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Original Article

Clinical correlation of magnetic resonance imaging with symptom complex in prolapsed intervertebral disc disease: A cross-sectional double blind analysis

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Abstract

Introduction: Low backache (LBA) is one of the most common problems and herniated lumbar disc is one of the most commonly diagnosed abnormalities associated with LBA. Disc herniation of the same size may be asymptomatic in one patient and can lead to severe nerve root compromise in another patient. **Objective:** To evaluate correlation between the clinical features of disc collapse and magnetic resonance imaging (MRI) finding to determine the clinical importance of anatomical abnormalities identified by MRI technique. **Summary:** From January 2010 to January 2012, 75 otherwise healthy patients (43 males 32 females) between the age of 19 and 55 years (average age was 44.5 years) with low back pain and predominant complaint of root pain who presented to our clinic were included in the study. **Materials and Methods:** Proper screening was done to rule out previous spine affection and subjected to MRI. **Results:** The results were analyzed under four headings viz. disc herniation, disc degeneration, thecal sac deformation and neural foramen effacement. All patients had a visual analog score (VAS) score more than 6. The interrater correlation coefficient kappa was calculated to be k=0.51. There were total 44 patients with herniation, 25 patients had mild, one patient had moderate degree of thecal sac deformation, 21 patients had one or more levels of foraminal effacement by the herniated tissue, 100% of the patients had disc degeneration ranging from grade 1 to 3 at different levels; and 48 patients (64%) had radiculopathy, six (8%) patients had bilateral and others had ipsilateral affection. **Conclusion:** In our study, the correlation was made between clinical findings and MRI findings. It can safely be concluded that treating physician should put more emphasis on history, clinical examination, and make the inference by these and then should correlate the clinical findings with that of MRI to reach a final diagnosis.

Key words: Disc degeneration, disc herniation, neural foramen effacement, thecal sac deformation

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INTRODUCTION

Low backache (LBA) is one of the most common problems encountered in medical practice, with 70-80% of adults experiencing it at some time during their lives.[1] Low back pain results from many causes including degenerative changes, spinal stenosis, neoplasm, infection, trauma, and inflammatory or arthritic processes. Herniated lumbar disc is one of the most commonly diagnosed abnormalities associated with LBA.[2] Disc herniation of the same size may be asymptomatic in one patient and can lead to severe nerve root compromise in another patient.[3] The diagnosis

of the disc herniation many a times becomes complex because one not only has to correlate clinical symptoms and signs with image findings but also has to determine which of the anatomic abnormality is the cause of the patient's pain.[4] Magnetic Resonance Imaging (MRI) has emerged as an investigation of choice over the other investigations for a herniated disc and become a gold standard to diagnose herniated disc.[5] Despite the high sensitivity of MRI, there is still a question about whether the modality is acceptably specific or not as sometime it reveals abnormal finding in the absence of clinical signs and symptoms.[6] Though MRI represent a tool for morphologic and biochemical analysis of disc disease, yet there is only a moderate correlation between the imaging evidence of disc herniation and the presence of symptoms.[7] To jump from identification of an anatomic derangement in MRI to symptom complex must be made with caution. Therefore, correlation between the clinical features of disc collapse and MRI is necessary to determine the clinical importance of anatomical abnormalities identified by MRI technique.[8] A prospective, cross-sectional, double blind, observational study thus was planned to evaluate the association between MRI findings with clinical features in symptomatic patients.

MATERIALS AND METHODS

From January 2010 to January 2012, 75 otherwise healthy patients (43 males 32 females) between the 19 and 55 years with low back pain and predominant complaint of root pain who presented to our clinic were included in the study. One case was excluded because of grade 1 spondylolisthesis. Written and informed consent was taken. The study was approved from our institute's scientific review board. Patients with previous history of spinal trauma, infection, tumor, lumbar canal stenosis, spondylolisthesis, cauda equina syndrome, metabolic spinal disease, previous spinal surgery, or any contraindication to MRI (pacemakers and metal implant, prosthesis inside the body, etc.) were screened before and excluded from the study. A detailed general physical examination, abdominal examination, as well as examination of hips and sacroiliac joints were carried out to ensure that the cause of pain and other symptoms are not arising from them. Standard radiographs of the lumbar spine were taken to rule out above - mentioned ailments.

