

Lumber spine disorder findings: Magnetic Resonance Imaging versus Computed Tomography



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Abstract— Radiological imaging of the human body provided medical specialists with useful findings that helped obtain accurate diagnosis to select the better treatment option. Computed tomography (CT) and magnetic resonance imaging (MRI) is the ability to demonstrate the degenerative change that causes Low back pain (LBP). The currents work intended to evaluate the clinical indications and the lumbar spine findings based on CT and MRI images. The mean patient's age was 45 ± 12 (30-80) years. The procedures were performed using a multislice CT machine, 64 slices, and a 1.5 T MRI machine (GE SIGNA). In this study, 222 CT procedures were performed for patients suffering from lower back pain diseases. 81.1% of the patients' populations undergone CT procedures for lumbar spine, while 19.9% of the patients' populations undergone MRI scans. 45.6% of patient populations are females, while 54.4% are males. A total of 180 patients data were recruited for this study, including 110 males (61%) and 70 (39% females) for CT procedure and 42 patients (25 (59.5%) males and 17 (39.5%) females) for MRI procedures. CT provides useful findings of the disease based on the images. CT's ability to illustrate the degenerative changes of the lumbar spine and the MRI has proved superior over CT in proving the prevalence of the infection and other related degenerative changes.

Keywords— MRI, CT, lumbar spine imaging, low back pain, Radiology

1. Introduction

Radiological imaging of the human body provided medical specialists with useful findings that helped obtain accurate diagnosis to select the better treatment option. Nowadays broad spectrum of imaging modalities are available for clinical usage since the discovery of X-ray in 1895, and the invention of computed tomography (CT) in 1971, magnetic resonance imaging (MRI) in 1981, and hybrid imaging in 2001[1,2].

The recent technological advances in the imaging modalities have improved radiologists' capability in providing accurate diagnosis of diseases. However, the main challenge is how to choose the suitable imaging modality from a range of imaging modalities and the proper imaging protocol from a specific modality for particular clinical indications. To do so, the referring physician has to know the advantages and weaknesses of each modality. Thus, a justified request of the best imaging modality and technique will potentially increase diagnostic outcomes and lessens the need for further imaging. Additional images increase the cost, risk of ionizing radiation, and affect the effective intervention in the suitable time.

MRI CT is 3D imaging modalities used frequently for the diagnosis of a large number of pathological conditions. MRI, which is an emission imaging modality, provides high resolutions images and is used mainly to assess the central nervous and musculoskeletal systems in addition to the functional and spectroscopic applications. MRI provides high contrast images without a need for contrast medium in most cases, free of ionizing radiation risk. CT is a transmission imaging modality as the other modalities that use X rays for image acquisition. CT can provide excellent anatomic information in a short time. The main drawback is the high dose of ionizing radiation, which constitutes 70% of collective radiation doses from

medical exposure [3,4].

Back pain is the leading cause of disability, causing severe pains that affect human activities. It was estimated that 80% of the population would have back pain during their lifespan [5], while the incidence of chronic lower back pain is estimated to be 23% of the general population [6]. The main clinical indications include disc prolapse, sciatica, ankylosing spondylitis, spondylolisthesis, and trauma [7]. The main solitary clinical indication for spinal MR imaging is presently in degenerative spinal disease, usually performed to diagnose a possible disc herniation. The degenerative changes are common amongst middle-aged persons. Medical imaging, specifically MRI and CT, is used to assess patients' clinical circumstances based on radiological images evidence that may assist in asorting the treatment's superlative option. The currents work aimed to evaluate the clinical indications and the lumber spine findings based on CT and MRI images

2. Materials and Methods

2.1 Patient's populations

A total of 180 patients data were recruited for this study, including 110 males (61%) and 70 (39% females) for CT procedure and 42 patients (25 (59.5%) males and 17 (39.5%) females) for MRI procedures. The mean patient's age was 45 ± 12 (30-80) years. Clinical indications include lower back pain and trauma. The clinical findings were classified due to the clinical findings' causes as musculoskeletal or other causes, including abdominal and retroperitoneal pain. The study was evaluated and approved by the institutional review board (IRB), the local ethics committee.

2.2 Imaging Equipment

The procedures were performed using a multislice CT machine with 64 slices from GE (Lightspeed VCT) (GE health care, USA). The machine has 0.35 s Gantry rotation, V-RES 64 digital detector, and noise reduction filter. The MRI machine used in this study was 1.5 Tesla GE SIGNA (GE Health care system). The machine has a high image quality software (AIR™ Recon).

2.3 Imaging protocols

CT scan is requested in general if MRI is unavailable or challenging to have an image in a reasonable time or due to an emergency resulting from trauma. Transverse plain images, as well as sagittal and coronal reconstructions, where needed. The field of view extends from the twelfth thoracic spine vertebra to the first sacral vertebra. Constant x-ray tube potential (120 kVp) with variable tube current-time product range from 200 to 350 mAs.

