



Original Article

Corresponding Author

Suchit Khanduja

<https://orcid.org/0000-0001-7257-8424>

Department of Anesthesiology, Henry Ford Hospital, 2799 W Grand Blvd, Detroit, MI 48202, USA
Tel: +1-248-525-0801
Fax: +1-313-916-2600
E-mail: drsuchit@gmail.com

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Retrospective Review of Magnetic Resonance Imaging of the Lumbosacral Spine: Are We Overinvestigating?

Suchit Khanduja, Vivek Loomba, Joseph Salama-Hannah, Aman Upadhyay, Neha Khanduja, Gaurav Chauhan

Department of Anesthesiology, Henry Ford Hospital, Detroit, MI, USA

Objective: Lower back pain (LBP) is a worldwide health problem, and magnetic resonance imaging (MRI) is a common modality used to aid in its diagnosis. Although specific guidelines for assessing the necessity of MRI usage exist, the use of MRI as the initial imaging method for LBP seems to be more common than necessary in general practice.

Methods: We conducted a retrospective chart review of 313 patients who had undergone MRI of the lumbosacral spine during 2014–2015. We recorded and compared various factors, including age, sex, body mass index, current smoking status, race, symptoms, MRI findings, and progression to surgery within the next year. All rates were compared according to whether the MRI results showed radiographically significant findings (MRI-positive) or not (MRI-negative) using the chi-square or Fisher exact tests (if the expected cell count was <5). All analyses were performed using SAS version 9.4.

Results: There were no statistically significant differences in the rates of each symptom between the MRI-positive and MRI-negative groups, which accounted for 58.5% (183 of 313) and 41.5% (130 of 313) of the MRIs, respectively. The difference in the rate of surgery in the next year (18% among MRI-positive patients and 8.5% among MRI-negative patients) was found to be statistically significant ($p < 0.05$).

Conclusion: Based on our findings, 41.5% of patients underwent lumbar MRI unnecessarily and 81% of patients with positive MRIs did not have surgery within the next year. Further physician training is needed to avoid unnecessary investigations and expenditures.

Keywords: Lower back pain, Spinal surgery, Lumbar magnetic resonance imaging

INTRODUCTION

Lower back pain (LBP) is a worldwide health problem in adults.¹ This is the fifth most common reason for all doctor visits in the United States.² Despite technical progress in imaging, the precise cause of the pain can only be determined in less than 50% of cases.³ Magnetic resonance imaging (MRI) is a common imaging technique used to aid in the diagnosis of LBP. There are specific guidelines, such as failure of conservative treatment for 6 weeks and worsening of condition thereafter, abnormal electromyography or nerve conduction study etc.,⁴ to assess the necessity for MRI usage. Further, the guide-

lines recommend the clinician not to routinely obtain imaging in patients with nonspecific LBP⁵ since this costly diagnostic modality has added a considerable burden on health systems of many countries. Often times obtaining a lumbar spine MRI can be of little value in making a definite diagnosis. This is because a large number of spinal MRI findings can be present in asymptomatic individuals.² It is also true that a large number of symptomatic individuals can have nonspecific findings on MRI. Yet there is a widespread belief amongst physicians that an MRI is needed to diagnose LBP. Associating LBP with lumbar MRI findings can have many challenges. First of all, there is no accurate definition of LBP. Secondly, symptoms can range from a

purely dull aching back, solely leg pain or mixed with fluctuations between both symptoms. The symptoms can also be confused with isolated nerve compression. There are many MRI findings that are primarily associated with LBP such as Modic changes, vertebral compression fractures and degenerative disc degeneration. Many findings are associated with radicular pain such as spinal stenosis, disc extrusions and compressive neuropathy.³ The above stated observation makes the differentiation of symptoms and their etiology complex since there may be multiple symptoms in the patient and more than one positive MRI finding. To best of our knowledge there is hardly any study to find if the recommended guidelines had any impact on the usage of MRI in LBP. Therefore in this study we present a retrospective review of records of patients who had undergone MRI of lumbosacral spine for LBP.

