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Lumbar Disk Herniation: A Clinical Epidemiological and Radiological Evaluation

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Abstract

BACKGROUND: A herniated disc in the spine is a condition during which a nucleus pulposus is displaced from intervertebral space.

AIM: The study aimed to investigate and observe variation of clinical, epidemiological, and radiological aspects for patients suspected of lumbar herniation based on observed evaluation of CT and MRI imagery.

METHODS: This is a cross-sectional study conducted during the periods March 2015 and November 2019. Patients were subjected to MRI and CT based on the emergency or scheduled of diagnose. All MRI scans were obtained with 1.5 tesla MRI machine and for CT had undergone examinations with one of the following equipment: Siemens with 128 slice and Phillips 64 slice. The patients were placed in supine position.

RESULTS: Overall 194 symptomatic patients were recruited as a participant in this study, 118 men and 76 women with an average age of 44.9 ±10.4 years. Patients belong to the active age (35–44-years-old and 45–54-years-old) appeared to have the highest percentage of lumbar disk herniation (LDH) 30.9% and 25.8%, respectively. There were a significant association between such as epidemiological data (such as gender, BMI, age groups, and employment status) and presence of LDH, $p < 0.05$. Acute pain was presented in 69.07% of patients and according to complaint associated with low back pain (LBP), most of them 47.4% appeared with Right Sciatica. MRI is the most diagnostic methods used in evaluation of LDH in 52% of patients, and CT was used in 48% of them. The most common changes were between L2-L3, L3-L4, and L4-L5. Furthermore, the grading findings which corresponding to lumbosacral segment were Grade I and Grade II. Grade V was less common.

CONCLUSION: This study involving patients with lumbar disk herniation and associated LBP showed that a combination of clinical features and epidemiological predicted the presence or absence of a significant association. Further research is required to validate these findings in different types of LDH and LBP for other findings and conditions.

Introduction

A herniated disk in the spine is a condition during which a nucleus pulposus is displaced from intervertebral space. The pathophysiology of herniated disks is believed to be a combination of the mechanical compression of the nerve by the bulging nucleus pulposus and the local increase in inflammatory chemokines [1]. Disk herniation is a common cause of low back pain (LBP) to the human. There is a higher rate of disk herniation in the lumbar and cervical spine due to the biomechanical forces in the flexible part of the spine. The thoracic spine has a lower rate of disk herniation [2], [3]. The lumbar disk herniation (LDH) is common disease, affecting about 5% of the population. While LDH-induced pain accounts for 5% of all low-back pain cases, only 15% all LDH cases are managed with surgical intervention [4]. The primary signs and symptoms of LDH are radicular pain, sensory abnormalities, and weakness in the distribution of one or more lumbosacral nerve roots. Focal paresis, restricted trunk flexion, and increases in leg pain with straining, coughing, and sneezing are also indicative. Patients frequently report increased pain when sitting, which is known to increase disk pressure by nearly 40% [5]. In practice, most radiologists consider clinical information useful, especially in patients suspected of LDH. Little evidence is available on the impact of clinical information when evaluating MR images of the lumbar region [5].

Disk herniation is one of the most frequent diagnoses in the radiological practice of spine pathology [6]. One of the diagnostic imaging techniques available for this purpose is computed tomography (CT). Nowadays, CT plays a key role in spinal imaging and has largely replaced invasive imaging techniques, particularly because CT is associated with less morbidity than invasive techniques [7]. Non-contrast CT also plays an important role in the preoperational assessment of lumbar disk herniated diseases, with a diagnostic performance similar to that of lumbar spine magnetic resonance imaging (MRI) [8]. However, the accuracy of MRI for predicting the presence of disk herniations at surgery is relatively high, and it has become the investigation of choice for patients suspected of LDHs [9], [10], [11].