MRI examination

After screening all the patients were subjected to MRI examination. A 1.5 Tesla machine was used to obtain MRI with standard protocol. (Magnetom Vision, Siemens Medical System, Erlangen, Germany) using a circular polarized spine array coil placed under lumbar spine. The protocol consisted of T1-weighted fast spin echo scans (TR/TE/NEX: 500 ms /12 ms /1 ms, slice thickness: 3 mm, matrix size: 256 × 516 FOV: 25 cm, and flip angle: 90°) and T2-weighted fast spin echo scans (TR/TE/NEX: 2,220 m s/ 80 ms/ 20 ms, slice thickness: 3mm, matrix size: 256 × 516 FOV: 25 cm, flip angle: 67°). Scans were obtained in axial and sagittal plane; axial sections were taken across the lumbar discs and superior and inferior end plates of lumbar vertebrae. After MRI, the scans were first examined for any evidence of inflammatory, infective, neoplastic, and metabolic diseases; previous spinal surgery, spinal stenosis, and then films were studied for disc disease.

Radiological methodology[9,10]

To assess interrater reliability, two different radiologists (SB and SS), who were blinded about the clinical findings, did the reporting independently and to assess intrarater reliability both radiologist evaluated all the images after an interval of 3 months from initial evaluation. The radiologists recorded the findings using following criteria on a Performa (Annexure A). 1. Disc herniation- Protrusion, extrusion and sequestration. Protrusion was taken as a herniation that maintains contact with the disc of origin by a bridge as wide as, or wider than, any diameter of the displaced material. Extrusion of the herniated disc was taken when the diameter of the disc material beyond the interspace is wider than the bridge, if any, that connects to the disc of origin. A sequestered disc was taken as an extrusion that is no longer contiguous with the parent disc. 2. Disc degeneration: Grade 1-5, 3. Thecal sac deformation: 0-absent, 1-minimal, 2-moderate (anteroposterior [AP] diameter ≥7 mm) 3-severe (AP diameter <7 mm), 4. Nerve compression: 0-absent, 1-minimal (displacement <2 mm), 2-moderate (displacement ≥2 mm).

Clinical methodology

One senior orthopedic surgeon who was blinded about the MRI findings evaluated the clinical symptomatology and recorded the findings according to a detailed performa citing visual analogue score (VAS), pain drawings, Oswestry Disability Index (ODI), neurological examination pertaining to root irritation and root compression signs (annexure B). Predominant complaint of root pain was taken as leg pain and-/or parasthesia approximating to dermatome distribution radiating to ankle or foot and greater than low back pain, and pain with intermittent history or with periods of remission, positional and postural relief. Root irritation signs were taken as restricted straight leg raising (SLR), well leg raising, and Leségue test or bowstring test. The most important feature of nerve root irritation was taken to be the reproduction of leg pain, from any of the above mentioned test. Root compression signs were considered when there was muscle weakness, muscle wasting, sensory impairment to fine touch and reflex depression approximating to myotomal or dermatomal pattern.

Statistical analysis

The data obtained thereof was subjected to standard statistical analysis on Statistical package for Social Sciences (SPSS) 10 and Microsoft Excel programs. The results were expressed as percentages, mean and standard deviations and were statically analyzed by using chi-square test. A *P*-value of ≤ 0.05 was considered to be significant and *P*-value of < 0.001 was considered to be highly significant. The statistical method utilized for rating agreement between pair of evaluators was a standard 2 × 2 table with a kappa coefficient. The kappa value had poor agreement if it is less than 0.20, fair agreement between 0.20 and 0.40, moderate agreement k = 0.40-0.60, good agreement k = 0.60-0.80, and very good agreement if k = 0.80-1.00.

Association

No correlation between the MRI findings and the clinical features was considered when signs of nerve root compression or irritation were not there at the same level or higher or ipsilaterally as reported by radiologist with higher intrarater reliability, that is, having a higher kappa value when tested 3 months apart. Central disc was taken as cause of symptomatology of either side. The severity of the disc lesion and its symptom complex was further analyzed and is described further.

Results

The results were analyzed under four headings viz. disc herniation, disc degeneration, thecal sac deformation, and neural foramen effacement.

There was comparable sex distribution, 43 were males and 32 females and most of the patients were between age group of 31 and 40 years, the average age was 44.5 years. There was equitable distribution of patients as per occupation; 27 were manual laborers, 26 were housewives, and 22 were professionals having mainly sedentary lifestyle.

Duration of pain was plotted on a graph and the curve obtained was bell-shaped with a sag in the middle indicating that majority of the patients came either initially within 3 months or after a year when their chronic pain did not subside.

67% patients had a history of previous episode of backpain and/or pain radiating to the leg and in 40 percent of the cases activities of daily living (ADL) were hampered, showing significant burden on their respective families.

L4 L5 and L5 S1 disc was involved in 94% of the cases. L4 L5 level of disc was involved in 36 % of the patients. All patients had a VAS score more than 6.

Cohen's correlation coefficient

The interrater correlation coefficient kappa was calculated to be k=0.51 (rounded off) indicating 'moderate' agreement between the two radiologist. The kappa score for the first radiologist indicated higher intrarater correlation (k=0.88) as compared to the second (k=0.73) done 3 months apart, therefore findings of the former radiologist were considered while comparing the clinical with MRI findings.

