 to S1) was performed by two experienced musculoskeletal radiologist using standardised evaluation protocols. MSU classification [21] was used as an objective measure of lumbar disc herniation on MRI [Table/Fig-1].



[Table/Fig-1]: a) Grade 3 disc herniation with most impact on nerve compression; b) MRI axial T2 weighted image; and c) Sagittal T2 shows L4-L5 lumbar disc herniation.

STATISTICAL ANALYSIS

The SPSS version 20.0 for windows (SPSS Inc., Chicago, IL, USA) was used to perform the statistical analysis. Mean and the Standard Deviation (SD) of age, duration, height, weight, VAS and disability score was taken in all the patients. Pearson's correlation coefficient was done to find the correlation between the variables.

RESULTS

In this study, 57 patients with grade-3 disc herniation were evaluated and there were 30 males (52.6%) and 27 females (47.4%). The mean age of the patients was 36±8.1 (range: 20-50-years) [Table/Fig-2]. There were 18 males and 20 females in 41-50 years age group [Table/Fig-3].

Variables	Mean±SD
Age (years)	36±8.1
Weight (kg)	75±8.9
Height (cm)	171.6±7.79
Duration (days)	84±9.79
Male/Female	30/27

[Table/Fig-2]: Demographic data.

Age group (years)	Males	Females	Total
20-30	3	2	5
31-40	9	5	14
41-50	18	20	38
Total	30	27	57

[Table/Fig-3]: Distribution of the patients with reference to their age group.

Among the 3 types of level 3-disc herniation of MSU Classification, the prevalence of AB type was high in present study subjects with the 26 patients (45.6%) followed by the type B herniation with 21 subjects (36.8%). Only 10 subjects (17.6%) were there with type A herniation.

There was no significant relationship between the level of lumbar disc herniation and sex of the patients (p=0.567). Mean VAS score of these patients were 8±1 (range: 1-10), whereas the mean RMDQ score was 16±2 (range: 12-23). Pain intensity measured with VAS score in the patients with L4-L5 level and L5-S1 level disc herniation is shown in [Table/Fig-4].

Grade-3 disc herniation had weak correlation with pain intensity (r=-0.147; p=0.001) and also with functional disability (r=0.155; p=0.001). Pain intensity also had weak correlation with functional disability (r=0.293; p=0.02) in severe low back pain patients [Table/Fig-5].

Variables	Mean±SD
VAS	8±1
RMDQ	16±2
Pain score (VAS) at L4-L5 disc prolapsed patients	7.2±1.3
Pain score (VAS) at L5-S1 disc prolapsed patients	7.9±1.19

[Table/Fig-4]: Mean and standard deviation of the variables.

Variables	'r' value	p-value	Interpretation
Pain and disability	0.293	0.02*	Weak correlation
Pain and MSU	-0.147	0.001*	Weak correlation
Disability and MSU	0.155	0.001*	Weak correlation

[Table/Fig-5]: Correlation between pain, disability and level of disc prolapse.
*p-value is significant at <0.05; MSU: Michigan State University Classification.

DISCUSSION

In the present study, clinical symptom such as pain and disability in grade-3 disc herniation patients and its clinical correlation with the MRI findings was evaluated to determine the clinical importance of anatomical abnormalities identified by this radiographic technique. Not like the previous research works [22-24] which included only males, this study included both males and females. Low back pain and sciatica may develop as a result of disc degeneration and its cause may be multifactorial, which includes age-related changes, physical activity and their medical history [25]. With respect to the body mass index, subjects with overweight had 5.7 times higher risk of getting low back pain when compared to normal subjects [26]. Similarly, lifestyle also contributes in developing low back pain. A study showed that people who engaged in mild activity had more chances of getting low back pain than the one who did strenuous activity [26].

In this demographic study, clinical and MRI parameters has weak correlation with the pain intensity and disability in both male and female. It had been documented in an autopsy study of 647 lumbar spine that the disc degeneration is common in L4-L5 level [27], present study also observed similar findings. This usual presence of pathology at L4-L5 is not as high as noted in the previous research [28]. In low back pain, pain intensity influences the functional disability but, in this study, there was a weak correlation observed between the characteristic of pain and disability. This might be because of the young age group participants. In a study, it was found that pain intensity is a major variance to predict the disability among chronic low back pain [29]. To measure the severity of the back pain, disability is the best clinical evaluation tool. It also helps us to analyse the transformation of pain from acute to chronic stage [30] and acts a determinant of function such as return to work [31]. Sometime disc herniation can lead to more clinical symptom and higher incidence of disability [32]. This study found a weak correlation between the pain intensity and disability, which was in contrast to the previous research reported correlation of disability not only with pain intensity but also with other factors such as depression, fatigue, psychosocial factor, financial status and unemployment [33]. Disc protrusion and bulges were found to be highest in the 5th and 6th decade [34], but in present study it was in the 4th decade, this may be due to the limitation of the subjects' age.

Limitation(s)

The limitation of the present study was that body mass index, psychosocial factors such as depression, anxiety, financial status, smoking habits etc., were not evaluated. Also, asymptomatic subjects (control group) were not assigned.

CONCLUSION(S)

Level of disc herniation is frequently understood as the reason behind pain and disability. But this study shows that the grade-3 disc herniation in lumbosacral spine had weak correlation with both pain intensity and functional disability among patients with severe low back pain. Thus, authors encourage the clinicians to correlate the level of disc herniation in MRI with the clinical symptoms of the patients with low back pain.

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