"Correlation of Magnetic Resonance Patterns of Lumbar Disc Disease with Clinical Symptomatology of Patients"

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Abstract

Objective: To describe the patterns of degenerative changes in lumbar spine discs in correlation with clinical symptomatology of patients.

Patients and Methods: This cross sectional analytical study was carried out in Radiology Department of Children Hospital Lahore, from October 2006 to October 2007. The study included 170 patients who presented with low back and leg pain. All patients underwent lumbar MRI using 1.5 T – scanner. MRI scans were evaluated for magnitude and location of nerve compression, disc bulge or disc herniation and the nature of nerve and thecal sac deformation and association of these findings with age, sex and clinical symptomatology of patients was evaluated.

Results: The study included 170 patients, the age range was 20 to 79 years (mean 47 years). Disc bulge was most frequent finding seen in 128 patients (74%), disc herniation was seen in 42 patients (25%) and was common in patient with acute history of backache, while disc bulge was common in patients with chronic symptoms. Overall 131 patients (76%) had MRI evidence of nerve or thecal sac compression. There was no significant association between segmental distribution of symptoms and presence of anatomic impairment. However, severe nerve compression and disc herniation were significantly associated with pain distal to the knees.

Conclusion: The presence of disc herniation or ipsilateral severe nerve compression at one or multiple sites is strongly associated with distal leg pain and sensory symptoms in that leg. Mild to moderate nerve compression, disc degeneration or bulging, and non disc degenerative changes are not significantly associated with specific pain patterns.

Introduction

Back pain resulting from degenerative disease of spine is one of most common cause of disability in working age adults.[1] Between 60% – 80% of adults suffer from low back pain at some time in their lives. Degeneration of intervertebral disc complex begin early in life and it is consequence of variety of environmental factors as well as of normal aging.[2] Degenerative spinal stenosis can be of bone origin (Spondylolisthesis, Spondylosis, Osteophytosis and facet hypertrophy), ligamentous origin especially ligamentum flavum or disco – genic origin (disc bulge and herniation[3]). Most of the cases are due to combination of bone, ligament and disc disease[4]. Most common location for these changes is lumbar spine followed by cervical spine. CT scan and myelography have long been used for evaluation of degenerative disease of spine.[5] CT myelo provides even more sensitive modality by increasing the contrast between thecal sac, nerve root and soft tissues of spinal column.[6] With the development of MRI, the debate over CT scan / mylography for diagnosing

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disease of spine became moot.[6] MRI has become a modality of choice in evaluation of lumbar spinal degenerative disease.[7] The multiplanar capability and high soft tissue contrast resolution of MRI provide superior delineation of disk, fat, nerve, ligament, CSF and bone.[8] MRI is sensitive to disc disease especially degenerative disc disease and it provide a best tool for determining the extent of disc disease whether disc bulge, protrusion, extrusion or sequestration and its effects on cord / foraminal compression.[9-11] Foraminal narrowing, degenerative changes of facet joint and nerve root swelling are all better shown on detailed protocol.

Material and Methods

This cross sectional analytical study was conducted at Diagnostic Radiology Department, Children Hospital and Institute of Child Health Lahore, in one year from October 2006 to October 2007. One hundred and seventy patients were included in the study by Convenience sampling. Patients of both sexes and all ages presented with low back pain or lower extremity radiculopathy were included. Patients having other abnormalities like infective, inflammatory, neoplastic or congenital anomalies of spine were excluded. MRI of all the cases was performed at 1.5 tesla MR system (Philips gyroscan NT, Compact Plus, Holland). Patient for the study were selected while they were undergoing lumbar MRI as a part of diagnostic workup for low back pain or lower extremity radiculopathy. Patients were asked for location of their pain, duration of symptoms, and presence of weakness, numbness and parasthesias. There referral form was also checked for straight leg raising test performed by physician. All this data was collected in a performa. Segmental classification system of pain distribution was used. This classification has seven groups based on segmental distribution of pain according to lower extremity dermatomal pattern, however, for the purpose of statistical analysis second classification system based on the categories 1, 2 and 3 of Queback Task Force was used. Queback Task Force has merged seven groups according to segmental distribution into three groups. First group was with low back and thigh pain, second group has distal lower extremity pain and third included patients with weakness, numbness and parasthesia. MRI of lumbar spine, using surface coil, was performed. Imaging study consisted of sagittal T1W images, sagittal T_2W images with and without fat – saturation and axial T_2W– weighted images. MR images were interpreted by radiologists experienced in reporting spinal MRI and each scan was reviewed by two radiologists. Consensus on all cases was produced by discussion on points where there was difference of interpretation. Using a standardized procedure, an indepth report identifying the presence and location of various anatomic impairments, including magnitude and location of nerve compression was generated. In addition presence and absence of disc herniation was also noted. The nature of nerve and thecal sac compression was classified as mild, moderate and severe. Mild to moderate degree of nerve compression was considered when disc material displacing the nerve 2 mm or more. Severe degree of nerve compression was considered when disc material completely obscure the nerve. Statistical analysis was performed using computer program SPSS (Version 10). Frequencies and percentages of different MRI findings were made. Chi-square test of analysis was used to determine the significance of associations between age, gender, chronicity of symptoms, sensory symptoms and various MRI findings. Chi-square test was also used to determine significance of association between degree of compression, duration of symptoms, site of pain and presence of of weakness and numbness with different MRI find-