Disc herniation

According to degree of disc herniation, the patients were divided into i) subjects with no disc herniation, ii) having protrusion at one or multiple levels, iii) patients having extrusion of any level of disc even if they had protrusion at any other level, and iv) patients having sequestered disc.

There were total 44 patients with protrusion, 14 with extrusion, two with sequestration, and 15 patients with no herniation of the disc.

The protrusion group had mean VAS of 7.6 and mean ODI of 37%. sixteen patients had sensory deficit on the corresponding sign; 11 patients had motor weakness out of 16 patients with sensory deficit; 31 patients had radiculopathy and out of 15 who did not have, five had sensory deficit on ipsilateral side.

The extrusion group had mean VAS of 7.8 and mean ODI 37.92%. Ten patients had motor weakness with three out of them showing no sensory deficit. One patient had sensory deficit, but and radiculopathy but no motor weakness. Two patients showed no features of neural compression but one of them showed evidence of nerve irritation seen as radiculopathy. Only one patient had no neurological signs or radiculopathy. Four patients had neural foramen encroachment. Interestingly this group with rather serious ailment had only one female patient.

The sequestration group had n = 2, both had sensory motor involvement but one did not have radiculopathy; the MRI in this case also showed that there is no canal encroachment of the disc compressing the neural foramina.

The group, which had no disc herniation, was most extensively studied. It was found that mean VAS was 7.6 and ODI was 31.06%. Only three of them had radiculopathy and no features of neural compression or irritation were found in rest of them, thus indicating good correlation with MRI findings. Interestingly the second opinion on MRI scans of these patients revealed protrusions at the corresponding levels.

Thecal sac indentation

This results in symptoms of canal stenosis. In our study 25 patients had mild and one patient had moderate degree of thecal sac deformation. No thecal sac indentation was found in rest of the patients. This has correlated well with the clinical findings in these patients with P value ≤ 0.05. The sensitivity and specificity of MRI in predicting absence of neural claudication thus is 98.6 and 99%, respectively from our present study as regards mild and moderate indentation as mild indentation does not cause significant symptoms in a previously spacious canal. Severe degrees of thecal sac indentation were not found as the clinical exclusion criteria included features of canal stenosis.

Neural foramen effacement

This entity should correlate with the radicular pain. In this study, 21 patients had one or more levels of foraminal encroachment by the herniated tissue. But 48 patients had radiculopathy. Two patients from the absent disc group and three from the protrusion group were reported to be having minimal to moderate neural foramen encroachment but they did not have radiculopathy. Rest all had ipsilateral symptoms. It could be thought that rest of the other patients had nerve root irritation signs from the protruding disc inside the canal. With P ≤ 0.05 there is a good correlation between MRI predictions of having a radiculopathy as only two patients from no disc herniation group with no symptoms of nerve irritation were reported to have foraminal effacement.

Disc degeneration could be correlated well as being the mechanical cause of persistent back pain present in all the patients. It was found that 100% of the patients had disc degeneration ranging from grade 1 to 3 at different levels.

Radiculopathy

Out of total 75 patients; 48 (64%) had radiculopathy, 6 (8%) patients had bilateral and others had ipsilateral affection

(22 patients having left and 20 patients right side). In 14 patients with extrusion, 13 (93%) had radiculopathy, in 45 patients having pure protrusion, 31 (69%) patients had ipsilateral radiculopathy; and out of 14 patients with no disc herniation three (21%) had radiculopathy. We analyzed this group carefully and found that all three were reported as protrusion by the second radiologist. They were having minimal thecal sac indentation and two of them had exit foramen stenosis also. Interestingly two patients had sequestered disc, out of whom only one had radiculopathy, In these patients the disc was not indenting the thecal sac nor was it encroaching upon the the exit foramina. When the side of the radiculopathy was analyzed, out of six patients with bilateral affection, five were in protrusion group; one was in the group with no disc herniation, (the same patient reported positive by the second radiologist). Hence, it could be deduced that there is a clear correlation between the side of the disc herniation and radicular involvement.

DISCUSSION

To our knowledge this is the first detailed double blind study analyzing pure disc herniation with clinical symptomatology from this part of the globe. Similar studies are done elsewhere, but this study statistically proves many facts prevailing in our society. One of the most significant finding was that the degree of disc herniation was correlating well with the symptoms as we saw in different groups. The kappa value that is highly sensitive to the variations made by two individual or the same person spatially displaced in time leaves very little room of error. In our case we found it to be slightly more than 0.5, which is good correlation between two radiologists. It was also significant that no statistically significant difference was seen in the ODI or VAS in patients with or without disc herniation indicating that significant backache might not have mechanical etiology.

