Original Article

Observer variation in MRI evaluation of patients with suspected lumbar disc herniation and nerve root compression: Comparison of Neuroradiologist and Neurosurgeon's interpretations

Imaad-ur-Rehman,[1] Rana Shoaib Hamid,[2] Waseem Akhtar,[3] Muhammad Shahzad Shamim,[4] Rohana Naqi,[5] Haji Ismail Siddiq[6]

Department of Radiology,[1-3] Department of Neurosurgery,[4,5] Aga Khan University Hospital,
Medical Graduate, Karachi Medical and Dental College,[6] Karachi.

Corresponding Author: Rana Shoaib Hamid. Email: drschoaib@hotmail.com

Abstract

Objective: To analyse inter-observer variation between a neuroradiologist and neurosurgeon in the MRI diagnosis of lumbar nerve root compression. Although lumbar MFI is primarily analyzed and reported by a radiologist, neurosurgeons often analyse it independently as they have sufficient clinical background as well as radiological expertise to diagnose most spinal pathologies on Magnetic Resonance Imaging (MRI).

Methods: Retrospective analysis was carried out for images of 54 patients who underwent MRI between March and July 2010 of lumbar spine with suspected lumbar disc herniation and nerve root compression, at Aga Khan Hospital, Karachi, Pakistan. One fellowship trained neuroradiologist and one neurosurgeon evaluated the images on PACS system separately. Both observers were unaware of the patient's clinical history and each other's findings. Lumbar discs at L3-L4, L4-L5 and L5-S1 levels were evaluated by both observers for disc disease and nerve compression. Findings were recorded on a proforma and analysed with SPPS Version 16.

Results: Total 162 lumbar discs were studied by both readers in 54 patients. Excellent inter-observer agreement was seen for the presence or absence of nerve root compression (Percentage agreement = 88.89%; k = 0.774; p = 0.737). For disc bulge, inter-observer agreement was fair but statistically insignificant (Percentage agreement = 72.84%; k = 0.414; p = 0.132). In case of disc herniation, although inter-observer agreement was fair, but the difference was statistically significant (Percentage agreement =84.57%; k = 0.511; p = 0.002).

Conclusion: Inter-observer agreement between neuroradiologist and neurosurgeon in diagnosing nerve root compression due to lumbar disc disease was excellent. Agreement regarding disc bulge and herniation was fair.

Keywords: Lumbar disc herniation, Nerve root compression, Neuroradiologist, Neurosurgeon. (JPMA 62: 826; 2012)

Introduction

Lower back pain is the most common symptom-related reason, after common cold and headaches, for clinician visits and accounts for more sick leave and disability than any other single medical condition.[1,2] The lifetime prevalence of back pain is estimated around 65 to 80%, though a specific diagnosis for back pain cannot be reached in approximately 80% of these cases.[3,4] Further management of patients with lower back pain, either surgical or conservative, primarily depends upon the presence and severity of nerve root compression.[2]

For radiological evaluation of lumbar disc disease both MRI and Computerised Tomography (CT) have been used.[5,6] In a series of comparative radiological studies on the evaluation of lumbar herniated discs, the difference between MRI and CT was not significant.[7-10] However, for evaluation of nerve root compression, MRI was found to be superior to CT because of its ability to demonstrate excellent soft tissue details.[11] The reported sensitivity and specificity of MRI for detection of nerve root compression is 80.65% and 100% respectively.[12] Since nerve root compression is the most important factor that determines the course of further management, therefore, according to current guidelines, MRI is the first choice investigation and CT should be used as the alternative in the evaluation of the lumbar back if MRI is contraindicated or unavailable.[13-15]

In addition to the presence and severity of nerve root compression assessed radiologically, the management of patients with or without surgery also depends upon patient evaluation for the degree of pain and disability produced by nerve root compression. Although the reporting radiologist has the required radiological and anatomical knowledge, but he is unaware of the patient's actual condition which renders him at a deficit in comparison to the treating neurosurgeon who has the added advantage of knowing the complete clinical picture.

Around the world it is common practice that neurosurgeons analyse MR images independently as they believe that they have sufficient radiological expertise with the additional benefit of being better aware of the patients' clinical picture as compared to the reporting radiologist. Also because backache forms one of the most common causes of referral to neurosurgeons, it becomes essential to know the basic interpretation of a lumbar MRI. Moreover, there exists intra-observer variability between reporting radiologists.[16] Therefore, clinical decision making requires self interpretation of images on neurosurgeon's part. In addition it saves time.

