ORIGINAL ARTICLE

AGREEMENT BETWEEN COMPUTED TOMOGRAPHY AND MAGNETIC RESONANCE IMAGING IN GRADING LUMBAR SPINAL STENOSIS

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ABSTRACT

BACKGROUND: Lumbar spinal stenosis is an important pathologic entity to recognize in patients with radicular symptoms as it can have a negative impact on quality of life. Although MRI is considered an appropriate tool for studying spinal stenosis. CT can be performed rapidly and allows precise evaluation of spinal canal and has a superior ability to discriminate cortical bone from soft tissue such as ligamentum flavum. **OBJECTIVE:** To determine agreement between CT and MRI in grading lumbar spinal stenosis. **STUDY DESIGN:** Descriptive cross sectional study. **DURATION AND SETTING:** The study was conducted at Radiology department, PNS Shifa Hospital, Karachi from 01st Feb 2015 to 31st Jul 2015. **SUBJECTS AND METHODS:** 100 patients with chronic backache referred to Radiology department for MRI or CT scan of lumbar spine between 18 to 70 years of age were included on the basis of consecutive non probability sampling. The MRI and CT scan were performed on every patient which included axial images at mid inter vertebral disc level L4-5. Total of 100 pairs of MRI and CT axial images were created and Dural sac cross-sectional area (DSCA) were calculated using image analysis software. Lumbar spinal canal stenosis was graded as Grade 1 (No stenosis) with DSCA > 100 mm^2, Grade 2 (Moderate stenosis) with DSCA 75-100 mm^2 or Grade 3 (Severe stenosis) with DSCA < 75 mm^2. **RESULTS:** There was agreement between CT and MRI in the grades of lumbar spinal stenosis in 73 cases (73%). The degree of agreement in grading lumbar spinal stenosis was calculated and kappa value was observed as 0.527 (p-value = 0.000) which signifies good (but not excellent, kappa > 0.75) agreement between CT and MRI for grading lumbar spinal stenosis. **CONCLUSION:** It was concluded that the agreement between CT (without myelography) and MRI in grading Lumbar Spinal Stenosis is good although not excellent. So in cases where MRI is either not available or is contraindicated CT can be of diagnostic use.

Key words: CT; Lumbar spinal stenosis; MRI.

Introduction

Lumbar spinal stenosis (LSS) is a condition in which the spinal canal narrows at the level of lumbar vertebrae and compresses the spinal cord and nerves. It causes back pain and/or neural symptoms in the lower extremities and results in reduced quality of life.[1] The natural history of spinal stenosis remains poorly understood with studies reporting that about a half of patients remain clinically stable, with a quarter worsening or improving.[3]

Several methods are used to image the lumbar spine, including plain radiography, sagittal tomography, conventional myelography, computed tomography (CT),

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CT-myelography (CTM) and magnetic resonance imaging (MRI). CTM or MRI have become the methods of choice for preoperative radiological evaluation of patients with lumbar spinal stenosis.[4,5]

CTM is an invasive procedure with several potential complications including anaphylactic reactions to the contrast material, headaches, arachnoiditis and infection.[6] MRI also has few drawbacks e.g. takes longer time for image acquisition, comparatively expensive and is contraindicated in patients with metal/cochlear implants. Also lack of MRI facilities is an important factor in choosing CT scan over MRI in a developing country like Pakistan.[8,9] A Study by Eun SS et al revealed superior ability of CT over MRI to discriminate cortical bone from soft tissue such as ligamentum flavum hypertrophy which is one of the common causes of LSS.[2]

A large number of patients are referred to Radiology units for evaluation of lumbar spinal stenosis. Due to the factors stated above it is important to choose wisely between the imaging modalities.

The rationale of our study is to investigate agreement between MRI and CT (without myelography) in grading lumbar spinal stenosis so that we can generate a local and current data that will help us choose judiciously between CT and MRI. The MRI facility is available in only few tertiary care hospitals of our country, moreover it is a costly investigation when compared to CT scan. Utilization of CT in these patients can help in catering a larger portion of our population with LSS.