Table 1: *Association of nerve compression with distal extremity pain.*

Nerve Compression	Distal Extremity Pain				Total	
	Present		Absent			
	No.	%	No.	%	No.	%
Severe compression	43	42.2	5	7.5	48	28.2
Mild to moderate	54	52.9	29	41.8	83	48.8
No compression	5	4.9	34	50.7	39	22.5
Total	102	100.0	68	100.0	170	100.0

Statistical Analysis
Chi-square = 56.369 Df. = 4
P value = 0.001 (< 0.05)

ings. A p-value of < 0.05 was considered to indicate statistically significant association.

Results

Out of 170 patients 101 (59.4%) were males and 69 (40%) were females.

Age range was from 20 – 79 years (mean age 47 years). Maximum patients were in the age range from 30 – 39 years (30.6%) followed by 40 – 49 years (24.7%).

Of 170 patients 23 (13.5%) patients had history of acute pain i-e first episode of low back pain presented for less than 2 months. 129 patient (79.9%) had chronic symptoms of longer than 2 months duration.

The most common location of pain was distal lower extremity in 102 patients (60%) followed by low back and thigh pain.

Sensory symptoms such as weakness, numbness and parasthesia was present in 43 patients (25.3%).

Straight leg raising test was positive in 80 patients (47%) and negative in 90 patients (62%).

Single disc disease pattern was present in 85 patients (50%) and commonest location was $L_4 – L_5$ level in 43 patients (50.6%) followed by $L_5 – S_1$ level present in 40 patients (48.9%). Disc bulge was commonest pathology and 128 patients (74%) had disc bulge while 42 (25%) had disc herniation.

Overall 131 patients (76%) had MRI evidence of nerve or thecal sac compression. 83 patients (48%) had mild to moderate compression while 48 patients (28%) had severe nerve compression.

Of the total 131 patient who had MRI evidence of nerve compression, distal extremity pain was present in 102 patients and chi-square test shows a strong association with p-value of 0.001 (Table 1). Thirty four patients (26.2%) had right sided, 42 patients (32.2%) had left sided and 54 patients (41%) had bilateral nerve tissue compression. When comparing these sites of nerve compression to sites of radiation of pain either to the right leg or to the left leg, the results show significance with P value = 0.006 (Table 2).

Table 3: Association of disc bulge / herniation with distal extremity pain.

Multiple Disc Pathology		Distal Extremity Pain		Total
		Present	Absent	
Disc bulge	Count	29	33	63
	%	59.2%	97.1%	75.0%
Disc herniation	Count	20	1	21
	%	40.8%	2.9%	25.0%
Total	Count	49	34	84
	%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square 15.69 Df. = 1 P value = 0.001 (<0.05)

Table 2: Association of side of nerve compression with distal extremity pain.

Side of Nerve Compression		Distal Extremity Pain		Total
		Present	Absent	
Right	Count	32	2	34
	%	33.0%	6.3%	26.2%
Left	Count	33	9	42
	%	34.0%	28.1%	32.3%
Bilateral	Count	32	22	54
	%	33.0%	65.6%	41.5%
Total	Count	97	33	130
	%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 14.425 Df. = 2 P value = 0.006 (< 0.05)

Table 4: Association of sensory symptoms with the nerve compression.

Degree of Nerve Compression		Sensory Symptoms		Total
		Present	Absent	
Severe compression	Count	33	15	48
	%	76.7%	11.8%	28.2%
Mild to moderate	Count	8	75	83
	%	18.6%	59.1%	48.8%
No compression	Count	2	37	39
	%	4.7%	29.1%	22.9%
Total	Count	43	127	170
	%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 67.127 Df. = 2 P value = 0.0001 (< 0.05)

When comparing the distal extremity pain with type of disc pathology, disc bulge / disc herniation it was found that distal extremity pain showed very strong association with disc herniation while moderate association with disc bulge with p-value of 0.001 (Table 3).

