The Diagnostic Test in Lumbosacral Vertebrae Image towards Magnetic Resonance Imaging in Radicular Low Back Pain

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Abstract

Background: Lower back pain is one of the most common consulted cases in neurology and neurosurgery. The approximately 80% of these cases are musculoskeletal disorders. Magnetic resonance imaging (MRI) is still a rare examination in the suburban area and requires a relatively high cost. Moreover, there are contraindications in patients who have cardiac pacemakers and metal objects in the body. The examination of lumbosacral image is easy to conduct. The price is relatively inexpensive and there are no contraindications to perform the test. **Objectivity:** This study aimed to assess the sensitivity and specificity of the lumbosacral image towards MRI in patients with radicular lower back pain. **Method**: The study was a clinical, cross-sectional study, analytical, and a diagnostic test design. It was performed on all patients with radicular lower back pain in Dr. Soetomo Teaching Hospital Surabaya from April to July 2012. There were 34 subjects who fulfilled the inclusion criteria. **Results**: The sensitivity of plain images to MRI in detecting radicular lower back pain was 87.5%. This figure indicated that the plain image had a high sensitivity. However, the specificity was only 50.0% which meant that plain image had a low specificity. **Conclusion**: The lumbosacral image had high sensitivity. However, the specificity was low for the examination of radicular lower back pain.

Keywords*: diagnostic test, radicular lower back pain, sensitivity, specificity.*

Introduction

Lower back pain (LBP) is one of the most heavily consulted cases in neurology and neurosurgery unit and approximately 80% is musculoskeletal disorders. Most patients who complaint of acute LBP will experience relapse after healing. LBP complaints can disturb daily activity and work productivity as well as most often attack the productive age which is less than 45 years [1–3]. The prevalence of LBP is about 67.6% of the entire adult population per year in Australia, 42.6% of whom have mild LBP and mild disability; Another 10.9% had severe back pain and mild disability, while the remaining 10.5% had severe disability [4]. The mean prevalence of lower back pain in African teenagers was 12%, and adult age was 32% [5]. The estimated prevalence of lower back pain in the United States is about 5-20% and around 25-45% of the population in Europe [6]. Although epidemiologic data on LBP is not observed yet in Indonesia, it is estimated that 40% of Central Java residents aged between 65 years old have suffered from back pain and its prevalence in males was 18.2% and 13.6% in females. LBP is one of the ten causes of patients visiting a doctor. The cause of the pain is often not found even with neuroimaging test; thus, the patient returns with an idiopathic LBP diagnosis [2].

One of the LBP diagnostic support tools is radiological examination. The best radiological modality to evaluate herniated disc is MRI with sensitivity and specificity of 96% and 97%. MRI has sensitivity of 89% - 100% whereas the specificity was 43% - 57%. MRI is the golden standard of herniated disc. Besides that, MRI can detect soft tissue abnormalities (muscles, tendons, and ligaments) as well as edema that occurs around herniation nucleus pulpous (HNP) and detect other serious disorders such as tumors or infections [7]. MRI is still a rare examination in the suburban area

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and requires a relatively high cost. Moreover, there are contraindications in patients who have cardiac pacemakers and metal objects in the body [8,9]. The examination of lumbosacral image is an easy task to be conducted because almost all local hospitals have conventional x-ray aircraft and they are relatively inexpensive. Furthermore, there is no contraindication to conduct such examination.

Based on several previous studies of lumbosacral bone radiographic assessment of 200 patients with non-specific back pain and no neurological signs, it suggests that radiographic examination of the lumbosacral vertebra is adequately represented by a projection that is only antero-posterior or lateral to reduce the risk of radiation [10]. The National Institute of Clinical Studies Emergency Care Community of Practice issued a recommendation that routine radiological examination is not recommended for non-specific acute lower back pain (level III-2 evidence) in May 2007 [11]. Similarly, a study published by the British Journal of General Practice in May 2002 examined the psychological effects of lower back pain patients who performed radiological examination (X-ray photograph of the lumbar vertebra) at the beginning of LBP diagnosis established [12].

This study attempted to re-examine the diagnostic test of lumbosacral image towards MRI in radicular lower back pain patients to assess the sensitivity and specificity of the lumbosacral plain image towards the lumbosacral MRI. In addition, a neurological clinical examination has been performed to determine the diagnosis of radicular lower back pain.