Compared with CT the MRI has the advantage of not using ionizing radiation and has good visualizing capacities especially of soft tissue [12]. The study aimed to investigate and observe variation of clinical, epidemiological and radiological aspects for patients suspected of lumbar herniations based on observed evaluation of CT and MRI imagery.

Methods

This paper is performed a cross-sectional study between March 2015 and November 2019 as part of the diagnostic process for patients with lumbosacral radicular pain at the Department of Imagery Hospital "Mother Theresa" Centre and "Shefqet Ndroqi" Hospital.

Patients were recruited from the neurology, traumatology, orthopedic, and rheumatology outpatient department. Eligible criteria of patients were all of them referred by their specialist with lumbosacral radicular syndrome (LRS) with suspected disk herniation at levels L1-L2, L2-L3, L3–L4, L4–L5, or L5–S1, in whom conservative treatment was unsuccessful. Patients have other proven diseases there are not related to LDH, patients younger than 25 years or older than 70 years, and patients with contraindications for MRI have been excluded from the study. After confirmation of the LRS diagnosis by the specialist, patients were subjected to MRI and CT based on the emergency or scheduled of diagnose. Two MRI scans were obtained with 1.5 tesla MRI machine (General Electric and Magneton, Siemens medical system). The patients were placed in supine position with their head toward the magnet. The studies consisted of three spin-echo sequences: The sagittal T1W- and T2W-images and transverse T2W-images. The slice thickness was 3 mm for all sagittal and axial sequences. The radiologists record the types of disk herniation identify by the MRI images. Diseases excluded by diagnostic radiologists were degenerative disk disease. Patients had undergone CT examinations (two devices) with one of the following equipment: Siemens with 128 slice, and Phillips 64 slice. Patients were scanned in the supine position with the gantry vertical. Sections of 3 mm were obtained in the lower 3 intervertebral lumbar space.

Descriptive parameters such as demographic data, clinical and neurological examination findings, as well as radiological information derived from MRI views were recorded. Data analysis was carried out with SPSS software for Windows version 20.0 (SPSS Inc., Chicago, IL, USA). Continuous variables are presented as mean ± SD, frequency or percentage, as appropriate. Chi-square test are used to establish data correlation. Standard Student's t-test and Mann–Whitney U tests for paired samples or one-way ANOVA performed for group comparisons or comparing data, as needed. $p < 0.05$ was considered to be statistically significant.

Results

Table 1 shows epidemiological and demographic data of diagnosed patients with lumbar disk herniation during the period March 2015 until to November 2019. According to the inclusion and exclusion criteria in this study, 194 symptomatic patients (118 men and 76 women; mean age, 44.9 years ±10.4 Std age range, 23–70 years) were recruited as participant of this study. The most predominant gender was men compared to women with a significance level between them.

Table 1: Epidemiological and demographic data of patients with LDH

Demographic variables	Frequency	Percentage	p value
Gender			0.001
Women	76	39.2	
Men	118	60.8	
Age groups			0.02
25–34-year-old	36	18.6	
35–44-year-old	60	30.9	
45–54-year-old	50	25.8	
55–64-year-old	34	17.5	
≥65-year-old	14	7.2	
Residence			0.39
Urban	114	58.8	
Rural	80	41.2	
Education level			0.24
Elementary	26	13.4	
8 years	45	23.2	
High school	68	35	
University	55	28.4	
BMI, kg/m^2			0.005
≤25	27	13.9	
26–30	76	39.2	
≥30	91	46.9	
Family history with LHD			0.38
Yes	86	44.3	
No	108	55.7	
Employment status			0.004
Employed	122	62.9	
Unemployed	31	16.0	
Retire	31	16.0	
Invalid	10	5.2	

LDH: Lumbar disk herniation, BMI: Body mass index.

Patients are separated between five age groups. Patients ≥65-years-old appeared the lower percentage 7.2% (14/194) of LDH compared to other age groups. Patients belong to the active age (35–44-years-old and 45–54-years-old) appeared to have the highest percentage of LDH 30.9% and 25.8%, respectively. Patients in the age groups of 25–34-years-old and 55–64-years-old appeared almost the same percentage of lumbar disk herniation with 18.6% and 17.5%, respectively. There is a significance association between the age groups and presence of LDH in $p = 0.02$.

