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Extraspinal incidental findings and reporting rates at lumbar spine magnetic resonance imaging: more than a spinal examination?

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ABSTRACT

Aim: To reveal the prevalence characteristics of extraspinal findings incidentally detected in lumbar spinal MRI examinations, determine their rate of reporting status, and analyze the findings in terms of clinical significance and patient benefit to help prevent possible medicolegal and ethical problems.

Material and Method: A total of 2,912 lumbar MRI examinations were retrospectively reviewed. The extraspinal findings were identified and analyzed according to their clinical significance. MRI examination reports were analyzed and whether extraspinal findings were included in these reports was determined.

Results: The study included a total of 2,912 patients, of whom 41% (n=1,195) were male and 59% (n=1,717) were female. The mean age of all patients was 48.25±15.92 (8-90) years. The mean age of men was 47.31±16.96 (9-90) and that of women was 48.91±15.12 (8-90) years. Extraspinal findings were present in 29% (n=844) of the patients and absent in 71% (n=2,068). The number of extraspinal findings 1 for 25.10% (n=731) of the patients, 2 in 3.61% (n=105), 3 in 0.24% (n=7), and 4 in 0.03% (n=1), with the total number being determined as 966.

Conclusion: Lumbar MRI images should be more carefully examined during the reporting stage and clinical evaluation in order to prevent possible morbidity-mortality situations by making accurate and early referrals in patient management and to avoid ethical-judicial problems that physicians may face due to the inability to recognize existing pathologies that may be outside the targeted area.

Keywords: Lumbar, magnetic resonance imaging, extraspinal, spinal

INTRODUCTION

Low back pain is one of the common complaints in society, and although the incidence of chronic low back pain has been reported as 23%, it is estimated that the probability of experiencing low back pain during a lifetime reaches 84% (1). Low back pain is mostly caused by the musculoskeletal system (2). Lumbar magnetic resonance imaging (MRI) is a frequently preferred imaging method in patients presenting with this complaint since it allows for the high spatial resolution and does not contain radiation (3). The use of computed tomography and MRI as diagnostic methods in patients with low back pain is becoming increasingly common (4).

Incidental findings (IFs) refer to findings that are unexpectedly detected during a radiological examination undertaken for an unrelated complaint in asymptomatic patients. In recent years, digital and technical developments in the evaluation of radiological examinations have led to a significant increase in the frequency of IFs (5).

A restricted field of view (FOV) is used in lumbar spinal MRI, and diagnostic images include especially spinal and paraspinal areas (6). A narrow FOV facilitates the focus of the attention of the radiologist reporting the images and the clinician requesting the examination on the spine, which is considered to be the primary source

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of pathology, and largely excludes abdominopelvic structures. However, FOV, which is used in lumbar MRI protocols in many radiology departments, can also display other elements, primarily those of the urogenital system, as well as abdominal main vascular structures, lymphatic system elements, and partially the peritoneal organs. Therefore, it is crucial to include extraspinal abdominopelvic pathologies observed in diagnostic images in radiology reports for both radiologists and other clinicians to prevent medicolegal problems.

This study aimed to reveal the prevalence characteristics of extraspinal IFs detected in lumbar spinal MRI examinations, to determine the reporting rates, and to analyze the findings in terms of clinical significance and patient benefit. Thus, the focus was to prevent possible medicolegal and ethical problems by increasing the awareness of both radiologists and clinicians that request an MRI examination concerning extraspinal IFs.

MATERIAL AND METHOD

After obtaining the approval of the Hitit University, Clinical Researchs Ethics Committe (Date: 26.08.2020, Decision No: 2020.07.03). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The study was performed by retrospectively evaluating the MRI images and reports of lumbar spinal MRI examinations of patients that presented to the outpatient clinic with the complaint of low back pain and were followed up and treated with a diagnosis of discopathy and/or spinal pathologies. Lumbar MRI images were re-examined using the hospital Picture Archiving Communication System (PACS) by a radiologist with 12 years of experience in musculoskeletal system examinations, who was blinded to the previous radiology reports of the patients. Spinal findings were not noted in the re-evaluation, and extraspinal findings were recorded in axial and sagittal images. Simultaneously, the MRI examination reports were examined using the hospital automation system by another blinded physician independently from the radiologist that performed the re-examination, and the presence and variety of extraspinal findings were noted. For the study, a total of 3,135 lumbar MRIs were initially examined over the PACS system, but 223 were excluded from the study due to repeated scans or previous diagnoses related to the extraspinal findings included in FOV in the MRI examinations. For the remaining 2912 patients, demographic characteristics, namely patient age and gender were recorded. The detected extraspinal findings were categorized in terms of clinical significance according to the Modified Computed Tomography Colonography Reporting and Data System (C-RADS), which was previously used in studies investigating IFs (7). According to this classification, anatomical variations were included in the C-RADS E1 category, findings that were clinically insignificant or did not require an additional examination for diagnosis in C-RADS E2, those that could not be fully characterized and required a further examination to demonstrate their clinical significance in C-RADS E3, and other findings of clinical significance requiring specialist field consultation and additional radiological or pathological examinations in C-RADS E4. Then, the re-examination records and the first MRI reports obtained from the hospital automation system were compared in terms of the rate of IF reporting.

