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Association between Severity of Low Back Pain (LBP) and Magnetic Resonance Imaging Pathologies in Patients with Acute LBP

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Abstract

Background and Objectives: Low Back Pain (LBP) is a common health problem that affects people worldwide, and about 15% of Iranians. It imposes high costs to societies and requires great attention. Magnetic Resonance Imaging (MRI) is considered a reliable and accurate diagnostic tool, however some studies have questioned the appropriateness of MRI in LBP. Thus, this study aimed to evaluate the relationship between the intensity of LBP and positive findings in MRI, in patients with acute LBP.

Materials and Methods: A cross-sectional study was performed on all patients, who reported less than four weeks of LBP and were referred to the radiology center of Shafa-e-Yahyaeian hospital, ranged from March to July, 2014, to perform MRI. Data collected included demographics and pain characteristics, in addition to an Oswestry Disability Index questionnaire. MRI pathologies were distinguished by two spinal surgeons and one radiologist. Data was analyzed using the SPSS software.

Results: A total of 200 patients were enrolled in this study with a mean age of 41.78 years. Nearly half (48%) of the studied patients had positive MRI findings on L4-L5, and NFS and disc bulging (42.5%, and 38%, respectively) were the most common pathologies, while 11.5% of patients had normal MRIs. The mean ODI was highest in patients with vertebral body fracture, and disc herniation and lowest in hemangioma.

Conclusion: A noticeable percentage of patients demonstrated a high ODI score, but MRI findings were in significant association with age of patients, indicating that patients with acute LBP do not require MRI immediately. Using the ODI questionnaire can help us towards a better diagnostic approach.

Keywords: Low Back Pain, Acute Pain, Magnetic Resonance Imaging, Pathology

1. Introduction

Low Back Pain (LBP) is a common health problem with a high prevalence; as reported, mean global prevalence of point LBP is 18.1% with one-year prevalence of 38.1% and a high rate of episode remission in one year (54% to 90%) (Hoy, Brooks, Blyth, & Buchbinder, 2010). In Iran, point prevalence of LBP is reported at about 15% in teenagers and adults (Mohseni-Bandpei & Bagheri-Nesami, 2007; Davatchi et al., 2008) with a one-year prevalence of 21% in adult industrial workers (Ghaffari, Alipour, Jensen, & Farshad, 2006).

In addition, LBP is one of the diseases imposing the highest overall degree of resource used, among individuals under 60 years old, and imposes high costs to societies (Rapoport, Jacobs, Bell, & Klarenbach, 2004). Thus, evaluating the factors affecting its incidence is of great importance. The associated risk factors include age 50-69 years, low education and income, depression, sleep disturbances, and medical comorbidities (Weisman, Witter, & Reveille, 2013).

The wide range of differential diagnosis, necessitates great attention to a patient's history, physical examination, and diagnostic tools (Amirdelfan, McRoberts, & Deer, 2014). Magnetic resonance imaging (MRI) is considered a sensitive tool for the diagnosis of secondary pathologies underlying LBP (Millán, Cabrera, Muñiz, Sola, & Zubia, 2013). As suggested, some MRI findings, such as disc height and annular tears, are associated with the frequency and intensity of pain (Videman, Battié, Gibbons, Maravilla, Manninen, & Kaprio, 2003) and other findings, like spondylolisthesis, are related to leg symptoms (Ishimoto, 2015). Thus, MRI is the preferred investigation method and is increasingly requested for the diagnosis of LBP (Sheehan, 2010). Yet, studies have questioned the

appropriateness of MRI in LBP, as subjects without LBP symptoms showed a high percentage of positive pathologies on MRI (Jarvik, Hollingworth, Heagerty, Haynor, & Deyo, 2001), 67% of those whom may have experienced complications with LBP in the past three years (Jarvik, Hollingworth, Heagerty, Haynor, Boyko, & Deyo, 2005). In addition, early MRI is considered to induce greater costs, and iatrogenic effects (Webster, Bauer, Choi, Cifuentes, & Pransky, 2013) and seems not to affect the treatment results (Gilbert et al., 2004). Thus, the American College of Physicians and the American Pain Society, have suggested conservative recommending an MRI (Chou et al., 2007) and various indications for requesting MRI (Millán, Cabrera, Muñiz, Sola, & Zubia, 2013).