Related to the residence of patients, 58.8% were living in urban area and 41.2% werein rural area. There is no association for residence of patients with lumbar disk herniation $p = 0.39$.

Elementary level of education appeared in 13.4% of patients, 8 years' level appeared 23.2% of them, in high school level appeared the highest percentage of patients 35%, and them with university level appeared 28.4%. There is not found association between residence (rural vs. urban area) of patients and lumbar disk herniation $p = 0.24$.

Regarding employment status of patients with LDH, 62.9% (122/194) of them were employed,

unemployed and retire were 16.0% (31/194) of them, and invalid were 5.2% (10/194). There is a significant association between the employment status and presence of LDH, p = 0.004.

Body mass index (BMI) is seen as a risk factor for the lumbar dick herniation. Related to this variable, 13.9% (27/194) of patients appeared to having BMI ≤ 25, about 39.2% (76/194) appeared with BMI 26–30 and 46.9% (91/194) in BMI ≥ 30. There is a significant association between BMI and presence of LDH, p = 0.005.

Family history with LHD referred 44.3% of patients and the others 55.7% do not have. There is no a significance association between the family history and presence of LDH for 95% confidence interval (CI), p = 0.38.

Patients were interviewed by the radiologist regarding the clinical and neurological examination done in advance. The detailed information of the patients regarding the clinical and neurological examination findings is presented in Table 2. Hence, according to onset of pain 69.07% (134/194) of them were presented with acute pain at the Department of Imagery and 30.93% (60/194) with chronic pain. According to complaint associated with LBP, 47.4% (892/1949) appeared with, Right Sciatica (RS); 35:65% (69/194) with LBP, Left Sciatica (LS), and 17% (33/194) with LBP and Bilateral Sciatica (BS).

Table 2: Clinical and neurological examination findings

Variables	Frequency	Percentage
Onset of pain		
Acute	134	69.07
Chronic	60	30.93
Complaint		
LBP, RS	92	47.4
LBP, LS	69	35.6
LBP, BS	33	17.0
Time of onset		
1–3 weeks	38	19.6
4 weeks	91	46.9
More than 1 month	65	33.5
Recurrence of lumbar disk herniation		
Yes	78	40.2
No	116	59.8
Evaluation of the first episode of LDH		
With treatment	59	75.6
Without treatment	19	24.4
Type of treatment		
Chirurgical treatment	16	27.1
Medical treatment	23	39
Physiotherapy	20	33.9

LDH: Lumbar disk herniation, LBP: Low back pain, RS: Right Sciatica, LS: Left Sciatica, BS: Bilateral Sciatica.

Time of onset of pain varied from 1 week until to more than 1 month. Hence, 19.6% (38/194) of patients with LDH, referred that the time of onset were between 1 and 3 weeks, 46.9% (91/194) referred time of onset for 4 weeks, and 33.5% (65/194) for more than 1 month.

Some of patients may be have the recurrence of lumbar disk herniation. Related to recurrent lumbar disk herniation (rLDH), 40.2% (78/194) of patients referred yes and 59.8% (116/194) referred that is the first episode with LDH in their live. Referred to the evaluation of the first episode of LDH in 78 patients that had a recurrence, 75.6% (116/194) were undergone treatment and evaluation of others 24.4% (19/194) were without treatment. Patients that undergone treatment, 27.1% referred that have a chirurgical treatment, 39% a medical treatment with drugs, and 33.9% have used the physiotherapist treatment.

MRI is the most diagnostic methods used in evaluation of LDH among patients of this study. So almost half 52% (101/194) of patients were diagnosed with MRI and others 48% (93/194) with CT (Table 3).

