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Original research article

Magnetic Resonance Imaging as a Modality for Evaluation of Degenerative Lumbosacral Diseases

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Abstract

Background: Low back pain is a common cause of morbidity in all individuals. An accurate diagnosis regarding the type and extent of pathology is essential for operative as well as non operative treatment. The most widely used diagnostic modality to asses backpain are X-ray and MRI. X-ray though inaccurate, is cheap and readily available along with the drawback of ionizing radiation and less soft tissue detailing. MRI has now been accepted as the best imaging modality for non invasive, non ionizing evaluation of low back pain.

Methods: This is Prospective study, In a tertiary care hospital, symptomatic patient who were referred from various referral hospitals and units, with history of back pain were referred to Department of Radiodiagnosis, NMCH, Patna. Patients: 100 patients with backpain who underwent MRI were selected for study Period Two years. Investigation, clinical examination and X-ray were performed and findings compared with MRI.

Results: Result: Of the total 100 patients evaluated, most of the spine changes were of degenerative type, of which disc degeneration was major cause of backpain. Lumbar spine was more significant in involvement than thoracic spine in the study group and also among the genders females had higher preponderance with correlation of findings, found a higher incidence in 4th decade of life.

Conclusion: From these observations we find that MRI is a superior, non invasive, radiation free imaging modality with multiplanar capability and excellent soft tissue delineation. It can accurately detect, localize and characterize various derangements of the spine and help in arriving at a correct anatomical diagnosis there by guiding further management of the patients.

Keywords: Backapain; MRI; X-ray.

Introduction

Back pain is major cause of concern affecting various age groups around the world. MR has become the leading imaging technology in diagnosis of spine pathology as compared to traditional x-ray with it capability to detect disease and its progress along with exact route to operative improvement of patient condition. A variety of considerations, including clinical, technical, and anatomical factors, influence MR imaging (MRI). Unlike the head, where a survey examination may be adequate to delineate many clinical disorders, a survey examination of the spine is apt to be less rewarding. Instead, spinal imaging requires clinical expertise, special equipment, specific imaging sequences, and perhaps imager interaction to obtain adequate examinations. The application of multispecialty expertise seems essential to exploit MR's versatility. Translation of the clinical characterization and localization of neurologic disorders potentiates MR's effectiveness. The same thorough neurologic and neurosurgical evaluation that is key to an accurate clinical diagnosis is equally crucial in optimizing MR scanning sequences because confirmation of the diagnosis is often possible with MR.

Objectives

To study common locations of disc herniations causing radiculopathy. To determine dominant age group involved in the study with back ache and having undergone MR with corresponding spine changes in this imaging modality.

Review of Literature

MRI was discovered in 1972 and with its advent saw the new era of diagnostic imaging at a totally new level. From then and now, the most non-invasive detailing of the human anatomy was given by MRI with introduction of newer higher magnetic resonance technologies. It was found, in a study that both physicians and patients preferred MRI to radiographic evaluations but evaluations at the primary care setting had very little additional benefits to the patients because of increasing cost of care and increasing number of patients kept getting operated for spine disease[1].1 It is seen that L4-L5 and L5-S1 discs are most commonly affected level of the lumbar spine showing abnormal changes. It has been noted that abnormalities of intervertebral disc were significantly related to degenerative diseases but unrelated to other spinal disease and patient's gender. Also no relation can be found between other discs. It is clear that magnetic resonance imaging can detect a great amount of lumbosacral disease. Although its clinical significance remains unknown[2]. a neurologic abnormality and straight- leg raising sign and who have failed 4 to 6 weeks of nonoperative treatment were foun

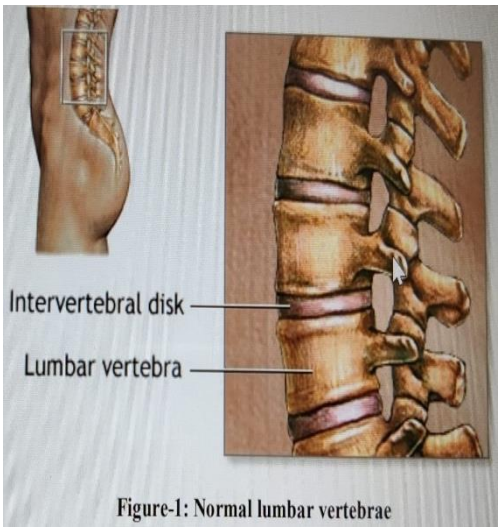

Figure-1: Normal lumbar vertebrae

d to have MRI as a highly sensitive and specific modality for diagnosis of primary or recurrent herniated nucleus pulposus and there fore for evaluation of associated spinal disorders[3]. There are 33 vertebrae, with the usual distribution being seven cervical, 12 thoracic, five lumbar, five sacral, and four coccygeal segments, but this may only be present in 20% of the population. The sacrum and coccyx are usually fused. Vertebrae may be 32-35 in number, with the no much change in cervical count and coccygeal being variable[4] . Various methods have been proposed to accurately determine vertebral levels Location of the right renal artery on sagittal images has been found mostly at the L1 to L2 disc level[5]. Identifying the position of C2 vertebral body on sagittal image is a good marker[6].

