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Original Article

The effectiveness of computed tomography scans versus magnetic resonance imaging for decision making in patients with low back pain and radicular leg pain

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Abstract

BACKGROUND: Low back pain (LBP) and radicular leg pain (RLP) are among the most common types of pain in human beings. Although magnetic resonance imaging (MRI) is very sensitive for diagnosis of discopathy, some factors, such as overestimation of pathology, expensiveness, unavailability, and using it for patients with cardiac pacemaker or metal foreign bodies, limit the utility. The present study is designed to evaluate the efficacy of computed tomography scan (CTS) in patients with disc herniation in each level of lumbar spine versus MRI findings at the same level.

METHODS: In a prospective trial, 100 consecutive patients with LBP and RLP and signs and symptoms of discopathy referred to our private clinic from September 2004 to April 2005 were studied. CTS and MRI and their data were compared level by level; i.e. CTS of the patients analyzed according to clinical signs and symptoms and compared with MRI at the same level in axial view.

RESULTS: Thirty-two patients had clinically S1 root signs and symptoms, in all of them CTS and MRI showed disc herniation at L5/S1 level in axial view. For L5/S1 level, positive predictive value (PPV) of CTS was 100%. In upper lumbar region, CTS findings were less reliable than MRI. CTS showed the pathology at 14.2% of upper lumbar, 27.2% at L3/L4 and 46.3% at L4/L5. In nine cases with more than one level involved, CTS confirmed the diagnosis in 11.1% of the cases.

CONCLUSIONS: MRI is the gold standard for diagnosis of lumbar disc herniation, but CTS is sensitive in 100% for L5/S1, 68% for L4/L5, 60% for L3/L4, 0% for upper lumbar discopathies and finally 78% for multilevel involvement. Therefore, the higher the level of disc herniation is, the lower the sensitivity of CTS.

KEY WORDS: Computed tomography scan, magnetic resonance imaging, low back pain, radicular leg pain.

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Low back pain (LBP) with radicular leg pain (RLP) is one of the most common problems in human beings [1,2]. Diagnosis of degenerative lumbar disease has been highly changed during the past three decades [1-3].

With the introduction of CTS in the late 1970's, the clinically useful spinal CTS improved and today with new version of high resolution CTS, diagnosis of the degenerative disc herniation is better than in the past [1,2]. The ligamentous, osseous, cartilaginous and spinal canal components are all well visualized on CTS [1,2]; hence, it is highly sensitive for detection of degenerative changes. Degenerative changes, foci of destruction and sclerosis, the sequelae of trauma and congenital anomalies may all be identified [3-5]. Many pathological processes are ideally visualized in the axial

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plane of CTS so it is absolutely necessary to evaluate the degenerative change level by level [4,6,7]. Because of anatomical standpoints, CTS evaluation of the spinal canal content from mid-cervical to the upper lumbar region is quite poor [5,7,8], but thanks to the large size of the spinal canal, intervertebral disc, ligaments and apophyseal joints, this is not the case for the lumbosacral region [5,8]. Even at the lumbar region, the quality of visualization of spinal contents on CTS is variable and depends on the amount of epidural fat and venous plexus [5,8]. Therefore, it appeared that sometimes CTS is very sensitive for detection of pathologies [5,9,10] so we decided to evaluate the discopathy of lumbar region level by level [5,9,10].

MRI of the spine is a rapidly evolving modality [9-12] and because of the introduction of surface coils and gradient-echo (fast scan) techniques, MRI is the first-line diagnostic tool for evaluation of spinal diseases [9,10]. But, some factors limit the utility of MRI such as: the over estimation of pathology, high cost, unavailability, and in patients with cardiac pacemakers or those who have metal foreign bodies [5]. Therefore in patients with signs and symptoms of discopathy with these limiting factors, CTS can be more reliable and safer especially when one decides to evaluate discopathy level-by-level [9-11]. Today different studies suggest that CTS or MRI should be the first choice for patients with suspected lumbar disc herniation [12]. Some authors believe that in patients with LBP and RLP, CTS followed by MRI is the best choice for diagnosis of disc herniation with an efficacy of 71% [5,9]. Those who claim that MRI is the best diagnostic tool believe that this is recommended as the initial study [9], but CTS could be more valuable for older patients because of the high incidence of osteophytosis [5,9]. Therefore it is obvious that MRI is better than CTS for demonstrating spinal degenerative disease [1,5,9]. However, this study was designed to show the efficacy of CTS compared with MRI according to clinical findings to find out the specific advantages of CTS if any.

Methods

One hundred consecutive patients referred to our private clinic from September 2004 to April 2005 were studied. Inclusion criteria were the patients with LBP, RLP and a positive Lasegue Test (LT) or Femoral Stretch Test (FST) and intermittent claudicating with related sensory disturbance. Patients with neurological deficits, leg atrophy, sciatic nerve injury, leg or spinal column deformity or those who had previous disc operation were excluded. Age, sex and duration of the signs and symptoms as well as reports of CTS and MRI were collected. In physical examination of the patients LT, FST, motor power and deep tendon reflex were assessed.

The gold standard for diagnosis of disc herniation is MRI and this was requested according to signs and symptoms of the patients. All patients were referred with CTS either because of unavailability of MRI or at the request of other physicians. MRI (1.5 tesla) was requested if clinical findings persisted despite medical treatments or for decision making regarding further treatments. CTS and MRI of the patients were reported again by one neuroradiologist who did not have any information about the previous reports. The conclusions of the new reports were considered as the main abnormal findings. All data were analyzed with SPSS.