Method

The study was a clinical, cross-sectional study, analytical, and a diagnostic test design. The sample collection was conducted in Neurology Unit dr. Soetomo Teaching Hospital Surabaya for 3 months. The research subjects are 46 patients with radicular low back pain who visited the neurological clinic Dr. Soetomo Teaching Hospital Surabaya, Indonesia and willing to fill and sign the informed consent. Then, a neurologic clinical examination was performed: anamnesis, provocation test, physiological and pathological reflex tests, motor, and sensory tests. Afterwards, it was examined a plain radiograph (Rontgen) in lumbosacral vertebrae of antero-posterior, lateral, and oblique projection after receiving description of the advantages and disadvantages of the photograph. Afterwards, a lumbosacral MRI was examined. The results of the examination were observed whether the abnormality was obtained or not.

The data was collected on the data collection sheet and the measurement result was expressed on the dichotome scale which was the nominal scale of positive and negative. The clinical examination results of lower back pain with radiological examination was analyzed using SPSS program (SPSS, Inc., Chicago, IL). The differences in the number of positive clinical and radiological findings were compared with the negative findings; then, it was also compared to MRI [13]

Results

Overall, there were 17 subjects of female patients and 17 male subjects. The subjects had the same complaints of radicular lower back pain or lower back pain that spreads to the back of the leg. There were 17 samples of males (50%) and 17 female samples (50%) with a ratio of 1: 1 in this study. Table 1 described the characteristics of research subjects based on gender.

Table 1. The Subject Characteristics Based on Gender

Gender	Total	Percentage
Female	17	50%
Male	17	50%

Table 2. The Subject Characteristics Based on Age Frequency

Age (year)	**Frequency**	**Percentage**
21-30	5	14.7
31-40	6	17.6
41-50	12	35.3
51-60	5	14.7
61-70	4	11.8
>71	2	5.9

Table 3. The Subject Characteristics Based on Mean Age

Variable	Subjects (34)			
	Mean	**SD**	**Minimum**	**Maximum**
Age (year)	46.03	1.38	22	71

Table 2 showed the age of the subjects in the study. The most frequent age of the subjects was 41-50 years old that was 12 times (35.3%). Table 3 showed that the mean age was 46 years old (SD = 1.38) with the youngest age was 22 years old and the oldest was 71 years old. The mean morbidity measured by visual analogue scale (VAS) was 7 (SD = 1.164) with a minimum score of 5 and a maximum of 9.

Table 4. The Subject Characteristics Based on the Frequency of VAS for Pain

VAS	Frequency	Percentage
5	3	8.8
6	11	32.4
7	10	29.4
8	6	17.6
9	4	11.8

Table 4 showed the severity of pain measured by VAS which was most often suffered in the scale of 6 which was moderate-severe scale. The scale 7 and 8 were categorized as severe pain. The onset of the subjects complained of radicular low back pain until the examination in Neurology Unit Dr. Soetomo Teaching Hospital was in a matter of weeks. Table 5 showed the most commonly seen subjects with an onset of more than 24 weeks, in other words, they already suffered from chronic LBP.

Table 5. The Subject Characteristics Based on the Disease Onset

Onset (week)	Frequency	Percentage
4	5	14.7
6	1	2.9
8	9	26.5
10	2	5.9
12	6	17.6
>24	11	32.4

Table 6. The Result of Plain Image Compared to MRI

Disorder		MRI		Total
		Normal		
Plain Image	There is disorder	28	1	29
	Normal	4	1	5
Total		32	2	34

Note: MRI= Magnetic Resonance Imaging

Table 6 showed the sensitivity of plain images to MRI in detecting radicular lower back pain by 87.5%. This figure indicated that the plain image had a high sensitivity. However, the specificity was only 50% which meant that plain image had low specificity.

Discussion

This study obtained a description of the lumbosacral plain photographs, including osteophytes, end plate sclerosis, narrowing of the intervertebral gap, and spondylolistesis, that is corresponding to MRI examination results: bulging intervertebral disc, protrusio, extrusiono, causing radicular lower back pain or radiating from the root to the length of the iskiadicus nerve. This condition is diagnosed as herniation nucleus pulposus (HNP). Another finding in this study by examining the lumbosacral plain photograph is the description of the destruction of the corpus, vertebral pedicles and scalloping features. This corresponds to the results of MRI examination in the form of tumor masses, both metastases and primary tumors in the lumbosacral area.

The characteristics of the subjects by gender in this study obtained the same number of male and female that was 17. This is not in accordance with the epidemiology of lower back pain that stated that 40% of Central Java residents aged 65 years old have suffered from lower back pain and the prevalence in males was 18.2% and in women was 13.6% [14]. The cause of this discrepancy can be some of the epidemiological shifts of most males with lower back pain. However, females mostly cause of the vast majority with LBP. They consisted of factory and office workers. Another reason was that the most frequent LBP patients who visited Neurology Unit in Dr. Soetomo Teaching Hospital was males than females. The subjects who experienced a drop out in this study was 12 male subjects. In addition, the most frequent age was 41-50 years old. This is consistent with the epidemiological theory that the majority of LBP patients are of productive age because their load is also greater. LBP complaint disturbs daily activity and work productivity as well as most often attacks the productive age which is less than 45 years old [14].