Due to the above-mentioned controversies, we aimed to evaluate the relationship between the intensity of LBP and positive pathologic findings in MRI, in patients with acute LBP.

2. Materials and Methods

2.1 Study Design

A cross-sectional study was performed on all patients with acute LBP (less than four weeks), who were referred to the radiology center of Shafa-e-Yahyaeian hospital from between March to July, 2014, to perform MRI. After explaining the objectives of the study to the patients, those who gave consent to participate in the study were enrolled in the study. The sample size was calculated based on following equation:

$$n = \frac{\left(z_{1-\alpha/2} + z_{1-\beta}\right)^2 \times P \times 9}{D^2} = 196 \quad (1)$$

The inclusion criteria included, patients who were referred to the radiology center of Shafa-e-Yahyaeian hospital ranged from March to July, 2014 to undergo MRI, had LBP for 4 weeks, and any acute LBP patient with less than 4 weeks was excluded from the study.

All participants filled a demographic checklist, including age, gender, occupational status, current smoking status, and history of chronic diseases, including diabetes mellitus, hypertension, hyperlipidemia, hypo- or hyper-thyroidism, congestive heart disease, osteoporosis and rheumatologic diseases, asthma, and psychosomatic diseases. Also, history of LBP, falling, trauma, and history of spinal, and abdominopelvic surgery were recorded. In addition, radicular pain and numbness to hips or legs and feeling weakness in legs, as well as genito-urinary problems during LBP were recorded for all participants.

Then, the Persian version of the Oswestry Disability Index (ODI) questionnaire was handed to patients, which was completed under direct supervision of a research team member, in order to answer the participants' questions and ensure the completion of all questions and prevent missing data. The questionnaire includes 10 sections namely; pain intensity, duration, ability to do personal care, sitting, standing, sleeping, lifting, sexual activities, social life, and travelling. The Persian version of ODI was validated by Mousavi and colleagues, indicating a Cronbach's alpha of 0.75 and excellent test-retest reliability (intra-class correlation coefficient = 0.91) (Mousavi, Parnianpour, Mehdian, Montazeri, & Mobini, 2006).

The MRIs and T2 were performed with the study participants lying supine, and proton density-weighted images (PDW) of the lumbar spines were obtained using a 1.5-Tesla scanner (Magnetom, Siemens AG, Germany) with surface coil and 260 mm field of view, 4 mm slice thickness, and 0.4 mm interslice gap for sagittal images and 3 mm and 0.3 mm, respectively, for axial slices.{{{ The T1-T2 MRI were performed with study participants lying supine, no proton density weighted images of lumbar spine were obtained using a 0.35 Tesla scanner (Neusoft China) with Quadricher coil and 350mm field of view, 4mm slice thickness, and 1mm interslice gap for sagittal images and 7mm and 1 mm, respectively for axial slices}}} MRI images were then interpreted by two spinal surgeons and one radiologist, and the results were recorded.

2.2 Ethical Considerations

The protocol of the study was approved by Ethical committee of University. The design and objectives of the study were explained to all participants and written informed consent was obtained from those willing to participate in the study. All participants were informed that, they were free to leave the study whenever they wished to. All ethical considerations of the Declaration of Helsinki were met during the study.

2.3 Statistical Analysis

Results were presented as mean ± standard deviation (SD) for quantitative variables and were summarized by frequency (percentage) for categorical variables. Continuous variables were compared using the Independent Samples T-test and One-Way ANOVA; while binary categorical variables were compared using the chi-square test.

For statistical analysis, the statistical software SPSS version 18.0 for windows (SPSS Inc., Chicago, IL) was used. P values of 0.05 or less were considered statistically significant.

3. Results

A total of 200 patients were enrolled in this study with a mean age of 41.78±14.23 years. Among all patients recruited in this study, 122 (61%) were female with a mean age of 43.83±12.91 years, and 78 (39%) were male with a mean age of 38.59±15.63 years (P-value=0.47). Of the participants, 51.1% were housewives, 16.3% were businessmen, 9.2% had government jobs, 7.6% were students, 5.4% were manual workers, 5.4% were retired, 2.2% were teachers, 1.6% worked in the army and 1% were occupied in other jobs.