Results

In 100 patients with LBP and RLP, sixty-six (66%) were male and thirty-four (34%) female. The range of the age was between 17 to 73 years with a mean age of 44.3 years. In forty (40%) cases, RLP was in left leg, twenty-five (25%) in right and in the remaining patients it was in both legs. Fifteen percent (15%) of the patients had intermittent claudicating but CTS and MRI showed canal stenosis in nine and fifteen percent, respectively. In six (6%) patients, deep tendon reflex was decreased. Lasegue and femoral stretch tests were positive in seventy-two (72%) and five (5%) patients, respectively. The distribution of the involved disc level and CTS findings are shown in table 1.

Table 1. The frequency of CT-Scan findings for each disc level.
PPV: positive predictive value, NPV: negative predictive value, F: false, T: true.

Level	Total	T positive	T negative	F positive	F negative	Sensitivity	Specificity	PPV	NPV
Upper Lumbar	7	1	2	1	3	0%	50%	35%	65%
L3/L4	11	3	5	1	2	60%	83%	75%	71%
L4/L5	41	19	9	9	4	68.2%	50%	68%	69%
L5/S1	32	32	0	0	0	100%	0%	100%	0%
Multiple levels	9	1	5	1	2	33%	83%	50%	58%

For L5/S1 involvement, CTS and MRI showed the same pathology in all cases. For upper lumbar discopathies (T12/L1, L1/L2 and L2/L3) the findings of CTS and MRI were identical in 14.2% of cases. For L4/L5 level findings, CTS showed disc herniation in sixty cases, but for L3/L4 level findings, it was revealed in 68.2% (table 1). In nine cases, more than one level was involved and the CTS and MRI findings were identical in 11.1% of cases.

Discussion

LBP with or without RLP is one of the most common kinds of pain during the lifetime [5]. Although different techniques and tools have been invented for their etiologic diagnosis [5,9], still clinical examination is the first step for treatment planning [5]. In the past three decades, a dramatic resolution in the imaging of spinal abnormalities has occurred as a result of the introduction and rapid development of two imaging modalities, CTS and MRI [5,9].After invention of MRI all other diagnostic tools have been pushed to the corner, but as mentioned above a few problems still exist for this diagnostic modality [1,2,5], such as over estimating the pathologies, expensiveness, the lack of MRI in many centers and contraindication for those patients who have pacemaker and metal foreign bodies [5]. Also, some of the patients prefer CTS instead of MRI [9]. It has been claimed that CTS is superior to MRI for diagnosis of osteophytes in lumbar canal stenosis [5,9,10].

According to Albeck's study on eighty patients with monoradicular sciatica myelography, CTS and MRI, the largest amount of diagnostic information was obtained from CTS followed by MRI and myelography [9,11,12]. Another study concluded that CTS or MRI should be the first choice diagnostic modality in patients with suspected lumbar disc herniation [9,11]. Also, other study on 80 patients with LBP and RLP has demonstrated that CTS followed by MRI is the best modality for the diagnosis of disc herniation with an efficacy of 71% [9], but still the level was not considered. The resolution of an MRI is the same throughout the lumbar region, but this is not the case for CTS [5]. Even in the lumbar region the degree of visualization of spinal contents is variable because of the amount of epidural fat [5]. So the resolution of disc herniation and bulging is different for lumbar canal on CTS. Since the efficacy of CTS for diagnosis of lumbar disc herniation has been considered globally and the resolution of axial view is different in each segment, the present study was designed to compare the findings of MRI and CTS in the same level.

Although the sensitivity of CTS for detection of discopathies is shown globally to be approximately 70% and for MRI more than 95% [5,9,11], this is not true for each level if considered alone.

In our study, findings of CTS and MRI were the same for patients with L5/S1 discopathies and in all 32 patients with clinical involvement of S1 root, the expected disc herniation was at L5/S1 disc space with positive predictive value and a sensitivity of 100%. Therefore, in patients who have signs and symptoms of S1 radiculopathy there is no difference between CTS and MRI in the detection of disc herniation. In 41 patients with L4/L5 radiculopathy, which is the most common level involvement in lumbar discopathy, sensitivity and PPV were 68.2% on

CTS. This difference is the result of sensitivity of MRI, which can show the less surgically and clinically important degenerative discopathies. For L3/L4 disc involvement CTS showed positive findings in 27.2%. At this level the PPV and sensitivity CTS were 75% and 60%, respectively.

For upper lumbar disc herniation (T12/L1, L1/L2 and L2/L3) with overall incidence of 10% in other studies [5] (7% in the present study) the findings were different between CTS and MRI; i.e. only 11.1% of findings were the same on CTS and MRI, which is not sufficient for decision making. In our study, 9% of the patients had multilevel disc herniation and most of them had signs and symptoms of L4/L5 and L5/S1 disc involvement. This occurs less commonly when disc herniation is at a higher level, therefore CTS was 78% sensitive and its PPV was 77%. In other studies, 70% to 85% of disc herniations occur at these two levels [5] which is compatible with our study.

In summary, CTS showed a PPV of 77% for diagnosis of lumbar region discopathies, 100% for L5/S1, 68% for L4/L5, 60% for L3/L4, 0% for upper lumbar discopathies (T12/L1, L1/L2 and L2/L3) and finally, 77% for multilevel involvement. Because of the anatomical variations of the lumbar region that have been mentioned before, the sensitivity of CTS versus MRI was 100% for L5/S1, 68% for L4/L5, 60% for L3/L4, 0% for upper lumbar level and finally, 33% for multilevel disc herniation.

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