Most of the vertebrae look alike with variations in each region[7]. The first two cervical vertebrae are an exception because they are highly specialized structures. In general, each vertebra is composed of a body, which is located anteriorly, and a posterior arch. The posterior arch is formed by two pedicles that extend from the body to an articular mass or pars interarticularis. Projections of bone extend above and below each articular mass to form the superior and inferior facets. They articulate with the corresponding facet of the adjacent vertebral bodies at a synovial joint. Two laminae extend posteriorly where they fuse to form the spinous process, thus completing a ring and forming the spinal canal. The intervertebral discs are interposed between adjacent vertebral bodies and hydrostatically cushion the mechanical forces present. The disc consists of a central gelatinous nucleus pulposus remnant of the primitive notochord and peripheral fibrocartilage[8],[9]. A midline septum anchors the posterior longitudinal vertebral body to the posterior longitudinal ligament. Thin membranes extend laterally from the posterior longitudinal ligament, dividing this space. These structures predict how neoplasms and infection will appear[10]. Magnetic resonance imaging (MRI) and computed tomographic (CT) scanning have been found to demonstrate abnormalities in "normal" asymptomatic people.[11,12] Thus, positive findings in patients with back pain are frequently of questionable clinical significance. In one study, MRI scans revealed herniated discs in approximately 25 percent of asymptomatic persons less than 60 years of age and in 33 percent of those more than 60 years of age. The etiology of disc herniation in the lumbar spine is unknown, but degenerative disc disease, repeated trauma, and genetic factors have been implicated. Even more obscure is the etiology of the pain associated with disc herniation. Although mechanical pressure of the herniated disc on the nerves is certainly an important factor, this does not explain all symptoms in every case. [13,14] Lindahl[15] showed that pressure on normal nerves is insufficient to cause pain unless the nerves are already hypersensitive to pain. Inflammation caused by release of histamine, bradykinin, or prostaglandins can sensitize the nerves to pain by activating pain receptors (nociceptors) when the disc herniates. Lumbar spinal stenosis includes central spinal canal stenosis, lateral recess stenosis, and foraminal stenosis. These conditions may coexist or occur independently in any given patient. Central canal stenosis is most common at the L2-3, L3-4, and L4-5 levels. [16,] and patients present with symptoms of radiculopathy or myelopathy, often with bilateral lower- extremity claudication on exertion. The degenerative complex in acquired spinal stenosis includes diffuse disc bulging, facet hypertrophy and ligamentous thickening, and redundancy. [17] Lumbar central stenosis is characterized by circumferential (“napkin-ring”) narrowing of the central canal to an area less than 1.5 cm2 or an anteroposterior diameter of less than 11.5 mm. [18] The nerve rootlets of the cauda equina are compressed by this process, resulting in neurogenic claudication. Lateral recess stenosis is present when the distance between the superior facet anteromedially and the posterior vertebral body margin is less than 4 mm. Lateral recess stenosis is caused by the hypertrophic superior facet encroaching on the lateral recess and produces symptoms by compressing the nerve root before it exits the neural foramen.

Material and methods

This is Prospective study, In a tertiary care hospital, symptomatic patient who were referred from various referral hospitals and units, with history of back pain were referred to Department of Radiodiagnosis, Nalanda medical college and Hospital, Patna, Bihar. Patients: 100 patients with backpain who underwent MRI were selected for study Period Two years. Investigation, clinical examination and X-ray were performed and findings compared with MRI.

Inclusion criteria

Known complaints of low back pain Prospectus of surgery +/- signs on x ray d)

Exclusion criteria

Known H/o trauma H/o prior surgery 1year Recent H/o spinal epidural aneathesia
All casses with known history of backpain will be subjected to an MRI scan.
Patients will be subjected to an MRI scan and X-ray LS Spine as and when directed by the physician and subject to availability of an appointment Equipment HITACHI ELITE 0.3 TESLA SCANNER Protocol i) T1 weighted images in axial and sagittal plane ii) T2 weighted images in axial, coronal and sagittal plane iii) STIR images where ever required X-Ray GE 500MA X-Ray and Image Intensifier

Results

A descriptive statistical analysis and correlation evaluation of study group consisting of 100 patients with complaints of low back pain is undertaken to study the spectrum of MRI findings in cases of low back pain refered to NMC Hospital Patna, and comparison of X-ray and MRI with distribution of pathology.