Materials & Methods

This study proposal was discussed on the forum of Hospital Ethical Committee to get a formal approval. Patients were explained the purpose and application of the study, as well as the possible hazards of exposure to radiation; following which a verbal and written consent to volunteer in the study was obtained. All the data was anonymized. PNS Shifa hospital provides free of cost therapeutic and diagnostic services to its entitled armed forces personnel and their families. All patients recruited in our study were entitled.

A descriptive cross sectional study was carried out at the department of Radiology of PNS Shifa Hospital, Karachi from 01-02-2015 to 31-07-2015. A total of 100 patients were recruited through consecutive non probability sampling.

Inclusion Criteria

- Patients referred to our radiology department for MRI or CT scan of lumbar spine to evaluate the cause of chronic low back ache for more than 3 months duration.
- Both genders
- Age 18 years to 70 years

Exclusion Criteria

- Patients with scoliosis, spinal infections or tumors, metastatic tumors, prior surgery or spinal injury were excluded.
- Patients with any contraindication to CT or MRI were also excluded e.g. pacemaker, metallic implant, metallic foreign body, aneurysm clips, claustrophobia or pregnancy.

The MRI scans were performed on a Toshiba superconducting MRI system which included axial T2 weighted images at mid inter vertebral disc level L4-5. CT was performed using a Whole Body Multislice CT Scan System Aquillion 16 Toshiba which included axial scans at the same level.

For each patient, axial scans at L4-5 intervertebral disc level were taken by MRI and CT and thus a total of 100 CT and MRI pairs were created. The images were randomized, coded with a number, and presented to a qualified radiologist who evaluated the images separately. The rater was kept blinded of the patient's clinical history and any previous exam findings. Dural sac cross-sectional area (DSCA) of lumbar spinal canal at L4-5 level was calculated using image analysis software (Excelart Vantage GP Software) of each patient. Lumbar spinal canal stenosis was graded as Grade 1 (No stenosis) with DSCA > 100mm^2, Grade 2 (Moderate stenosis) with DSCA 75-100 mm^2 or Grade 3 (Severe stenosis) with DSCA < 75 mm^2. All the collected data was entered in Statistical Package for the Social Sciences (SPSS) version 21 for analysis. Mean ± SD was calculated for age, duration of disease. Frequency and percentage was calculated for gender and grades of stenosis.

Kappa statistics was used to assess the strength of agreement between MRI and CT in assessing grading of lumbar spinal stenosis. Effect modifiers were controlled through stratification of age, gender, duration of disease. Post stratification kappa test was applied. Kappa value ≥ 0.8 was considered significant.

Results

Patients were distributed into two age groups, it showed that 76 % (n=76) were between 18 - 50 years of age while 24 % (n=24) were between 51-70 years of age, mean ± SD was calculated as 43.98 ± 12.003 years. However, moderate to severe LSS (grade 2 and grade 3 patients) was found more in the older age group (79% in age group > 50 years versus 45% in the younger age group). Patients were distributed according to gender, it showed that 79 % (n=79) were male and 21 % (n=21) were females. However the frequency of spinal stenosis (Grade I & II) was found to be higher in females (61%) as compared to males (50%) when graded by CT. Similar results were seen with MRI where 42% of females had spinal stenosis vs. 33% in males, (Chart 1,2). Mean ± SD of pain duration was calculated as 12.06 ± 7.493 months.