The average age of people presenting with low backache was in accordance with other studies (Horal and Suk *et al*).[11,12] and there was no specific trend seen in degree of disc herniation, degeneration, VAS, or ODI.

Male preponderance is seen in many studies investigating backache, we had almost equitable distribution of males and females the reason perhaps is that in this hilly state female have more physical activity and it is generally a matriarchal society. According to our groups, the number of males increased as the degree of herniation increased. The group with no disc herniation on MRI consisted of predominantly females, whereas extrusion and sequestration group had male predominance.

The subjects in no disc herniation group had a VAS and ODI similar to that in the extrusion group ($P \geq 0.05$) indicating there were no difference in pain and disability in all these groups. The male predominance was also found in the observations made by Takahashi *et al.*,[13] the male patient were 53% and it is slight more than that seen in findings by Horal and Jensen *et al.*[11,14]

The occupation of the patients had significant association (P value ≤ 0.007) with the development of lumbar disc prolapsed, this is contrary to the study of Damkot *et al.*,[15] and Wilder *et al.*,[16] that the males working environment, working posture and patterns of asymmetric postural demands play a significant role in the development of low backache. In present study of 75 patients, 27 of the patients were manual laborer and 22 were professional which shows significant correlation between the working environment of a person and effect on lumbar disc prolapse as it was proved by the study of Panjabi *et al.*,[17] in which he found static or vibration environment had a significant epidemiological association.

It was found that in most of the patients the duration of low back pain was 1-2 yrs, which is comparable to study made by Ng and Sell[18] where the duration of low back pain was 15 months. Charnley[19] in a study observed that 38% of the patients having duration of low back pain for 1-24 months, similar results were found in the study of Suk *et al.*[12]

The diagnosis of prolapse intervertebral disc made by history which also includes previous history of low back pain, similar observation was made by the study of Vroomen and Krom[20] and Rainville *et al*,[21] they concluded that previous episodes of low back pain with history of remission helps to make inference that patient is having lumbar disc prolapse. In present study, 50 patients had previous episode of low back pain with history of remission (P value ≤ 0.001).

In our study, radiculopathy was present in 48 cases (54%), 22 each had right side, and 20 left side radiculopathy, respectively; and six had bilateral radiculopahy, this is slight less than the study done by vroomen *et al.*,[22] in which he found 67% of the patients had radiculopathy. Hirsch *et al.*,[23] reported high degree of correlation between neurological sign and disc herniation. The SLR and Leségue test positive was found in 86% of the patients in their study that is slightly higher as compare to present study, which is 73% (P value ≤ 0.05).

The sensory deficit is having definite correlation between lumbar disc prolapse and nerve root compression, which was analyzed by Vroomen and Krom.[20] They found it to be highly sensitive for the diagnosis of lumbar disc prolapse. Thirty five percent of the patient in present study were found to be having sensory deficit and had abnormal MRI findings at the same level as the sensory deficit. We had 39% (P value ≤ 0.05) of the patients showing deep tendon reflex abnormality (ankle reflex), which is comparable to the study done by Weise *et al.*,[24] he found reflex abnormality in 36% of his patients. We agree with Beattie *et al.*,[9] that extrusion of the disc is strongly consistent with symptoms which we found in 93% of our patients in extrusion group[9].

It was found that there was interobserver variation of 23% (with kappa value ≤ 0.5) for the MRI reporting of the patient (P value ≤ 0.001), which was comparable with the study done by Brant *et al.*,[10] where interobserver variation was 19%.

Raininko *et al.*,[25] concluded in a study that observer variability in assessment of disc, the generation on magnetic resonance images of lumbar disc prolapse is 19% interobserver and 10% in intraobserver variation in making a diagnosis of lumbar disc

prolapse which is comparable to the present study in which intraobserver variation is 23%.

In our study 36% of the patients had L4 L5 level of disc involved and only 3% L1 L2 level of disc involved which is comparable with the study of Modic *et al.,* he found that 43% of the patient who had lumbar disc prolapse were having L4 L5 level disc involved; similar results were found by Garrdio *et al.,*[26]

In our study the correlation was made between clinical findings and MRI findings and it was found that 65 (87%) of the patients had significant correlation while 10 (13%) of that patients had no significant correlation (P value ≤ 0.001). Similar conclusion was made by number of studies done by Boden *et al.,*[27] Jensen *et al.,*[14] Boos *et al.,*[28] Kerr *et al.,*[29] Masui *et al.,*[30] Broetz *et al.,*[31]

CONCLUSION

It can safely be concluded that treating physician should put more emphasis on history, clinical examination and make the inference by these and then should correlate the clinical findings with that of MRI to reach a final diagnosis. It may usefull in gaining faith of patients and lowers the financial burden on patient, keeps update in sense of knowledge as today we are to much dependent on machine.

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