MRI Technique

MRI examinations were performed using a 1.5-T MRI device (General Electric, GE Medical System, Milwaukee, WI, USA) with a 32-channel spinal coil. Our routine lumbar spinal MR protocol includes sagittal T1-weighted; repetition time (TR)/echo time (TE), 496/9,8 ms; matrix, 288x256; FOV,34 cm; echo train length (ETL), 3, sagittal T2-weighted; TR/TE, 2500/110 ms; matrix, 288x256; FOV 32 cm; ETL, 23, and axial T2-weighted; TR/TE 3138/102 ms; matrix, 256x224; FOV, 24 cm; ETL, 23) sequences. The axial section images were taken between the L1 and S1 vertebrae. In all sequences, the slice thickness was 3 mm, the inter-slice gap was 1mm, and the number of excitations was 4. A presaturation band was only applied to the sagittal series. Some examples of extraspinal findings are presented in **Figure 1,2,3** and **4**.

Statistical Analysis

The statistical analysis of the data collected in our study was performed with SPSS (version 22, SPSS Inc., Chicago, IL, USA). The descriptive statistics of continuous variables obtained by measurements were reported using mean±standard deviation (min-max) values. Categorical variables were presented as numbers (n) and percentages (%).

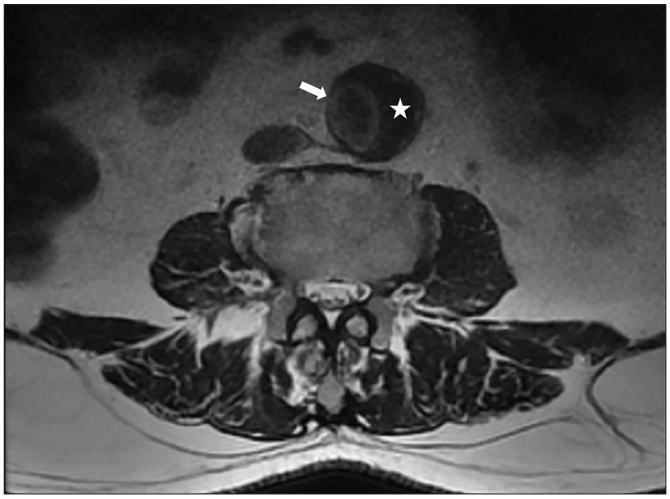

Figure 1. Abdominal aortic aneurysm (arrow) and mural thrombus (star) narrowing the lumen of the aorta in a crescent fashion in T2-weighted axial images in lumbar spinal MRI examination.

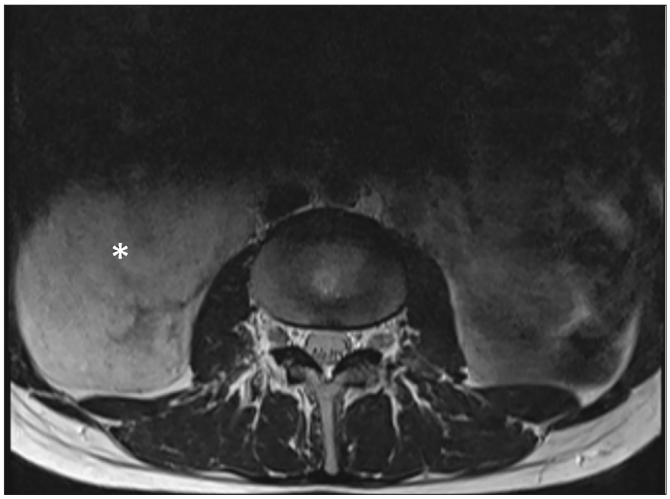

Figure 2. Hyperintense mass appearance of a giant angiomyolipoma in the right kidney (asterisk) in T2-weighted axial images in lumbar spinal MRI examination.