The purpose of the study was to analyse inter-observer variability between a qualified neuro-radiologist and a neurosurgeon in the evaluation of nerve root compression to assess if there exists any discrepancy between neuroradiologists and neurosurgeons in the interpretations of MRI lumbar spine for the diagnosis of this common pathology.

Patients and Methods

This retrospective study was carried out at the Radiology Departments of Aga Khan University Hospital in Karachi. Medical records and images of those patients were retrospectively reviewed who underwent MRI of lumbar spine with suspicion of spinal stenosis from March to July 2010 at the MRI section. All patients who were referred for MRI lumbar spine with clinical suspicion of disc herniation and lumbar radiculopathy were also included. Patients less than 18 years of age, patients with history of surgery, spinal infections or tumours were excluded from the study. The final sample comprised of 54 patients.

All images were acquired with a 1.5 T MRI system (Magnetom Avanto, Siemens Corporation, USA). The standard imaging protocol included T1 and T2 weighted sagittal images (Slice thickness 4 mm, FOV 350x350mm, Image Matrix 672x896), T2 weighted axial images (Slice thickness 4mm, FOV 230x 230mm, Image Matrix 314x448). T2 weighted fat suppressed sagittal images (Slice thickness 4 mm, FOV 350 x 350 mm, Image Matrix 214 x 256).

One fellowship trained neuroradiologist and one neurosurgeon evaluated the images on picture archiving and communication system (PACS). Both observers were blinded to patient's clinical history and each other's findings. The scans were interpreted in sagital and axial planes. Lumbar discs at L3-L4, L4-L5 and L5-S1 levels were evaluated by both observers. Disc at each level was evaluated for the presence or absence of disc bulge and disc herniation separately. No distinction was made between disc protrusion or extrusion and both were included in the term herniation.

Nerve roots from L3 to S1 levels were also evaluated for nerve compression. For nerve root compression a 5-point scale was used as proposed by Van Rijn et al[16] 1: No nerve compression, 2: Possibly no root compression, 3: Indeterminate, 4: Possible nerve compression, 5: Definite nerve compression. For the purpose of analyses, these grades of nerve compression were simplified as 'nerve compression' (possibly or definitely) or 'no nerve compression' (all other categories).

Findings of both observers were recorded on a proforma, entered and analysed in SPPS 16. Inter-observer agreement between neuroradiologist and neurosurgeon for evaluation of bulging and herniated discs and nerve root compression was calculated by applying Kappa statistics. Interpretation of Kappa was done as proposed by Cohen[17] i.e. value less than 0.4 was considered poor, value between 0.4 to 0.75 was considered fair to good, and value above 0.75 was considered excellent. Chi-square test was applied to see the association between neuro-radiologist and neurosurgeon in image interpretations. P-value less than 0.05 was considered significant.

Results

Initially 62 patients were included, but 8 were excluded from the study based on the exclusion criteria and the final sample consisted of 54 patients (31 female, 23 male, age range 19-76 years, mean age 46.1 ± 15.1 years). Total 162 lumbar discs were studied by both readers in these 54 patients. For determining presence or absence of disc bulge, the observers agreed in MRI findings in 118 (72.84%) readings and disagreed in 44 (27.16%). Inter-observer agreement for the assessment of disc bulge was fair (k =

Table: Inter-observer agreement in evaluation of disc bulge, herniation and nerve compression.

	Disc Bulge		
	Neuroradiologist		
Neurosurgeon	**No**	**Yes**	**Total**
No	82	15	97
Yes	29	36	65
Total	111	51	162
Inter-observer Agreement	(Percentage agreement = 72.84%; (118/162); k = 0.414; p = 0.132)		
	Disc Herniation		
	Neuroradiologist		
Neurosurgeon	**No**	**Yes**	**Total**
No	119	24	143
Yes	1	18	19
Total	120	42	162
Inter-observer Agreement	(Percentage agreement = 84.57%; (137/162); k = 0.511; p = 0.002		
	Nerve Root Compression		
	Neuroradiologist		
Neurosurgeon	**No**	**Yes**	**Total**
No	82	7	89
Yes	11	62	73
Total	93	69	162
Inter-observer Agreement	(Percentage agreement = 88.89%; (144/162); k = 0.774; p = 0.737)		

0.414; p = 0.132), but statistically insignificant.