MATERIALS AND METHODS

After obtaining Institutional Review Board approval from the Hospital Ethics Committee we performed a retrospective chart review of 313 patients who had undergone MRI of lumbosacral spine for LBP in the Henry Ford Health system between 2014–2015. The data was obtained from electronic health records, specifically from Epic and the Care Plus Next Generation databases. There was no exclusion criteria set except that all the patients were adults. We recorded and compared various factors including chief complaint, age, sex, body mass index (BMI), current smoking history, race, symptoms, MRI findings, and progression to surgery within the next 1 year.

While radiologists in our center give thorough reports in regards to MRI findings, it is up to the ordering physician to determine the importance of the MRI findings in the given clinical scenario. The findings that were considered positive were as follows: severe degenerative changes, lumbar disc herniation, spinal canal stenosis, spondylolisthesis, severe facet hypertrophy, nerve compression, spinal tumors, spinal infection, fresh vertebral fracture, and spinal deformity (kyphosis/scoliosis). Mild to moderate degeneration, annular tears, modic changes, and mild disc bulging were not considered to be positive as often times these findings can be present in asymptomatic individuals.² All continuous variables were described using means, standard deviations medians, minimums, and maximums, while all categorical variables were described using counts and percentages. All rates were compared between groups (MRI positive and MRI negative) using chi-square or Fisher exact tests (if expected cell counts are < 5). Statistical significance was set at

Table 1. The descriptive statistics for all variables in the dataset of 313 patients

Variable	Value
Sex	
Female	57.5
Male	42.5
Race	
Black	65.6
White	33.1
Hispanic/Latino	1.3
Current smoking	
No	80.9
Yes	19.1
Body mass index (kg/m ²)	
Mean ± SD	29.9 ± 7.9
Median (range)	28.1 (14.3–67.2)
Back pain	
No	23.0
Yes	77.0
Leg pain	
No	98.7
Yes	1.3
Back and leg pain	
No	80.5
Yes	19.5
Back injury	
No	100
Yes	0
Leg weakness	
No	90.1
Yes	9.9
Bladder/bowel dysfunction	
No	99.7
Yes	0.3
Other symptoms	
No	99.7
Yes	0.3
MRI (binary)	
Negative	41.5
Positive	58.5
MRI: normal	
No	58.5
Yes	41.5

(Continued to the next page)

Table 1. Continued

Variable	Value
MRI: lumbar disc herniation	
No	75.7
Yes	24.3
MRI: spinal stenosis	
No	70.5
Yes	29.5
MRI: Spondylolisthesis	
No	99.4
Yes	0.6
MRI: facet hypertrophy	
No	97.1
Yes	2.9
MRI: nerve compression	
No	73.2
Yes	26.8
MRI: spinal tumor	
No	94.9
Yes	5.1
MRI: spinal infection	
No	98.1
Yes	1.9
MRI: vertebral fracture	
No	94.3
Yes	5.7
MRI: spinal deformity	
No	96.8
Yes	3.2
Surgery	
No	85.5
Yes	14.5
Departments	
Emergency Medicine	39.6
Internal Medicine	22.5
Neurosurgery	19.8
Orthopaedic Surgery	3.8
Hematology/Oncology	4.2
Urology	1.0
Neurology	4.1
Family Medicine	4.1
Vascular Surgery	0.3
Pain Clinics	0.3
Critical Care Surgery	0.3

Values are presented as percentage unless otherwise indicated. SD, standard deviation; MRI, magnetic resonance imaging.