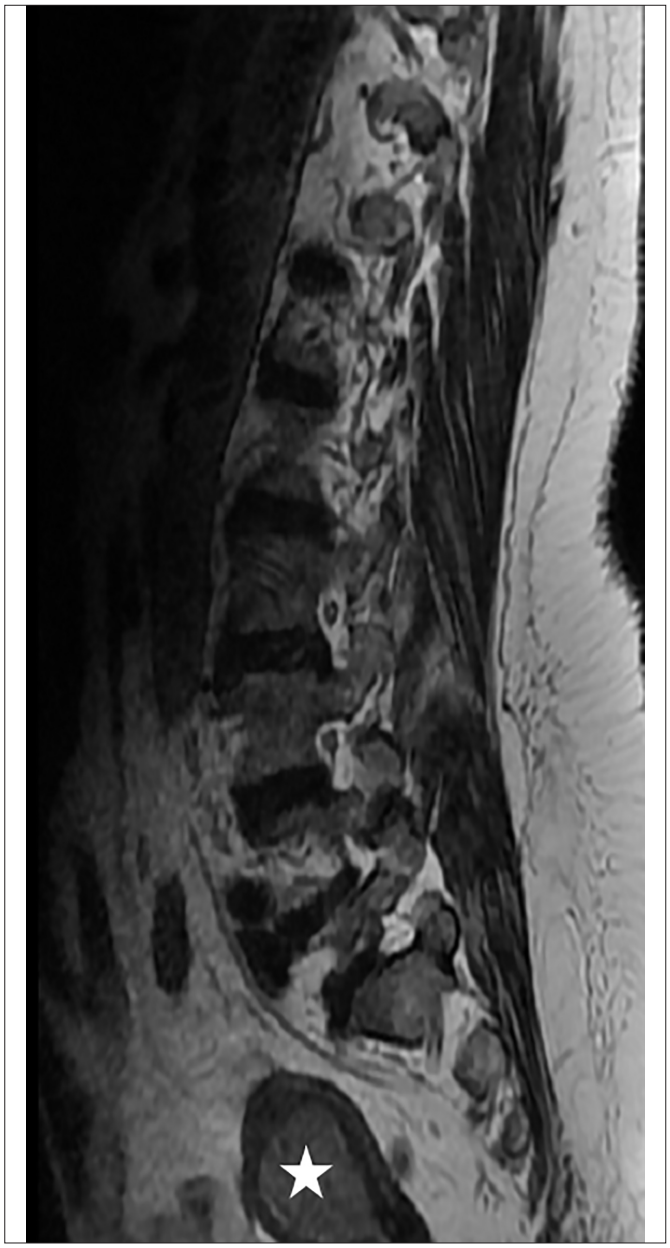

Figure 3. Postmenopausal endometrial hyperplasia (star) in the T2-weighted sagittal image.