Of all patients, 12% of patients (n=24) smoked, 6% of patients (n=12) had diabetes, 9.1% of patients (n=18) had hypothyroidism and 3% (n=6) hyperthyroidism, 5% of patients (n=10) were receiving treatment for rheumatic diseases, and 21% of patients (n=42) had a history of other diseases, as follows: 16% of the cases (n=5) had psychosomatic disorders, 13.3% (n=4) had dyspepsia, 13.3% (n=4) had asthma, 10% (n=3) had hypertension, 10% (n=3) had hypertension and hyperlipidemia at the same time, 6.7% (n=2) had osteoporosis, 6.7% (n=2) had congestive heart diseases, and 23% (n=7) had other diseases.

The duration of recent low back pain was more than one month in 39.8% of patients (n=78) and less than one month in 60.2% (118 patients).

Among all patients, 60.9% (117 patients) had a history of LBP in the previous year Among the participants, 4.6% (n=9) had a history of spinal surgery, 23% (n=45) had a history of abdominopelvic surgery; 11.6% (n=22) had a history of genito-urinary problems, 62.9% (n=124) had numbness and tingling in legs, 65.3% (n=128) had problems walking, and 67.2% (n=133) had weakness in legs.

Among all the patients, 73.3% (n=143) underwent physical examination by a physician, who referred the patient for MRI.

The frequency of the ODI score is demonstrated in Figure 1. The mean ODI score was 41.2±15.93 (severe back pain) and 88.5% of patient had pathologies on MRI, 48% (n=97) of which was on L4-L5 and 35% (n=70) on L5-S1, 27% (n=55) on L3-L4, 10% (n=20) on L2-L3, and 3% (n=6) on L1-L2, and 1% (n=2) on T12-L1, and 1% (n=2) on T11-T12. In addition, 42.5% (n=85) had NFS, 38% (n=76) disc bulging, 22% (n=44) disc protrusion, 12.5% (n=25) degenerative disc changes, 9% (n=18) spinal stenosis, 6% (n=12) spondylolisthesis, and 2% (n=4) had vertebral fractures (Table 1). The disc pathology was central in 40.4% (n=40), right in 22.3% (n=22), left in 22%, and posterior in 13.1% (n=13).

Table 1. Frequency of different pathologies and mean ODI in each pathology

Pathology reported in MRI	Percent	Number	Mean ODI
Neural Foraminal Stenosis	42.5%	85	36.54±13.28
Disc Bulging	38%	76	35.67±16.41
Disc Herniation	24.5%	49	46.2±15.76
Disc Protrusion	22%	44	37.79±15.12
Disc Degeneration	12.5%	25	37.1±12.2
Spinal stenosis	9%	18	38.52±17.20
Listhesis	6%	12	39.27±20.01
Vertebral body fracture	2%	4	62±15.58
Reduced disc space	3%	6	26.16±14.40
Hemangioma	2	4	45.50±21.25

The results of the Independent sample T-test showed significant association between ODI scores and disc bulging (P-value=0.02), NFS (which was lower in patients without NFS) (P-value=0.01), but not between ODI score and disc herniation (P-value=0.49), disc protrusion (P-value=0.21), spinal stenosis (P-value=0.11), listhesis (P-value=0.89), reduced disc space (P-value=0.55), and spine fracture (P-value=0.52).