Table 3: Radiological information derived from MRI and CT

Variables	Number total of patients with LDH		Women with LDH n=76		Men with LDH n=118	
	N	%	N	%	N	%
Diagnosis						
MRI	101	52	41	54	60	50.8
CT	93	48	35	46	58	49.2
Position of LDH						
L1-L2	18	9.3	7	9.2	11	9.3
L2-L3	64	33	25	32.9	39	33
L3-L4	59	30.4	21	27.6	38	32.2
L4-L5	38	19.6	14	18.4	24	20.3
L5-S1	15	7.7	9	11.8	6	5.1
Grade of LDH						
Grade I	57	29.4	25	32.9	32	27.1
Grade II	49	25.3	22	28.9	27	22.9
Grade III	33	17	13	17.1	20	16.9
Grade IV	31	16	9	11.8	22	18.6
Grade V	24	12.4	7	9.2	17	14.4

LDH: Lumbar disk herniation, MRI: Magnetic resonance imaging, CT: Computed tomography.

Regarding position of lumbar level herniation, the most common changes were between L2-L3, L3-L4 and L4-L5. Furthermore, the grading findings which corresponding to lumbosacral segment were Grade I and Grade II (Figures 2–7). Grade V was less common among patient's participant in this study. Figure 1 presented the disk herniation grading findings corresponding to each lumbosacral segment. Different borders present almost all Grades from I, II, II, IV, and V, respectively.

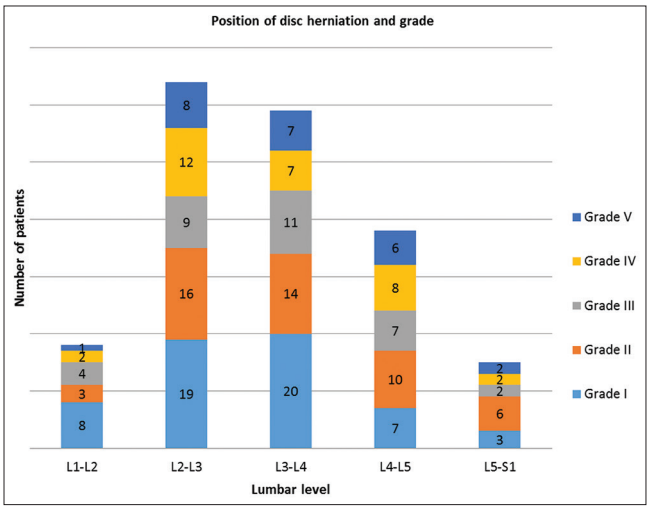

Figure 1: The disk herniation grading findings corresponding to each lumbosacral segment

Table 3 appears the radiological information derived from MRI and CT according to the gender (women versus men). MRI was most predominant diagnose used in both genders. In terms of imagery LDH diagnose regarding gender, 54% (41/76) of women were diagnosed with MRI and 35% (46/76) with CT. Furthermore, among

118 men analyzed for LDH, 50.8% (60/118) were diagnose with MRI, and 49.2% (58/118) with CT.

Figure 2: Patient with the lower back and right lower leg pain. The Ct scan shows right medio lateral herniated disk Grade I in the L4-L5 intervertebral space

As is reported before, most of participant patients in this study resulted with lumbar disk herniation changes in level L2-L3, L3-L4, and L4-L5. According to the gender the most predominant changes is at level L2-L3, where to women and men those changes resulted almost the same with 32.9% and 33%, respectively. Other level changes are as followed; LDH changes at L1-L2 level resulted 9.2% for women and 9.3% for men, at level L3-L4 resulted 27.6% for women and 32.2% for men, at level L4-L5 resulted 18.4% for women and 20.3% for men, and for the last level L5-S1 women presented a predominance of changes compared to men, the results were 11.8% for women and 5.1% for men.