Table 1: Age distribution of study subjects

Age	Frequency	Percentage
20-29	13	13.0
30-39	25	25.0
40-49	34	34.0
50-59	28	28.0
Total	100	100.0

Table 2: Sex distribution of study subjects

Sex	Frequency	Percentage
Male	45	
Female	55	
Total	100	

Table 3: Disc Changes in Study subjects

	Frequency	Percentages
Disc Changes	92	92.0
Normal	8	8.0
Total	100	100.0

Table 4: Cord changes in the subjects

	Frequency	Percentages
Cord changes	1	1.
Normal	99	99.0
Total	100	100.0

Table 5: Posterior elements in the subjects

	frequency	percentages
Post.Elements,changes	28	28.0
Normal	72	72.0
Total	100	100.0

Table 6: Paravertebral structures involvement in study subjects

	Frequency	Percentage
Paravertebral, involvement	0	0.0
Normal	100	100.0
Total	100	100.0

Table 7: Percentages MRI, finding in the total study group

MRI finding	Frequency	Percentage
yes	92	92.0
No	8	8.0
Total	100	100.0

All the statistical operations were done using SPSS v16.0 software. The other parameters employed during the statistical analysis were sensitivity, specificity, Positive predictive value (PPV) and Negative predictive value (NPV). χ 2 = 5.669, df=1, p=0.004, Significant.

Sensitivity and specificity Variable Value % 95% Confidence Interval Sensitivity 20.88 16.23 - 26.23 Specificity 100 87.24 - 100 Positive Predictive Value 100 93.74 - 100 Negative Predictive Value 11.11 7.462 - 15.74 Sensitivity: If MRI shows truly positive result, then chance of getting positive result in X-ray is 20.88%. Though we obtained an estimate of sensitivity as 20.88%, it could vary between 16.23 % – 26.23 % Specificity: If MRI shows truly negative result, then chance of getting negative result in X-ray is 100 %. Though we obtained an estimate of specificity as 100%, it could vary between 87.24 % - 100 %.

Discussion

Descriptive statistics was used such as mean, standard deviation(SD) and proportion. The Chi-Square test procedure tabulates a variable into categories for comparison between two categorical variables. A p-value less than 0.05 considered as significant and 0.01 as highly significant. All the statistical operations were done using SPSS v16.0 software. The other parameters employed during the statistical analysis such as, sensitivity, specificity, Positive predictive value (PPV) and Negative predictive value (NPV). χ 2 = 5.669, df=1, p = 0.004, Significant. Sensitivity and specificity Variable Value % 95% Confidence Interval Sensitivity 20.88 16.23 - 26.23 Specificity 100 87.24 - 100 Positive Predictive Value 100 93.74 - 100 Negative Predictive Value 11.11 7.462 - 15.74 Sensitivity- if MRI shows truly positive result, the chance of getting positive result in X-ray is 20.88%. Though we obtained an estimate of sensitivity as 20.88%, it could vary between 16.23 % – 26.23 % Specificity- if MRI shows truly negative result, the chance of getting negative result in X-ray is 100 %. Though we

obtained an estimate of specificity as 100%, it could vary between 87.24 % - 100 %PPV- if X-ray has a positive result; the chance of having MRI positive is 100% NPV- if X-ray has a negative result; the chance of having MRI negative is 11.11% The role of MRI has steadily increased and now it has the most preferred investigation of spine. It is also being used for pre and post operative evaluation. Complete evaluation of the spine was not possible with other modalities like conventional radiography and CT. A major number of disease process were diagnosed on MR often undetected on conventional radiography. Multiplanar MR provides remarkable diagnosis in the assessment of spinal and paraspinal structures. In our study degenerative spine pathology was the most common finding affecting 92 patients (92.0%) with age predilection in the 40-49 years age group seen in 34 patients (34%) with mean age group of 43 ± 10.76 SD. The study also saw sex predilection of females 55 (55.0%) to males 45 (45.0%) seen as 1.2 : 1 ratio. Vertebral changes: In our study veretebral changes were seen in 71 patients (71%) against normal vertebrae in 29 patients (29%). Disc changes: In our study, disc changes were seen in 92 patients (92%) against normal discs in 8 patients (8%). However, in an earlier study Hatice et al found disc degeneration in 65.1% of their study group (190 subjects). 73 Thecal sac: In our study, thecal sac changes were seen in 75 patients (75%) with predominance of thecal sac compression. Spinal cord: In our study spinal cord involvement was seen in 1 patient (1%) against normal spinal cord in 99 patients (99 %) Posterior elements: In our study posterior element involvement was seen in 28 patients (28%) of the 100 cases against normal posterior elements in 72 patients (72%). In an earlier study Hatice et al found posterior element changes in 14.8 % of theie study group (190 subjects)[19]. Paravertebral structure: In our study, paravertebral structures were seen to be involved in 0 patients. This study revealed the ability of MRI for superior evaluation of various degenerative spine changes including the detection, localization, characterization and assessment of the extent of disability and the strength of correlation between MRI and X-Ray findings confirms the value of MRI in assessment of back pain.

Conclusion

MRI is an excellent, non invasive radiation free imaging modality with multiplanar capabilities and excellent bone to soft tissue differentiation. It accurately detect, localize and characterize various pathology of spine causing back pain and helps in arriving at a correct anatomical diagnosis there by guiding further management of the patient.

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