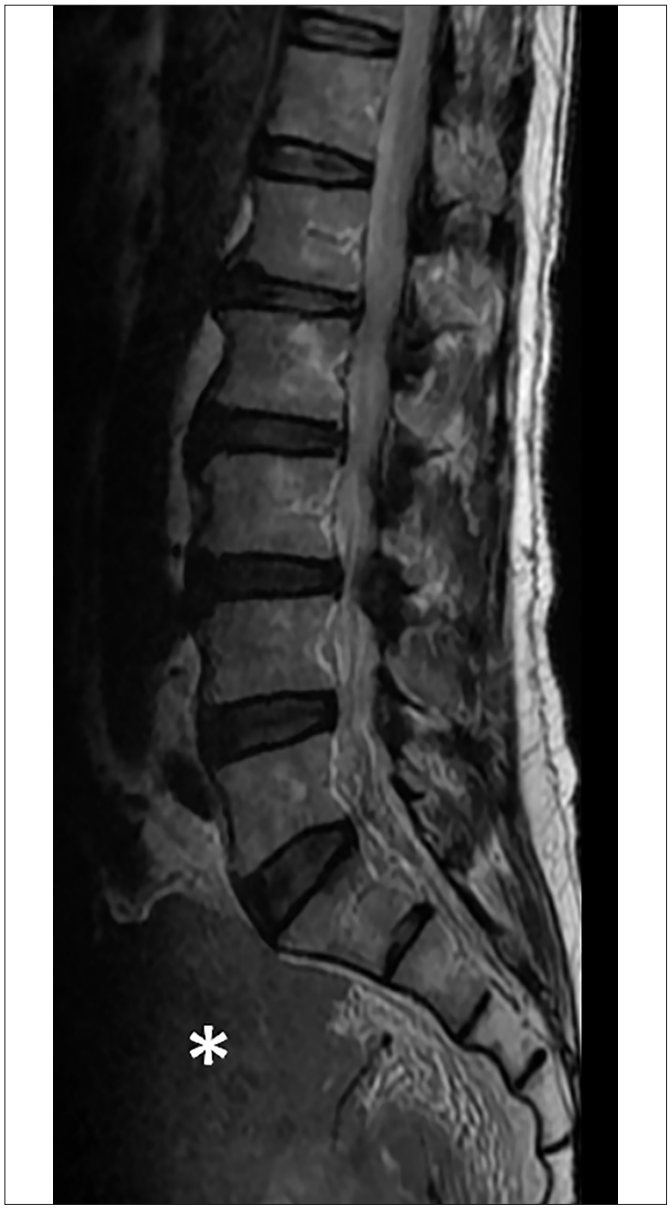

Figure 4. Pelvic mass (asterisk) in the T2-weighted image.

RESULTS

The study included a total of 2,912 patients, of whom 41% (n=1,195) were male and 59% (n=1,717) were female. The mean age of all patients was 48.25±15.92 (8-90) years. The mean age of men was 47.31±16.96 (9-90) years and that women was 48.91±15.12 (8-90) years. Extraspinal IFs were present in 29% (n=844) of the patients and absent in 71% (n=2,068). The number of extraspinal IFs was 1 for 25.10% (n=731) of the patients, 2 for 3.61% (n=105), 3 for 0.24% (n=7), and 4 for 0.03% (n=1). The total number of extraspinal IFs was 966. **Table 1** presents the frequency and percentages of extraspinal IFs categorized according to C-RADS in the study cohort and show their distribution by gender. The frequency and rates of the C-RADS categories among the patients in the study cohort and among those with extraspinal IFs are given in **Table 2**, and the rates of extraspinal IFs included in radiology reports are given in **Table 3** according to their C-RADS categories.

Table 1. Frequency and percentages of extraspinal IFs categorized according to C-RADS in the study cohort and show their distribution by gender

Category	Finding	Number (n)	Rate (%)	Male (n)	Female (n)
C-RADS E1	Variational findings	234	24.23	73	161
C-RADS E2	Unilateral renal atrophy	30	3.11	12	18
	Unilateral solitary kidney	12	1,24	5	7
	Renal stone	6	0.62	4	2
	Polycystic kidney disease	9	0.93	4	5
	Unilateral renal cyst	186	19.26	112	74
	Bilateral renal cyst	39	4,04	25	14
	Single uterine myoma	88	9.11	0	88
	Multiple uterine myomas	9	0.92	0	9
	Ovarian cyst	84	8.70	2	82
	Cavitary intrauterine device	46	4.76	0	46
	Migrating intrauterine device	2	0.21	0	2
	Benign prostate hyperplasia	36	3.73	21	15
	Nabothian cyst	45	4.66	0	45
	Submucosal myoma	1	0.10	0	1
	Transplanted kidney	1	0.10	1	0
	Gallbladder stone	3	0.31	0	3
	Uterine cervical myoma	2	0.21	2	0
Total		599	62.01	188	411
C-RADS E3	Paraaortic lymph node[a]	7	0.72	1	6
	Bilateral renal atrophy	3	0.31	1	2
	Hydroureteronephroses	30	3.10	15	15
	Liver lesion[b]	5	0.52	1	4
	Common bile duct dilatation[c]	6	0.62	1	5
	Subendometrial cyst	2	0.21	0	2
	Pelvic free fluid	2	0.21	0	2
	Bladder globus	1	0.10	0	1
	Ectatic abdominal aorta[d]	5	0.52	4	1
Total		61	6.31	23	38
C-RADS E4	Aortic aneurism[e]	5	0.52	5	0
	Paraaortic lymphadenomegaly[f]	32	3.31	14	18
	Renal mass	4	0.41	3	1
	Surrenal mass	9	0.93	1	8
	Pelvic mass	8	0.83	2	6
	Ovarian postmenopausal cystic lesion	6	0.62	0	6
	Postmenopausal endometrial hyperplasia	5	0.52	0	5
	Bladder wall thickening	2	0.21	2	0
	Postoperative recurrent lymphadenomegaly	1	0.10	0	1
Total		72	7.45	27	45
Total		**966**	**100.00**	**311**	**655**