Figure 3: Patient with the left lower back pain. The Ct scan shows the left lateral herniated disk Grade I in the L3-L4 intervertebral space

Regarding the grade of herniation is seen a predominance of Grade I until to III to women and to men the predominance is seen for Grade IV and V. Grade II appeared a predominance compared to others grade for both genders.

Figures 2–4 presented some of the CT image finding. Figure 2 in a 45-year-old man who presented with acute severe lower back pain. At standard CT, lumbar disk L4/L5.

Figure 3 in 49-year-old women who presented with acute severe lower back pain. At standard CT, lumbar disk L3/L4.

Figure 3 in 62-year-old men who presented with acute severe lower back pain. At standard CT, lumbar disk L5/S1.

Figure 4: Patients with the lower back and right lower leg pain. The CT scan shows the right medio lateral herniated disk Grade II in the L5-S1 intervertebral space

Discussion

LDH is a frequent degenerative disorder, commonly causing lower back pain and entailing substantial social and economic burden [13], [14]. Complications such as compressions of the spinal cord or spinal nerve root can result in irreversible morbidity [15], [16]. Therefore, fast and accurate diagnosis is necessary for rapid initiation of optimal therapy and to avoid poor outcome [14]. MRI, as a noninvasive radiological investigation, is regarded as the most reliable method for diagnosing LDH and is also of crucial importance in guiding the management of LDH [17]. Non-contrast CT also plays an important role in

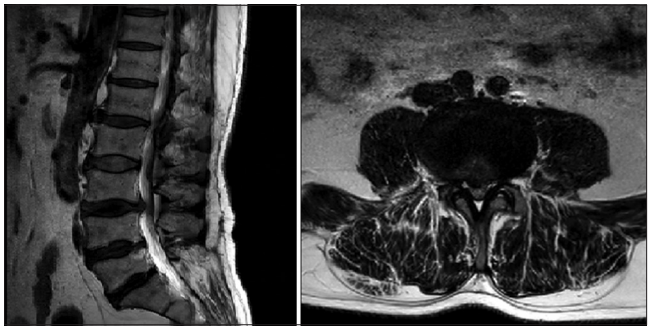

Figure 5: Patient with the lower back pain. The sagittal and axial T2W-images showed posteromedial herniated disk in the L3-L4 level

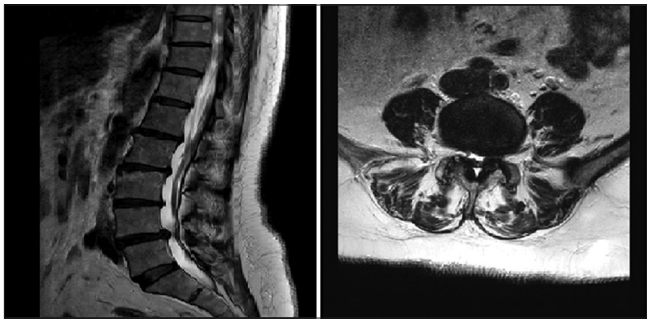

Figure 6: Patient with the lower back and left lower leg pain. The sagittal and axial T2W-images showed left posterolateral herniated disk Group I in the L4-L5 level

the preoperational assessment of lumbar disk herniated diseases [18], [19], [20], with a diagnostic performance similar to that of lumbar spine MRI [8], [19]. In this study, the diagnosis was based on MRI and CT and objective clinical findings.

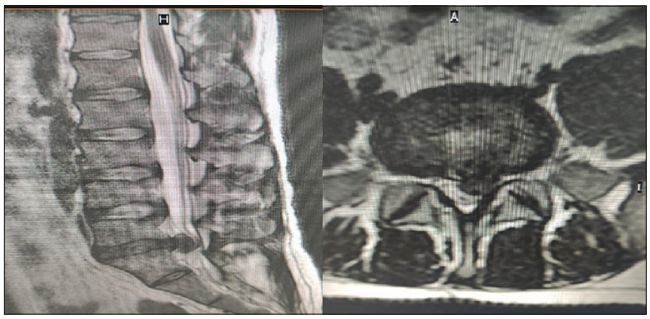

Figure 7: Another patient with the lower back and left lower leg pain. The sagittal and axial T2W-images showed the left posterolateral herniated disk Group II in the L4-L5 level