p < 0.05. All analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

RESULTS

The descriptive statistics for all variables in the analysis, proportion of positive MRI findings by symptom, and departments seeking MRI investigation of patients with LBP are shown in Tables 1-3 respectively. Females constituted about 57.5% of the population of the sample. The average age of patients was 63 ± 15.2 years Isolated LBP was the most common symptom and reason of getting the MRI done (77%) followed by both lower back and leg pain (19.5%). In percentage, 58.5% of the MRI results showed radiographically significant findings whereas, 41.5% of MRIs were negative. The most common findings of MRI positive patients were lumbar stenosis (29.5%), nerve compression (26.8%), and lumbar disc herniation (24.3%). There

Table 2. Percentage of negative and positive clinical findings by symptom in 130 MRI negative and 183 MRI positive patients

Variable	MRI negative (n = 130)	MRI positive (n = 183)	p-value
Back pain			0.108
No	18.5	26.2	
Yes	81.5	73.8	
Leg pain			0.644
No	99.2	98.4	
Yes	0.8	1.6	
Back/leg pain			0.209
No	83.9	78.1	
Yes	16.2	21.9	
Back injury			
No	100	100	
Yes	0	0	
Leg weakness			0.962
No	90.0	90.2	
Yes	10.0	9.8	
Bladder/bowel dysfunction			1.000
No	100	99.5	
Yes	0	0.5	
Other symptoms			0.415
No	99.2	100	
Yes	0.8	0	

Values are presented as percentage. MRI, magnetic resonance imaging.

Table 3. Percentage of MRI negative (130) and MRI positive (183) referred by different departments

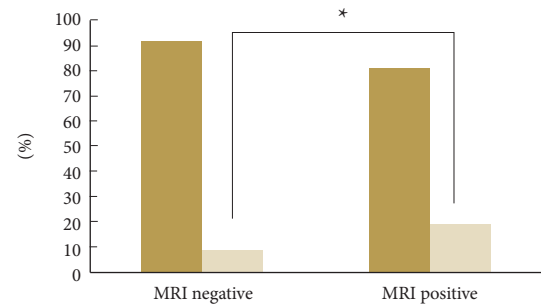
Department	MRI negative	MRI positive
Emergency Medicine	45.0	35.4
Internal Medicine	20.9	23.8
Neurosurgery	16.3	22.6
Orthopedic Surgery	3.1	4.3
Hematology/Oncology	3.9	4.3
Urology	0.6	1.2
Neurology	3.9	4.3
Family Medicine	3.9	4.3
Vascular Surgery	0.8	0
Pain Clinics	0.8	0
Critical Care Surgery	0.8	0

Values are presented as percentage.
MRI, magnetic resonance imaging.

were no statistically significant differences in the rates of each symptom between the 2 groups (MRI positive and MRI negative). Eighty-one percent of the population did not have a current smoking history. The average BMI of the patients who obtained an MRI was 29.9 ± 7.9 , throwing out the notion that obese individuals constitute the majority of the population that suffers with LBP. Fig. 1 depicts the difference in rates of surgery in next 1 year among 18.0% positive MRI patients (33 of 183) and 8.5% (11 of 130) among MRI-negative patients. The difference was found to be statistically significant at $p < 0.05$.

DISCUSSION

The aim of our study was to deduce when an MRI of the lumbosacral spine is deemed necessary among various physicians. We collected data on chief complaints, imaging findings, various demographic data and those whom ultimately obtained surgical intervention as well. The study revealed that 41.5% of the MRIs of lumbosacral spine performed in our center were negative. Among the MRIs that were positive, 81% did not have any surgical intervention within the next 1 year. Isolated back pain (77%), followed by back/leg pain (19.5%) were the most common reasons for obtaining an MRI. Based on percentages, lumbar spinal stenosis was the most common positive MRI finding (30.7%), followed by disc herniation (24.3%). We also found that of the multitude of departments included in our health system, the Emergency Department (ED) had the highest rate of ordering MRIs with negative findings. There in fact

**Fig. 1.** Percentage of patients undergone surgery (light bar) and having no surgery (dark bar) in magnetic resonance imaging (MRI) positive and MRI negative cases. * $p < 0.05$.