According to the department protocol, the first option for assessing the lumber spine is the MRI scans due to its superior image quality. The scan involved three plane localizers in planning image acquisition sequences. The image acquisition phase consisted of sagittal and axial T1-weighted and T2-weighted and STIR. The slice thickness of 3.5 mm to 4 mm was used for both sagittal and axial images. All patients signed consent for undergoing MRI procedures before the image acquisition. The patient's setup consisted of the following steps: supine position with head first, spine coil, and cushions. The FOV was carefully adjusted to ensure that all the vertebrae were included in the image (Figure 1). A saturation band was used to avoid artifacts that may results from involuntary motion (peristalsis and breathing) in the sagittal plane. The CT and MRI images were assessed by two experienced radiologists with experience of more than ten years.



Figure 1.A: CT and B. MRI field of view for lumbar spine

3. Results

In this study, 222 CT procedures were performed for patients suffering from lower back pain diseases. 81.1% of the patients' populations underwent CT procedures for lumbar spines, while 19.9% of the patients had undergone MRI scans. 45.6% of patients' populations are females, while 54.4% are males. The majority of patients undergoing the undergoing for chronic back pain include 67.6 (150) % acute back pain, 15.8% (35) chronic back pain, and 16.6 (37) for other clinical conditions. Figure 2 shows the findings of the CT procedures requested to evaluate the lower back pain causes. Patients' findings showed that 45 patients (25%) were diagnosed with Osteophyte, and 32 patients (17.7%) were diagnosed with endplate sclerosis. The others with less contribution include spondylolisthesis, lumbar facet joint, and spinal stenosis, as illustrated in Figure 2. Comparable findings were noticed for male and females.