Hoy *et al*., in their study found a higher incidence of LBP in the third decade of live, and overall prevalence increases with age until the 60–65 year age group and then gradually declines [21]. Results of this study showed a similarity with the previous study [21]. The age group 35–44-year-old in this study appears the higher number of patients (30.9%) with LBP. There is found a significant association between the age groups and LDH in this study. Differences between women and men for some of the diseases are not clear. One of diseases that have not been explored is the difference in how the two-gender experience a disk herniation [22]. The current study sought to explore differences gender-related to LDH. The most than predominant gender were men 60.8% of patients with LDH and there was found a significant association between gender and LDH. The finding of this study was similar with a study conducted by Strömqvist *et al*. that found a statistically significant difference between the sexes and lumbar disk herniation [23].

Obesity with its increased stress on the lumbar spine has a known adverse effect on lumbar intervertebral disks. The relationship between obesity and LBP has been repeatedly discussed previously. Numerous authors emphasized the unfavorable effects of obesity on the spinal column including back pain, facet arthrosis, and degenerative disk disease [24], [25], [26], [27], [28], [29]. Elevated BMI or overweight and obesity are pandemics. Samartzis *et al*. assess the role of BMI and its association with disk herniation on the largest Southern Chinese population-based study.

This study definitely noted that overweight and obesity significantly increased the likelihood of having lumbar disk herniation, its global severity, and the risk of developing sciatica [30]. The same finding is seen in this study, regarding the obesity and lumbar disk herniation for 85% CI p = 0.0005.

The medical literature has shown a hereditary tendency for disk degeneration, and disk degeneration is associated with an increased risk for a herniation. One extensive study found that a family history of lumbar herniated disks is the best predictor of a future herniation [31]. There was not found a significant association between the LDH family history among patients' participant of this study.

Heavy physical activities are known risk factors for lumbar degeneration [32]. However, these results are not consistent. Most studies have assessed occupational exposure based on occupation groups [32], [33]. Therefore, in current study is exploring lumbar disk herniation with occupational status. There is found a strong association regarding the status of employment of patients and LDH. A herniated disk is a condition that can occur anywhere along the spine, but most often occurs in the lower back. It is one of the most common causes of lower back pain, as well as leg pain or "sciatica." Although a herniated disk can be very painful, most people feel much better with just a few weeks or months of nonsurgical treatment. Acute LDHs are the most common cause of sciatica [34]. Regarding the onset of pain most of them (69.07%) presented acute pain and (30.93%) with chronic pain. Furthermore, LBP-RS (47.4%) was the most predominant complaint followed by LBP-LS (35:65%) and LBP-BS (17%). Meantime the recurrence rate has been reported to vary between 5% and 15% [35], [36]. The finding in this study does not appear some prevalence of rLDH as mention by Huang *et al*. About 40.2% of patients were presented to the imagery department with rLDH.

According to evaluation of disk herniation, the results of this study showed a predominance of MRI diagnose compared to CT scan. Almost half 52% of patients were diagnosed with MRI and others 48% with CT. Due to the unique anatomy of the upper lumbar spine, upper lumbar disk herniations are different from those that occur at lower levels of the lumbar spine. Related to the imagery finding most of patients presented lumbar disk herniation at L2-L3, L3-L4, and L4-L5 level. Furthermore, the grading findings which corresponding to lumbosacral segment were Grade I and Grade II. Grade V was less common among patient's participant in this study.

Conclusion

This study involving patients with lumbar disk herniation and associated LBP showed that a combination of clinical features and epidemiological predicted the presence or absence of a significant association. Further research is required to validate these findings in different types of LDH and LBP for other findings and conditions.

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