For assessment of disc herniation, the observers agreed on imaging findings in 137 (84.57%) cases and disagreed in 25 (15.43%). Inter-observer agreement for the assessment of disc herniation was fair, but clinically significant. (k = 0.511; p = 0.002).

The agreement between the two observers for the presence or absence of nerve root compression was achieved in 144 (88.89%) readings while they disagreed in 18 (11.11%). Inter-observer agreement was excellent. (k = 0.774; p = 0.737) (Table).

Discussion

Our study showed substantial disagreement between the observers regarding disc morphology. For disc bulge inter-observer agreement was fair (k = 0.414) but statistically insignificant (p = 0.132). However, in case of disc herniation although inter-observer agreement was fair (k = 0.511), the difference reached had statistical significance (p = 0.002). Previous studies regarding inter-observer agreement related to disc morphology showed highly variable results with kappa values between 0.32 and 0.79.[18-22] In the study conducted by Lurie J et al. the data showed only fair agreement (k = 0.32),[18] Brant-Zawadzki et al. found moderate inter-reader agreement (unweighted k = 0.59),[19] Jarvik et al reported moderate to substantial inter-reader agreement with weighted ks of 0.50 to 0.75[20] and Solgaard et al and Weishaupt et al found substantial agreement for classifying disc morphology, with inter-observer ks of 0.79 and 0.68, respectively.[21,22]

Different reasons for this variation between inter-observer variation have been suggested. Brant-Zawadzki et al. comparing two nomenclatures for lumbar herniations concluded that bulging disk was the main reason for moderate agreement.[19] Similar results were seen in study by Van Rijn where it was concluded that more than 50% of inter-observer variation in MRI evaluation of patients with lumbosacral radicular pain is caused by disagreement on bulging disks.[16] Bulging disks usually are assumed to be asymptomatic lesions because they are common in the general asymptomatic population. A patient with a bulging disk and radicular pain is likely to undergo conservative treatment and so this finding has very little clinical significance.

Analysing our data, we found that the neurosurgeon had labelled considerably fewer discs as herniated as compared to the radiologist i.e. 19 as compared to 42 by the radiologist, who had labeled 65 discs as bulging as compared to the radiologist's 51. Despite this difference, the agreement regarding nerve root compression is excellent (Percentage agreement for nerve root compression= 88.89 %; k = 0.774; p = 0.737) and is comparable to a study earlier conducted by Van Rijn despite the fact that in his study the inter-observer agreement was calculated between two neuroradiologists. Van Rijn reported a Kappa value of 0.77 for inter-observer agreement for nerve root compression, which is almost similar to our study.[16]

A probable explanation of this apparent discrepancy may be that since it is the nerve compression that is significant from surgical point of view, the neurosurgeon considered those herniations as bulges or normal which were not resulting in nerve root compression since no surgical treatment was required in such cases. The difference may have academic importance, but from surgical perspective it is unlikely to alter the course of management.

This disagreement, however, further emphasises the point made in earlier studies that increased effort is required by lumbar MRI readers to use terms regarding disc morphology in accordance with published guidelines. In this respect the Combined Task Force of the North American Spine Society, the American Society of Spine Radiology, and the American Society of Neuroradiology have issued guidelines that provide standardisation of terms to characterise disc herniation, as well as other disc pathologies.[23] However, the degree of it being followed across the relevant specialties appears questionable.

Another cause of this disagreement may be the lack of supervised training of neurosurgeons regarding the interpretation of lumbar MRI. This weakness may be overcome by arranging supervised training sessions of neurosurgeons in radiology by neuroradiologists. This would improve their understanding of lumbar MRI and enable them to be able to interpret lumbar MRI accurately.

Conclusion

Excellent inter-observer agreement was seen between the neuroradiologist and the neurosurgeon in diagnosing nerve root compression due to lumbar disc disease. Agreement regarding disc bulge and herniation was fair. Although this is clinically insignificant, but we suggest arranging supervised training sessions of neurosurgeons in radiology by neuroradiologists for their better understanding and interpretation of lumbar MRI.

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