[a]: Lymph node smaller than 10 mm in diameter, [b]: Hypertense liver lesion on T2-weighted images, [c]: Common bile duct diameter greater than 6 mm, [d]: Abdominal aorta diameter between 26 mm-30 mm, [e]: Abdominal aorta diameter greater than 30 mm, [f]: Lymph node larger than 10 mm in diameter

Table 2. The frequency and rates of the C-RADS categories among the patients in the study cohort and among those with extraspinal IFs

C-RADS category	Number of Patients	Age Mean ±SD (min-max)	Ratio in the whole sample (%)	Ratio among the patients with extraspinal IFs (%)	Ratio among the extraspinal IFs (%)
CRADS-E1	221	46.03±14.66 (19-82)	7.5	24.9	24,23
CRADS-E2	540	54.61±15.20 (15-90)	18.3	60.9	62,01
CRADS-E3	55	55.63±16.15 (18-82)	1.9	6.2	6,31
CRADS-E4	71	56.84±15.94 (19-88)	2.4	8	7,45

SD: Standard deviation, IF: incidental finding

Table 3. Rates of extraspinal IFs included in radiology reports

Category	Reporting status	Number	Percentage
C-RADS E1	Unreported	189	80.8
	Reported	45	19.2
	Total	234	100.0
C-RADS E2	Unreported	340	56.8
	Reported	259	43.2
	Total	599	100.0
C-RADS E3	Unreported	33	54.1
	Reported	28	45.9
	Total	61	100.0
C-RADS E4	Unreported	46	63.9
	Reported	26	36.1
	Total	72	100.0

DISCUSSION

IFs in imaging are mostly asymptomatic abnormalities that differ from expected pathologies and are typically found detected radiological examinations (2, 8). Advances in the radiological image processing technology and digital evaluation have increased the frequency and variety of IFs detected by different radiological modalities (9). This situation would also naturally increase the rate of variational or pathological findings, which are not related to the system examined to be included in radiology reports. Such findings present various practical and ethical problems related to the clinical management of patients for each branch. In medical practice today, many clinical disciplines are divided into specific sub-disciplines; therefore, the field of interest of the physician in clinical practice is narrowing. However, the need for a multidisciplinary approach for many diseases, the limited contribution of some symptoms to differential diagnosis, and the complex symptom characteristics of many disease groups can complicate the diagnosis process. In addition, it is known that radiological methods, which are among the most important diagnostic tools in clinical practice, are frequently requested to visualize a specific organ or system, and it remains controversial how much the clinician should be involved in the diagnosis of other pathologies that are not related to their patients' symptoms or within their range of expertise. For radiologists, the necessity to report pathological findings observed in the field of imaging, even if such examination is not basically within the expected radiological results, constitutes an ethical issue, as well as having a forensic aspect.

Lumbar spinal MRI is the most commonly used diagnostic radiological method in patients with low back pain in the presence of radiculopathy, discopathy or physical examination findings indicating degenerative spine diseases. Many extraspinal pathologies can be detected in the lumbar MRI images of patients. These extraspinal IFs can sometimes be more important than spinal pathologies, resulting in changes in the clinical management of the patient such as recurrence of renal cell carcinoma (10,11). This situation having legal implications for both the clinician requesting the examination and the radiologist.

In the current study, extraspinal IFs were found in 29% (n=844) of the patients. This rate was reported as 19.8% in a study that examined the lumbar MRI images of 1,278 patients in terms of extraspinal IFs, but the authors stated that the rate they detected was lower than the literature since they did not record small benign findings (5). In a similar study including 3,000 patients, the rate of extraspinal IFs was reported as 68.7% (12). In contrast, a study analyzing the frequency and clinical significance of abdominopelvic extraspinal IFs in lumbar MRIs recorded this rate to be 33.2% and suggested that it was consistent with the literature. The authors also noted that the 68.7% rate that had been reported by the previous study was significantly higher compared to other studies (6). The extraspinal IFs found in our study was in agreement with the literature, except for these two studies.