Of the 43 patient who had sensory symptoms i-e weakness, numbness and paraesthesia in their lower extremity, MR evidence of severe nerve compression was present in 33 patients (76%) and results were significance with P value = 0.0001 (Table 4). When comparing the sensory symptoms in lower limbs with type of disc pathology, disc bulge / disc herniation it was found that sensory symptoms showed very strong association with disc herniation while moderate association with disc bulge with p-value of 0.001 (Table 5).

Table 5: Association of disc pathology with sensory symptoms.

Single Disc Disease Pathology		Sensory Symptoms		Total
		Present	Absent	
Disc bulge	Count	6	58	64
	%	28.6%	89.2%	74.4%
Disc herniation	Count	15	7	22
	%	71.4%	10.8%	25.6%
Total	Count	21	65	86
	%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 23.7 Df. = 1 value = 0.001 (<0.05)

There is strong association of chronicity of symptoms with type of disc pathology. Disc herniation was seen in 42 patients (25%) and disc herniation was commonest in patient with acute history of backache. Disc bulge was present in 128 patients (74.0%) and commonest in patients with chronic symptoms, results are significance with P value= 0.006 (Table 6). Severe nerve compression also showed statistically significant association with chronicity of symptoms. It is commonest in patients who had acute onset of backache, seen in 52% of patients with acute symptoms and 21% patients with chronic symptoms, with p-value 0.006 (Table 7). When comparing disc involvement with different age groups, it was found that single disease pattern was common in younger age group i-e 20 – 39 years and multiple disc pattern was more common in adult and old age group and the results were significant with P value = 0.0001.

Straight leg raising test was positive in 80 patients (47.1%) and it showed a strong association with MR evidence of severe nerve compression with P value = 0.0001 (Table 8).

Discussion

In this study males were 60% and females were 40%, male to female ratio was 1.5 : 1. This correlates well with most of national and international studies.[12,13] The disease is more common in males as they are engaged in more heavy manual work.

Our study shows that maximum numbers of patients were in 4th decade (30.6%) and same is true in study of Ahmad M[13] et al. Recent study shows that maximum patients are in 5th decade.[14]

In our study most common level of disc involvement was $L_4 - L_5$ followed by $L_5 - S_1$. This also

Table 6: Association of nature of backache with nature of disc pathology.

Disc pathology		Backache			Total
		Acute	Chronic	Absent	
Disc bulge	Count	9	47	8	64
	%	50.0%	85.5%	61.5%	74.4%
Disc herniation	Count	9	8	5	22
	%	50.0%	14.5%	38.5%	25.6%
Total	Count	18	55	13	86
	%	100.0%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 10.28 Df. = 2
P value = 0.006 (< 0.05)

Table 7: Association of severity of nerve compression with nature of backache.

Severity of Nerve Compression		Backache			Total
		Acute	Chronic	Absent	
Severe compression	Count	12	28	8	48
	%	52.2%	21.7%	44.4%	28.2%
Mild to moderate	Count	10	65	8	83
	%	43.5%	50.4%	44.4%	48.8%
No compression	Count	1	36	2	39
	%	4.3%	27.9%	11.1%	22.9%
Total	Count	23	129	18	170
	%	100.0%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 14.51 Df. = 4
P value = 0.006 (< 0.05)

Table 8: Association nerve compression with straight leg raising test.

Nerve Compression		Straight Leg Raising Test		Total
		Positive	Negative	
Serve compression	Count	42	6	48
	%	52.5%	6.7%	28.2%
Mild to moderate	Count	33	50	83
	%	41.3%	55.6%	48.8%
No compression	Count	5	34	39
	%	6.3%	37.8%	22.9%
Total	Count	80	90	170
	%	100.0%	100.0%	100.0%

Statistical Analysis
Chi-square = 51.6 Df. = 2 P value = 0.001 (< 0.001)

correlates with study of M Ahmad[13] et al. Another study stated that approximately 95% of disc herniations occur at $L_4 – L_5$ or $L_5 – S_1$ level.[16]

In this study single disc involvement and multiple disc involvement pattern is equally prevalent with 1 : 1 ratio. This does not correlate with work of I A Bhutta,[15] who showed multiple disc involvement was more common (65%) as compared to single disc involvement (35%), however common level of involvement was same i-e $L_4 – L_5$ followed by $L_5 – S_1$ in both these studies. Disc bulge was commonest pathology in our study (74.4%) followed by disc herniation (25.6%), this does not correlate with work of Siddique AH[16] who showed disc herniation was common pathology followed by disc bulge. One possible reason for this that now patients are being referred for MRI early in their disease process than in 2002 because of increased availability and awareness about MRI.