		CT LSS Grade			Total
		Grade 1	Grade 2	Grade 3	
Gender	Male	39	32	8	79
	Female	8	9	4	21
Total		47	41	12	100

Frequency in Males = 50%
Frequency in Females = 61%

Chart 1: Freqeuncy of lumbar spinal stenosis by CT scan in males vs females

		MRI LSS Grade			Total
		Grade 1	Grade 2	Grade 3	
Gender	Male	53	22	4	79
	Female	12	6	3	21
Total		65	28	7	100

Frequency in Males = 33%
Frequency in Females = 42%

Chart 2: Freqeuncy of lumbar spinal stenosis by MRI in males vs females

Out of 100 patients 47% were graded as Grade I, 41% as Grade II and 12% as Grade III by CT scan whereas 65% were graded as Grade I, 28% as Grade II and 7% as Grade III by MRI, (Chart 3,4). There was agreement between CT and MRI in the grades

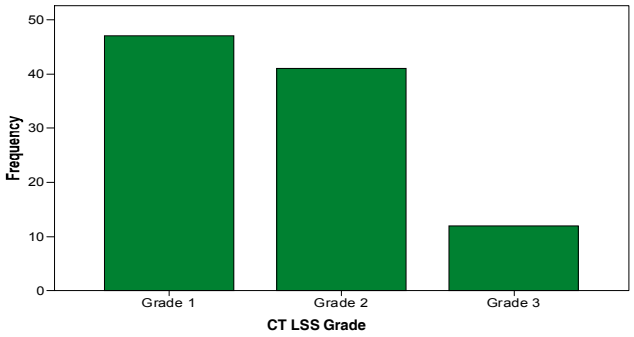

Chart 3: Lumbar spinal stenosis on CT scan (n=100)

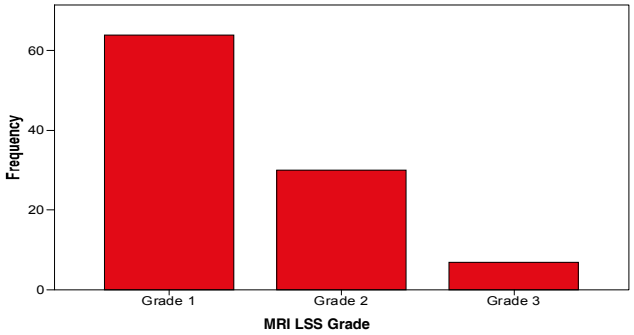

Chart 4: Lumbar spinal stenosis on MRI scan (n=100)

of lumbar spine stenosis in 73 cases (73%), (Chart No. 5). The degree of agreement in grading lumbar spinal stenosis was calculated and kappa value was

	No. of Patients	Percent
No agreement	27	27.0 %
Agreement	73	73.0 %
Total	100	100.0 %

Chart 5: Freqeuncy of agreement between CT and MRI in grading lumbar spinal stenosis (n=100)

observed as 0.527 (p-value = 0.000) which signifies fair to good agreement between CT and MRI for grading lumbar spinal stenosis, (Chart 6).

		MRI LSS Grade			Total
		Grade 1	Grade 2	Grade 3	
CT LSS Grade	Grade 1	45	2	0	47
	Grade 2	20	21	0	41
	Grade 3	0	5	7	12
Total		65	28	7	100

Kappa observed= 0.527 (p=0.000)

Kappa < 0.4	Poor
0.4 to 0.75	Fair to Good
> 0.75	Excellent

Chart 6: Agreement beween CT and MRI in grading lumbar spinal stenosis (n=100)

Disucssion

Lumbar spinal stenosis (LSS) is an important pathologic entity to recognize in patients with radicular symptoms as it can have a negative impact on quality of life.[1] In our study, the frequency of moderate to severe LSS (grade 2 and grade 3 patients) was calculated to be 53% on CT and 35% on MRI. MRI was seen to constantly give a larger Dural Sac Cross-sectional Area (DSCA) as compared to the CT for all patients. A study carried out by Eun SS et al. to compare the effectiveness of CT and MRI in visualizing soft tissues in lumbar spinal stenosis revealed that spinal canal area was more narrowed on CT than on MRI in axial cuts, which could be explained by the superior ability of spiral CT to discriminate cortical bone from soft tissues.[2]

MR imaging is considered the modality of choice for studying spine pathologies, especially spinal stenosis because of its better ability in the evaluation of soft tissue structures. However, it is not the practical choice in all cases due to its limited availability, greater cost and a higher number of contraindications as compared to the CT. CT has the advantage of being quick and allows precise evaluation of the spinal canal and differentiation between spinal canal compression caused by discs, ligaments and bony structures. Furthermore, multislice CT is found by some investigators to be superior to MRI for assessing LSS as it shows bony structures as well as soft tissues clearly.[2] MRI was reported to be unable to reliably distinguish cortical bone from soft tissues and underestimated the stenosis as compared to the CT, similar to what we observed in our study.