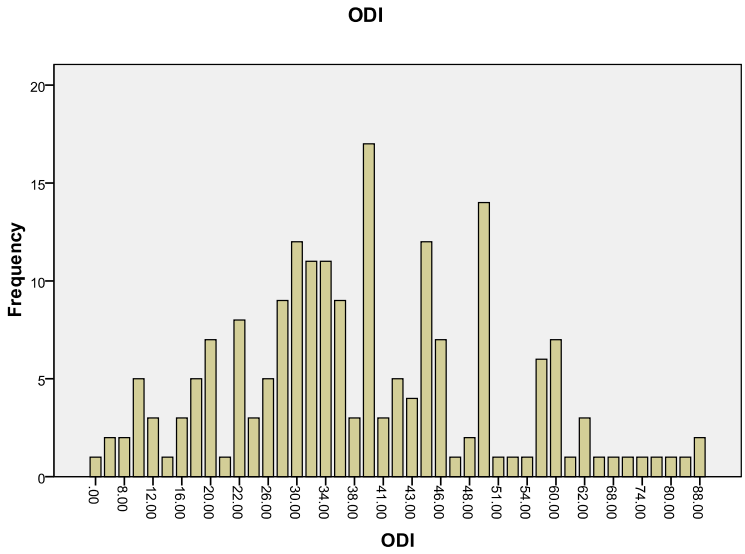

Figure 1. Frequency of ODI scores

The results of the One-way ANOVA test showed that, the overall score of ODI was significantly different in patients with different pathologies (P-value=0.04) and was higher in patients with "bulging + herniation + spinal stenosis", "herniation + NFS + listhesis", and "protrusion + disc degeneration".

There was also no statistically significant relationship between ODI scores and comorbid diseases (P-value=0.63), duration of LBP (P-value=0.17), and spinal surgery (P-value=0.38). However, the ODI score was significantly associated with history of abdominopelvic surgery as demonstrated by the Independent sample T test (P-value=0.01).

The mean ODI in different pathologies are presented in Table 1 and Figure 2. As demonstrated, the highest mean ODI score was related to patients with vertebral body fracture (mean= 62), and disc herniation (mean= 46.4) and the lowest to hemangioma (mean=29.8).

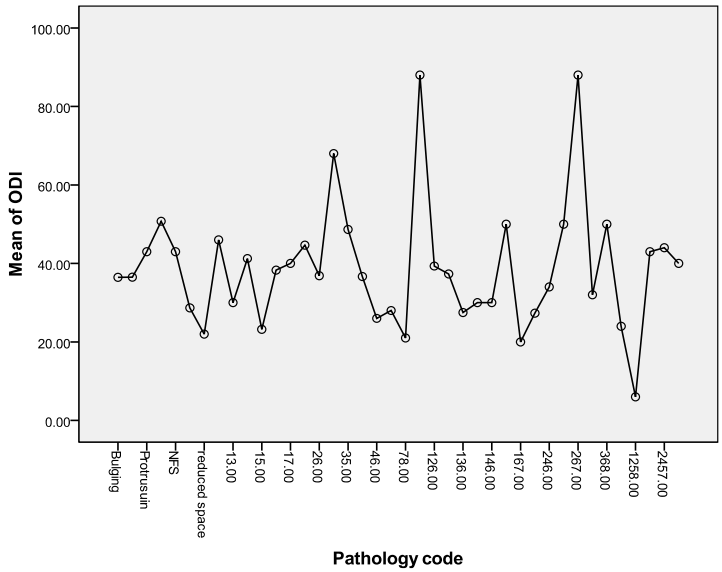

Figure 2. Mean ODI in different pathologies

1. Bulging 2. Neural foramen stenosis 3. Protrusion 4. Degeneration 5. Listhesis 6. herniation 7. Vertebral body fractures 8. Reduced disc space

4. Discussion

Nearly half (48%) of the study participants had positive MRI findings on L4-L5, while NFS and disc bulging (42.5%, and 38%, respectively) were the most common pathologies reported on MRIs, and 11.5% of the patients had normal MRIs. Only one-third of the patients were examined by the doctor before being referred for an MRI, and mean ODI was highest in patients with vertebral body fracture, and disc herniation and lowest in hemangioma.

Studies have reported different prevalence of LBP and MRI pathologies (Sheehan, 2010). In the study by Shepper and colleagues, 94% of the referred patients had abnormal MRIs (de Schepper, Koes, Veldhuizen, Oei, Bierma-Zeinstra, & Luijsterburg, 2015), while in the present study, 88.5% had pathologies on MRI, which is similar to the percentage (83.2%) reported in another study on an Iranian population (Aghaghazvini, Hashemi, Neshan, Aghaghazvini, & Shakiba, 2014), indicating that MRI is over-requested for patients with LBP in Tehran, Iran. Meanwhile, the characteristics of patients' demographics and pain details might have also caused such a difference, as in the present study, 34% of patients had chronic LBP, while in the study by Shepper and colleagues, 67% had chronic pain (de Schepper, Koes, Veldhuizen, Oei, Bierma-Zeinstra, & Luijsterburg, 2015).