have been guidelines laid out by the American College of Radiology (ACR) for ordering imaging in lower backache which may not be rigorously followed.⁵ In our study, we tried to minimize the false positive rate of MRI results by excluding findings such as mild to moderate degeneration, mild lumbar stenosis which are incidental findings in a large portion of patients. Our emphasis was on more critical findings such as severe degeneration, severe stenosis, or nerve compression which can warrant medical or surgical intervention. In 2007, the American College of Physicians and the American Pain Society published guidelines related to diagnostic imaging for backache.⁶ One of the guidelines states that diagnostic imaging should be performed only when a severe neurological deficit is noted or when on history and physical examination, an underlying disease is suspected. Also, physicians should only order an MRI if they feel a patient is a candidate for neuraxial injection and or surgical intervention.

While there is no radiation exposure associated with MRI imaging, it can be of potential harm in that they can lead to spine surgeries with no better outcomes.⁷ Carragee et al.⁸ performed MRIs at baseline (no symptoms of LBP) and then a repeat MRI if a patient developed an episode of LBP. The sample had 200 patients who were followed for 5 years. Eighty-four percent of the patients who had recurrence of pain over next 5 years did not have any changes in MRI findings.

There are several reasons postulated for the overutilization of MRIs in the management of low back ache. First, despite the presence of ACR guidelines for back pain management, there are very few practitioners whom are aware of these guidelines. Hence many physicians on the front line, such as ED physicians, resort to an MRI as the first line in diagnostic imaging. Since the MRI does not involve exposure to radiation, it is considered safer than other diagnostic modalities by some healthcare providers. Variability in resident training and a lack of emphasis on

complete history and physical examination may also lead to over use of MRIs. There is also the continued stress of medical liability on physicians, which may influence a physician's decision making process when encountered with the new onset of low back pain. This could be postulated as to the reason our study showed a higher propensity for ED physicians in our system to order MRIs.

All of the above stated studies and observations highlight the problems associated with overuse of MRIs for low back pain. We need to reinforce the importance of more conservative ways of managing low back pain, such as exercise, yoga and physical therapy. Physicians, and especially trainees, must be sensitized to the importance of a detailed history and physical examination as well as be exposed to the ACR guidelines early on. Patient education plays an important role in this scenario as well. Patients need to be educated of the benefits of introducing physical therapy as an initial means of treatment for pain. Many times preconceived notions and fear avoidance beliefs regarding physical therapy deter patients from participating. Many times a preoccupation with incidental findings on an MRI may impair healing patients and hence frequent reassurance and education is needed. A perfect example is that of Virginia mason health system in Seattle, WA.⁹ In 2004 Virginia mason was given notice by insurance companies that their specialty practices were costing 2 times the local practices in regards to imaging. Studies in the hospital revealed that the physicians were not practicing evidence based medicine. The physicians in the hospital system had gotten into the habit of ordering MRIs unnecessarily. The hospital changed numerous policies and brought physical therapy to the forefront in managing back pain. Consequently, the percentage of patients with LBP who got an MRI decreased from 15 to 10. The cost of care reduced substantially and decreased the need for extra physicians in this systems pain clinic. It also resulted in only 6 of patients losing time from work.

Our current study was a retrospective study of a segment of population visiting Henry Ford Health system and is not indicative of the overall population of the area. Also, the practices are more indicative of our health system and the analysis and demographics could be different in neighboring hospitals. Our study does not differentiate between early and late MRIs i.e., MRI that was performed before conservative management and the ones performed after conservative management had failed.

CONCLUSION

In short, there is still a possible overuse of MRI in our health

system. Both physician and patient education could help decrease the rate of MRIs performed for LBP and hence possibly decrease a part of the financial burden on our health care system.

CONFLICT OF INTEREST

The authors have nothing to disclose.

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