Several studies have been undertaken to validate quantitative methods of evaluating lumbar spinal stenosis.[4,10,11] This study was planned to investigate agreement between MRI and CT (without myelography) in grading lumbar spinal stenosis so that we can generate a local and current data that will help us judiciously choose between CT and MRI for our patients. Since the MRI facility is available in only few tertiary care hospitals of our country, utilization of the CT in these patients can help in catering a larger portion of our population with LSS.

In our study, out of 100 cases of low back pain, the mean ± SD age was calculated as 42.48 ± 11.36 years, 79% (n=79) were male and 21% (n=21) were females. Other studies report the presenting age of patients to be (24 - 90 years).[1] A population based survey conducted by Otani et al. in Japan showed a higher incidence of LSS in females as compared to males, especially in the elderly popu-lation1 (50% females versus 30% males, aged 70 - 84 years). In another study by Eun et al., more females were diagnosed with severe degenerative LSS and later required surgical decompression as compared to males.[2] Our study also revealed the frequency of spinal stenosis (Grade I & II) higher in females (61%) as compared to males (50%) when graded by CT. Similar results were seen with MRI where 42% of females had spinal stenosis vs. 33% in males. However, there is apparent increase in number of symptomatic male patients (79%) being referred to us which may be due to the reason that females in Pakistan have less access to healthcare compared to males and this difference is particularly significant in rural areas.

The majority of patients (80%) presenting for evaluation in our study were less than 50 years of age. However, moderate to severe LSS (grade 2 and grade 3 patients) was found more in the older age group (79% in age group > 50 years versus 45% in the younger age group). Other studies have also reported that prevalence of LSS to be greater in the elderly as the spinal canal area is observed to constrict with age.[2]

The degree of agreement between CT and MRI in grading lumbar spinal stenosis, by measuring dural sac cross sectional areas at L4/L5 level, was calculated as kappa value of 0.527, which was statistically significant. This suggests fair to good agreement between CT and MRI for grading lumbar spinal stenosis. A recent study similar to ours, that compared plain CT with MRI the L4/L5 level found a significant difference in the mean DSCA (63 mm^2 on CT vs. 75 mm^2 on MRI).[2] The study did not analyze the similarity of LSS grading but concluded that a combi-nation of CT and MRI have a higher true-positives detection rate than any of the test alone.

A systemic review was conducted by de Graaf I et al to investigate the diagnostic performance of tests used to detect LSS.[10] The imaging studies showed that accuracy of CT, MRI or CTM was comparable.[10] In a comparison of MRI and CTM for lumbar intraca-

nalar dimensions Ogura H et al found that grade of stenosis corresponded well between the two modalities. Cohen's Kappa was 82.4%, suggesting a high degree of correspondence.[4] It was a well designed study however Ogura H et al did not compare the plain CT with MRI. In contrast a study by Drew R et al suggested that CT scans are not a reliable method to examine the severity of lumbar spinal stenosis as agreement regarding the severity of stenosis was poor (kappa = 0.26 ± 0.04).[11] Other studies comparing plain CT with MRI for LSS have generally shown a close agreement in grading the LSS but statistically different values of the DSCA.[2]

Conclusion

It was concluded that the agreement between CT (without myelography) and MRI in grading Lumbar Spinal Stenosis is good although not excellent. So in cases where MRI is either not available or is contra-indicated CT can be of diagnostic use.

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