The results of this study indicate that, although patients can be reliably classified on the basis of segmental pain distribution, there appears to be a little association between their pain distribution and commonly observed anatomic impairments seen on lumbar MRI, this also correlate with work of other authors i-e Beattie PF and Siddique AH.[16] If the criteria of pain referral distal to the knee are used, strong associations are seen with severe ipsilateral nerve compression.

In a recent study by Michel T[17], patients with low back pain and radiculopathy were similar in age and sex but they differ in regard to their symptoms. Patients with radiculopathy more commonly present with sensory abnormalities and myotomal weakness. In our study severe nerve root compression is more commonly associated with radiculopathy (42%) as compared to lower back pain (21%). Study of Michel also match with our study that severe nerve root compression is more commonly associated with radiculopathy (23%) as compared to lower back pain (3%) with p-value < 0.001. In this study side of herniation on MR images agreed with side of radicular pain as in our study. There was no relationship between type of symptoms at presentation (patients with lower back pain or radiculopathy) and level of herniation and this also corelate with results of our study.

One of the goals of our study was to determine whether a specific threshold existed whereby the magnitude and location of nerve compression could be confidently related to the patient presenting symptoms. The findings imply that minimal or moderate compres-

sion on nerve roots or any degree of compression on thecal sac does not result in consistent pattern of pain, weakness and numbness. However, for patients with severe compression on one or more nerve roots, there is strong and significant association with distal lower extremity pain. This was also shown by Qurashi et al.[18] They described that in 27 patient with low back pain and unilateral L_5 or S_1 spinal nerve root pain, significant radiological changes were restricted to the symptomatic root level when compared with controls. If disc extrusion is present, association was more statistically significant. Considering these findings and previous reports, there is reasonably strong evidence supporting the role of disc extrusion and sever nerve compression as likely pain generator in people with lower extremity radiculopathy. Siddiqi A H et al.[16] showed that presence of ipsilateral severe nerve compression (37 patients) is strongly associated with distal leg pain, of the total 48 patient who had MRI evidence of nerve compression, distal extremity pain was present in 37 patients with p-value of 0.001. In our study of the total 131 patient who had MRI evidence of nerve compression, distal extremity pain was present in 102 patients with p-value of 0.001.

Another study by Beattie PF[19] et al gave same results that severe nerve compression and disc herniation was strongly associated with distal leg pain.

It is illustrated in our study that weakness and numbness (sensory symptoms) are strongly linked to nerve compression with p value = 0.001. Rankine et al[20] reported that numbness on the lateral part of foot was a primary marker for nerve compression. Vucetic et al[21] however, reported that numbness or weakness did not discriminate between the level of nerve compression. An explanation for variation in symptoms between people with similar MRI findings may relate to the presence of various chemical mediators such as substance P. These may cause irritation of nerve roots, but not generate a detectable signal on MRI.

In our study, 21% of patients with chronic symptoms had evidence of severe nerve compression on MRI whereas prevalence was 52% in patients with acute symptoms and this correlate with work of Siddiqui A H et al,[16] who showed that 42% of patients with chronic symptoms had evidence of severe nerve compression on MRI whereas prevalence was 52% in patients with acute symptoms. Regarding physical findings straight leg raising test shows strong association with severe nerve compression which correlate with Majlesi J et al.[22] The correlation of the physical examination findings with imaging remains a critical component of the diagnostic process for people with low back pain and radiculopathy. Further studies combining serial scanning with physical examination are needed to assess the temporal relation between the onset of symptoms and development of various anatomic impairments in lumbar spine.

Conclusion

This study shows that there is good association between history and examination findings in patients presenting with backache with MRI findings. The study shows that presence of severe nerve compression is strongly associated with distal leg radiculopathy. Mild to moderate nerve compression are not significantly associated with specific pain pattern. The side of radiation of pain to either leg show a strong association with side of nerve tissue compression. The presence of sensory symptoms i-e hypoesthesia or anesthesia in specific dermatomal pattern also give some idea of which nerve is compressed. Chronicity of symptoms has association with type of disc pathology, patients with acute history are more likely to have disc herniation than disc bulge. Disc herniation is also more commonly associated with distal extremity pain and sensory symptoms possibly due to more nerve compression in disc herniation as compared to disc bulge. Severe nerve compression also has strong association with sensory symptoms i-e numbness and parasthesias. In patients of positive straight leg raising test, which is a sign of nerve root compression also show strong association with disc herniation and severe nerve compression. Although segmental distribution of pain can be determined from patients symptoms. This finding alone is of little significance in predicting lumbar impairments. The symptoms and signs of sciatica and MRI findings of nerve root compression or displacement by disc herniation are correlated before invasive therapy is undertaken.

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