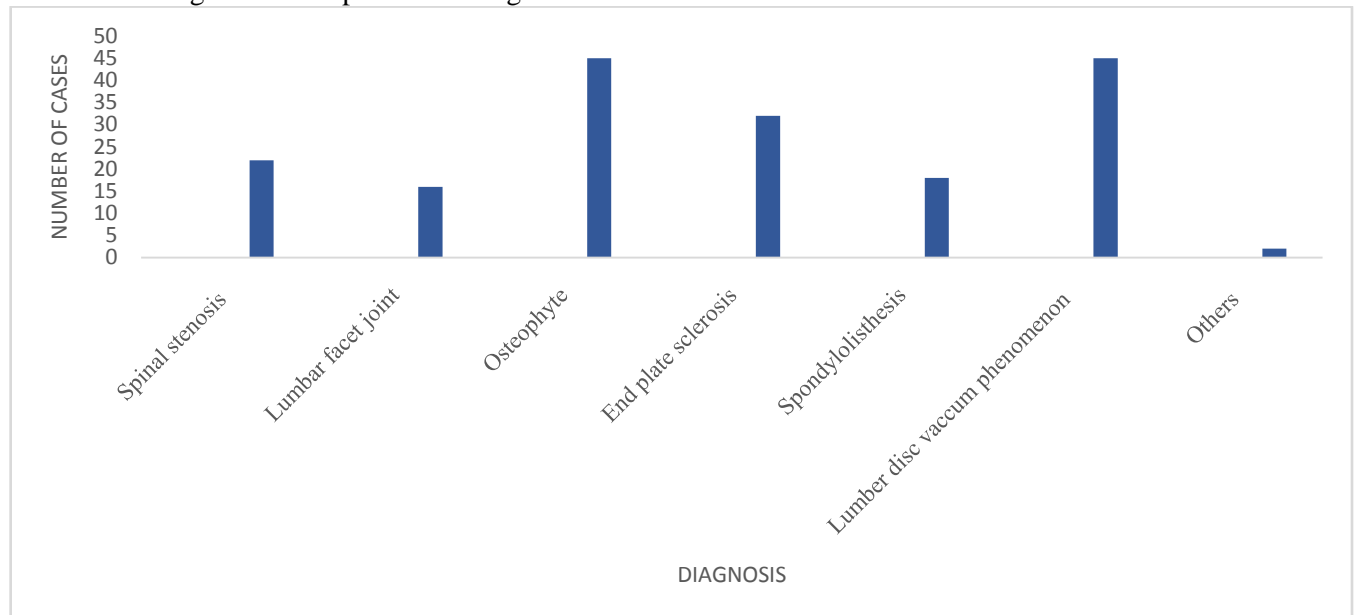


Figure 2. CT findings for patients examined for lower back pain

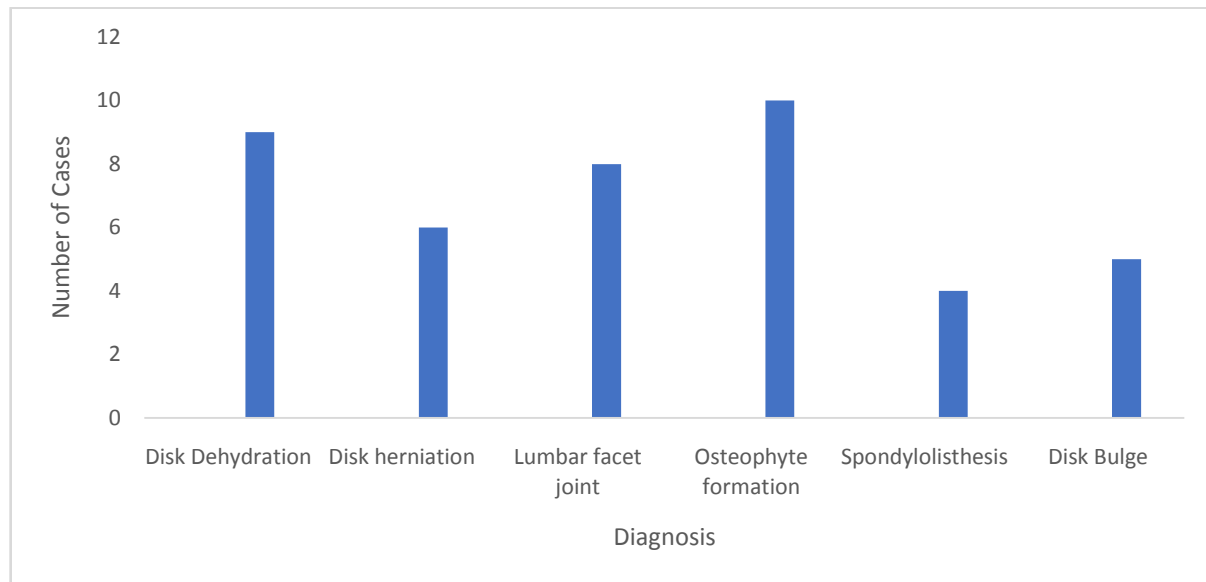


Figure 3. Distribution of patients' diagnosis examined for MRI lumbar spine

4. Discussion

Two hundred twenty-two patients were examined for lumbar spine pain, including chronic and acute pain. One hundred eighty patients underwent CT of the lumbar spine, and both sagittal and axial views of all images were used to identify the diagnostic findings. Most of the patients, 72.3% (165), undergone plain radiography examinations of CT procedure. Thus all patients were diagnosed with findings related to the study problem.



Figures 4 A&B: Patient diagnosed with lumbar disc vacuum phenomenon. The figure shows gas bubbles in the joint space L1-L3.

Previous studies showed that most patients suffer from the LBP at the age of 40 or above [8]. This is the age where the degenerative changes of the lumbar spine manifest due to aging or weight increasing. Other factors may increase the seriousness and early onset of the disease, including genetic factors that are documented to have a role in the early onset of the disease. The mean patient's age was 45 ± 12 (30-80) years, which confirms that these changes may strongly be affected by the patient's age and body weight.

The majority of the patients (46%) have are overweight or have a history of trauma. The study findings showed a strong association between the lumbar sine degenerative findings (Figure 2) and age. The current

study showed that CT examinations are useful in assessing the intervertebral disc narrowing and lumbar disc vacuum phenomenon, which indicate the occurrence of the degenerative disc disease. The study findings showed a high prevalence of osteophyte (25 % (45) of the patients' group that underwent a CT procedure. The prevalence of the lumbar disc vacuum phenomenon is (45%). In transmission imaging, CT, or digital plain radiography, the gas collection may be identified easily in the lumbar spine, as illustrated in Figure 4.

As previously mentioned, MRI has the capability of evaluating the lumbar spine changes. Figure 5 showed T2W images illustrating the disk's dark signal on T2W images due to the loss of water content. Initially, there are biochemical changes within a disk, resulting in dehydration of disk (Figure 5, A&B). In later stages of the disease, morphological changes such as loss of disk height, annular tears, rim lesions, and osteophyte formation materialize

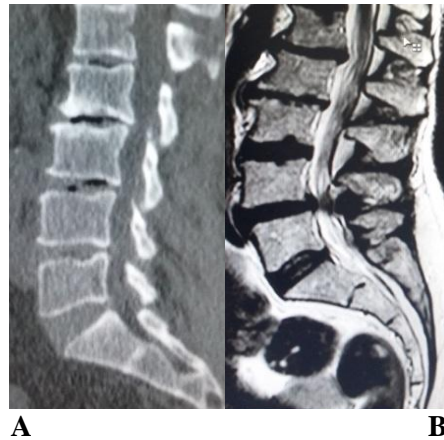


Figure 5. A: MRI T2 weighted scan and B lumbar disc vacuum

The degenerative findings of the lumbar spine increase with age and lifestyle. [8-10] CT provides useful findings of the disease based on the images. CT's ability to illustrate the degenerative changes of the lumbar spine and the MRI has proved superior over CT in proving the prevalence of the infection and other related degenerative changes.

5. Conclusion:

The current study showed that LBP incidence is a significant problem to the general population, and the incidence increase with age, especially in obese patients. The study shows a comparable incidence of both genders. The incidence of lumbar spine degenerative changes affects all the lumbar spine with higher frequency for the lower part of the lumbar spine. MRI procedures are useful in evaluating the soft tissue pathological findings without the need for the contrast medium. Due to the cost of the MRI and long waiting list, CT can be a good option for evaluating the LBP. However, the risk of ionizing radiation for young adults is significant, and the dose should be optimized to maximize the benefit of the procedure while maintaining the diagnostic yield.

6. References

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