The most frequent onset was more than 24 weeks and categorized as chronic. It should be distinguished between specific lower back pain and nonspecific. Because this study only focused on the specific LBP subjects, most of them are in chronic condition that conventional or medical treatment was usually not solve the problem and recurrence often occurs. Unlike the nonspecific LBP types that are mostly due to musculoskeletal or mechanical factors, the complaint can be relieved usually by 2 to 6 weeks of therapy according to the severity of pain [1,15].

Table 3 showed the sensitivity of the lumbosacral plain image compared to the lumbosacral MRI (as the golden standard) as the figure was 87%. The specificity of the lumbosacral plain photograph was 50%. This corresponds to the literature: a radiographic examination of a plain photograph to detect lumbosacral vertebral abnormality has a sensitivity of about 85% and a specificity of approximately 60% [16]. Thus, the hypothesis of this study aims to know the examination of plain images of the lumbosacral vertebra has a high sensitivity and specificity towards the lumbosacral MRI in patients with radicular lower back pain has been proven for the sensitivity of the lumbosacral plain photographs, but not for the low specificity.

The sensitivity here illustrates the sensitivity of the lumbosacral plain photograph as a diagnostic tool in detecting a radicular lower back pain, whether the subjects are really sick or not, and how likely it is that

the outcomes are positive or there are abnormalities. This sensitivity rate is derived from the proportion of the patients with positive diagnostic test results (true positive) over all patients (true positive + false negative). On the other hand, the specificity is the ability of the lumbosacral plain photograph to determine that the subject is not sick or normal and indicates how much probability the test result will be negative. In the results of this study, the positive predictive value of 96.6% is categorized as high. This means that if the subjects were examined with a plain lumbosacral image with a positive result, then 96.6% of the subjects suffered from a disease that causes radicular lower back pain. The negative predictive value is the probability that the subject does not suffer from the disease if the test result is negative. In this study, the results of negative predictive value of 20% indicates that there is a possibility of 20% of subjects who have been examined with plain lumbosakral image which results are negative and not suffer from disease that causes radicular lower back pain.

The interpretation of the diagnostic test result is influenced by several things, particularly the prevalence of disease and the severity of disease at the time of diagnostic testing. Other things to consider in assessing the accuracy of lumbosacral plain photographs include lateral and oblique positions are often confused by the iliac crest and gas image in the intestine and influenced by the accuracy of the radiographic technique as well as the radiologist's skill. The weakness of plain photographs cannot detect abnormalities in the ligaments, muscles, nerves, and other soft tissues around the bone. A plain photo sensitivity of 85% and a specificity of 60% only applies to detect solid organs such as bone [16]. Generally, neuroimaging has advantages as well as deficiencies that should be complementary, such as plain photographs (conventional radiography) and CT-scans have advantages in detecting abnormalities of solid organs such as bone and calcification.

On the other hand, MRI has more ability in detecting abnormalities in the soft tissues. Besides that, MRI can be drawn by multiple slices which can be rotated electronically on several orientations without changing the patient's position. MRI is also non-ionic and non-invasive; thus, it does not have radiation effects on body tissues and make patients feel uncomfortable during the examination. However, MRI has several disadvantages, including hearing loss can occur temporarily due to the noise of this tool during the examination. A research showed a loss of hearing <15dB when the subjects did not wear earplugs in 43% patients, whereas only 10% when the subjects used earplugs with an average length exposed to the sound for 42.1 minutes [17]. Furthermore, there may be an effect of increased temperature of the network by radio frequency absorbed of <1 W/kg. Ventricular fibrillation also can occur due to the influence of the magnetic field. This situation is influenced by the length of the pulse radiofrequency (RF) signal and repetition. It is stated that frequency >60Hz decreases the threshold value of ventricular fibrillation [18]. MRI has a low sensitivity in detecting sub-arachnoid classification and bleeding and not provide comfort in patients with claustrophobia [19].

Conclusion

The lumbosacral image had high sensitivity (87.5%). However, the specificity was low for the examination of radicular lower back pain (50.0%).

Ethical Clearance: This study protocol was approved by ethical clearance Dr. Soetomo Teaching Hospital Surabaya, Indonesia.

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