Kleinstuck and colleagues investigated 53 patients with chronic nonspecific LBP and reported that 11% had no abnormalities (Kleinstück, Dvorak, & AF, 2006), which is close to the present study, although they studied patients with chronic pain, who are expected to have higher frequency of MRI abnormalities. Moreover, they reported that MRI findings were not associated with better treatment outcome, which has also been reported by Gilbert and colleagues (Gilbert et al., 2004).

Another finding of the present study, which is in line with previous studies, is the fact that most of the abnormalities were observed in the lower lumbar spine (Aghaghazvini, Hashemi, Neshan, Aghaghazvini, & Shakiba, 2014; Kleinstück, Dvorak, & AF, 2006; Kjaer et al., 2005). Also, disc bulging is described as the first or second most common MRI pathology, as reported in a number of studies (Videman, Battié, Gibbons, Maravilla, Manninen, & Kaprio, 2003; Aghaghazvini, Hashemi, Neshan, Aghaghazvini, & Shakiba, 2014), which is consistent with the present study. Other studies have reported different pathologies as the most common sign, and have reported diverse reports regarding the association of the MRI pathologies to LBP. For instance, Kjar and colleagues have reported disc height as the most frequent MRI finding (Kjaer et al., 2005) and Videman and coworkers have reported that, disc height was associated with LBP variables studied, and annular tears with LBP frequency and intensity of LBP (Videman, Battié, Gibbons, Maravilla, Manninen, & Kaprio, 2003). In the present study, disc bulging and NFS, which were the most common MRI findings, were significantly associated with ODI score, and patients with NFS had higher pain scores. This finding suggests that we can prevent unnecessary MRI in patients with acute LBP by providing ODI questionnaires, which showed to have a high association with MRI pathologies.

As raised by other studies, as well, imaging should be reserved for patients with specific symptoms such as, red flags for cauda equina syndrome, recent trauma, risk of infection, severe or progressive neurologic deficits or serious underlying conditions (Chou et al., 2007; Herndon, Schiel Zoberi, & Gardner, 2015). According to the first recommendation of the American College of Physicians and the American Pain Society, precise history and physical examination is the primary step in patients with LBP, and the use of validated questionnaires, including ODI, the Roland–Morris Disability Questionnaire (RDQ), and the visual analogue scale (VAS), which can help patients' assessment (Chou et al., 2007), which is consistently documented in the present study.

Also, the overall mean ODI score in the present study was 41.2, which is in the category of severe back pain, which was similarly found in another Iranian study (Aghaghazvini, Hashemi, Neshan, Aghaghazvini, & Shakiba, 2014). Although this finding can also be attributed to the mean age of patients in the present study and the study by Aghaghazvini and colleagues, it shows severe pain in patients with acute LBP in Iranian population. As studies investigating the factors affecting LBP have determined that, workload and position as the most important risk factors (Videman, Battié, Gibbons, Maravilla, Manninen, & Kaprio, 2003; Hartvigsen, Bakketeig, Leboeuf-Yde, & Engberg, 2001), and due to the high ODI score of the study population, it is suggested that factors affecting LBP in the Iranian population should be elucidated, and policy-makers in Iran should make steps towards improving the general health of the public, through appropriate population education as well as other criteria. In addition, MRIs should not be requested so frequently for patients with LBP; and detailed history taking, physical examination, and ODI questionnaires can help in the prevention of unnecessary MRIs.

The limitations of the present study included, generalizability of the results, which requires multi-centric studies from random samples throughout the country to identify the confounding effects of other factors, like race, ethnicity, and geographic distribution etc.

In conclusion, although MRI is an appropriate diagnostic tool for patients with LBP, 11.5% of patients had normal MRI reports, indicating that, patients with acute LBP do not require MRI immediately. In addition, most patients

of the present study showed a high ODI score, but MRI findings were in significant association with age of the patients. Using the ODI questionnaire can help physicians towards a better diagnostic approach and reserve MRIs for definite indications.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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