The extraspinal IFs detected in our study were categorized according to the C-RADS system based on their clinical significance. Extraspinal IFs in the C-RADS E1 category were detected in 7.5% of the patients included in the study. Among all extraspinal IFs, the rate of C-RADS E1 findings was 24.23%. Lesions in this category were evaluated as normal variants, and their reporting rate was 19.2%. Although normal variant findings are evaluated in a subcategory in terms of clinical significance, care should be taken considering the possibility of medical problems that may occur or surgical procedures that may be required later.

We found 599 C-RADS E2 category findings in 540 of the patients included in the study, and therefore this category constituted the largest group among all extraspinal IFs (62.01%). C-RADS E2 findings constituted 18.3% of all patients included in the study and 60.9% of those with extraspinal IFs, which is similar to the literature (13). Although the E2 group findings in the C-RADS system are categorized as clinically insignificant since they do not require an additional examination for diagnosis, it may be necessary to inform the patient about some of these findings and provide guidance in terms of treatment options. For example, when gallbladder stone disease is detected in lumbar MRI, although it has a high diagnostic accuracy rate, the patient should be made aware that he/she may require gastroenterological surgery in future. For this reason, it is of great importance to identify C-RADS E2 category findings and share them with the patient. In our study, the rate of inclusion of these findings in lumbar MRI reports was found to be 43.2%. This shows that more than half of these findings were not reported, and we consider that this ratio should be increased.

C-RADS E3 category findings occur due to possible benign causes, and additional investigations are required to fully reveal their etiology and adequately characterize them. In our study, 61 (6.31%) E3 category findings were detected constituting 6.31% of all extraspinal IFs. In a previous study, 25.9% of all extraspinal IFs were reported to be in the E3 category (14). However, C-RADS is not a special classification system for MRI examinations; it categorizes IFs detected in various procedures such as diagnostic radiology and diagnostic endoscopy based on basic principles followed by researchers in similar studies. Therefore, we consider that these proportional differences may be due to the inclusion of some findings in different groups according to the researchers' evaluation. In our study, the reporting rate of C-RADS E3 findings was found to be 45.9%. However, it should be kept in mind that radiological findings with a high probability of developing secondary to benign causes, including hydroureteronephrosis and common bile duct dilatation may be related to malignancies, and their etiology should be revealed. For this reason, we considered the reporting rate of the E3 category findings to be insufficient, and we strongly emphasize the need to include them in MRI reports.

In studies conducted with similar patient groups, lesions in the C-RADS E4 group were detected at an average rate of around 5% among all extraspinal IFs (12,13). In our study, this rate was 7.45%, and the patients with E4 group extraspinal IFs constituted 2.4% (n=71) of all patients included in the study. E4 group extraspinal IFs mostly require malignancy exclusion. In addition, diagnosis and treatment processes should be initiated before the development of complications that may result in mortality, such as an abdominal aortic aneurysm. In this process, clinician-radiologist cooperation is extremely important for the management of patients with E4 extraspinal IFs which we detected at a considerable rate of 7.45%. The reporting rate of E4 group findings in MRI reports was 36.1%, and it was determined that this category was reported less frequently compared to the E2 and E3 groups. It is clear that lesions in this group are of critical importance with early diagnosis and treatment steps, and thus clinicians should be more careful in terms of possible E4 group findings that are not included in the MRI report.

In a patient presenting with low back pain, the clinician should also evaluate non-spinal causes and cooperate with the radiologist. With a systematic approach, the radiologist should carefully evaluate the spinal area, then the extraspinal area, and report all findings that are considered to be significant or insignificant. Although the inclusion of extraspinal IFs in the MRI report does not constitute a legal problem, it may lead to additional stress for the patient. However, it can also help reveal life-threatening situations that can reduce patient morbidity and mortality, as well as preventing other legal problems.

The single-center and retrospective nature of the study can be considered as negative aspects, but the results are important in revealing the necessity of a systematic evaluation of spinal and non-spinal structures in lumbar MRI images. We consider that multi-center prospective studies can better identify the prevalence and severity of this situation.

CONCLUSION

Lumbar MRI images should be more carefully examined during the reporting stage and clinical evaluation in order to prevent possible morbidity-mortality situations by making accurate and early referrals in patient management and to avoid ethical-judicial problems that physicians may face due to the inability to recognize existing pathologies outside the targeted area.

ETHICAL DECLARATIONS

Ethics Committee Approval: Hitit University, Clinical Researchs Ethics Committe (Date: 26.08.2020, Decision No: 2020.07.03).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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