

Incidental extraspinal findings on magnetic resonance imaging of intervertebral discs

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Abstract

Introduction: We aimed to evaluate pathological extraspinal findings and congenital anomalies/anatomical variations that were incidentally detected on the magnetic resonance imaging (MRI) scans of intervertebral discs, to find the frequencies of these incidental findings, and to emphasise the clinical importance of them.

Material and methods: A retrospective study including 1031 consecutive patients (730 females and 301 males, with a median age of 46 years) was conducted by evaluating a total of 1106 MRI examinations of intervertebral discs. Examinations were performed with a 1.5 T MRI unit. Incidental findings were classified as pathological findings and congenital anomalies/anatomical variations.

Results: The percentages of incidental extraspinal pathological findings and congenital anomalies/anatomical variations were 16.6% (95% confidence interval (CI): 14.4–18.8) and 3.7% (95% CI: 2.6–4.3), respectively. The percentage of incidental extraspinal pathological findings on cervical spinal MRI was 25.7% (95% CI: 20.1–31.7), thyroid nodules being the most common incidental findings. On thoracic spinal MRI ($n = 19$), inferior pole thyroid nodules were demonstrated as incidental extraspinal pathological findings, with a percentage of 10.5% (95% CI: 9.6–11.5). On lumbar spinal MRI, incidental pathological findings were detected with a percentage of 14.2% (95% CI: 11.9–16.6), while the percentage of congenital anomalies/anatomical variations was 4.8% (95% CI: 3.4–6.3). Eventually, 6.5% (95% CI: 2.6–9.4) of all cases with incidental extraspinal pathological findings underwent surgery.

Conclusions: On MRI examination of intervertebral discs, paying attention to incidentally detected pathological extraspinal findings and congenital anomalies/anatomical variations is very important due to the fact that they can alter the treatment of the patient or affect the patient's life.

Key words: magnetic resonance imaging, intervertebral disc, incidental findings, congenital anomalies.

Introduction

Back pain is one of the most common health problems in developed countries [1–4]. Different imaging modalities have been used in patients with back pain and neurological disorders. Plain radiography and computed tomography (CT) have a serious burden of ionising-radiation for the patient in various doses [3, 5, 6]. Magnetic resonance imaging (MRI)

provides multiplanary, non-ionising imaging for both bone and soft tissues, and it has become the most validated and preferred imaging modality due to the fact that it permits extraspinal evaluation [7]. In the course of a 12-year interval, use of lumbar MRI was reported to have increased by 307% [8]. Concordantly, the frequency of detecting incidental extraspinal findings has also increased [2, 3, 9]. Incidental findings were detected in 8.4% of patients who underwent spine lumbar MRI [10]. By reporting these findings properly and making a correct, definitive diagnosis, the radiologist will prevent unnecessary invasive operations and additional examinations for the patient. However, not reporting them may have clinical importance to a degree that can affect the patient's life severely, particularly in cases such as recurrence of a renal cell carcinoma. The main purpose of this study was to evaluate pathological extraspinal findings and congenital anomalies/anatomical variations which were incidentally detected on the MRI of intervertebral discs in patients who were referred with complaints of pain and neurological disorders, to find the frequencies of these incidental findings and to emphasise the clinical importance of them.

Material and methods

Procedures related to patient selection and follow-up

Between October 2009 and February 2010, a retrospective study including 1031 consecutive patients (730 females and 301 males with a median age of 46 years) was conducted by evaluating a total of 1106 MRI examinations of intervertebral discs. The patients who gave any information of a previously known extraspinal pathology (extraspinal masses, cancer, etc.) were excluded. Of these, 237 were cervical MRI, 19 were thoracic MRI, and 850 were lumbar MRI. There were 730 females and 301 males with a median age of 46 years (range, 8–82 years), with 95% CI of 44.9–47.0 years. This study was performed according to the World Medical Association Declaration of Helsinki. Incidental findings were classified as pathological findings and congenital anomalies/anatomical variations. Congenital anomaly was defined as an abnormal physical condition resulting from defective genes or developmental deficiencies, whereas anatomical variation was defined as marked difference or deviation from the normal or recognised form, function, or structure. When a pathology or congenital anomaly/anatomic variation was detected on a spinal MRI, the referring physicians were informed and they, in turn, undertook the follow-up of the patient. The patients who underwent an invasive procedure (biopsy, surgery) were recorded.

MR Imaging technique

Examinations were performed with a 1.5 T MRI unit (Philips Achiva, Philips Medical Systems, Eindhoven, Netherlands) with spine coil, in supine position. Cervical spinal MRI protocol included sagittal T1-weighted turbo spin-echo (TSE) images (TR/TE, 400/9 ms; slice thickness/interslice gap, 4/0.4 mm and NEX, 3), sagittal T2-weighted TSE images (TR/TE, 3000/120 ms; slice thickness/interslice gap, 4/0.4 mm and NEX, 3) and axial T2-weighted GE, FFE images (TR/TE, 600/14 ms; slice thickness/interslice gap, 4/0.4 mm, flip angle 25° and NEX, 3). Thoracic spinal MRI protocol included sagittal T1-weighted TSE images (TR/TE, 400/9 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3), sagittal T2-weighted TSE images (TR/TE, 3000/120 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3), and axial T2-weighted TSE images (TR/TE, 4000/120 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3). Lumbar spinal MRI protocol included sagittal T1-weighted TSE images (TR/TE, 400/9 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3), sagittal T2-weighted TSE images (TR/TE, 3000/120 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3), and axial T2-weighted TSE images (TR/TE, 3000/110 ms; slice thickness/interslice gap, 4/0.4 mm; NEX, 3). On cervical spinal MRI, thyroid glands, parathyroid glands or their probable locations, paranasal sinuses, cerebellum and other posterior fossa structures, vascular structures, and lymph nodes of the neck were evaluated. On thoracic spinal MRI, lung parenchyma, mediastinum, pleura, lymph nodes, posterior ribs, and adrenal glands were evaluated. On lumbar spinal MRI, kidneys, adrenal glands, liver, lymph nodes, and vascular structures (inferior vena cava, abdominal aorta, renal veins and arteries, and other vasculatures) were evaluated.

Image analysis

Spinal MRI (cervical, thoracic, and lumbar spinal) images were evaluated by three radiology specialists, each with at least 5 years experience. One of the specialists had expertise in head and neck radiology, one in thorax radiology, and the other in abdomen radiology. The images were evaluated on the same computer. We used a picture archiving and communication system (PACS), and reported the pathologies, congenital anomalies, and anatomical variations, all of which could be detected during the interpretation of the images.

Statistical analysis

Descriptive statistics were calculated for incidental extraspinal findings in the neck, thorax, and abdomen. All analyses were carried out using

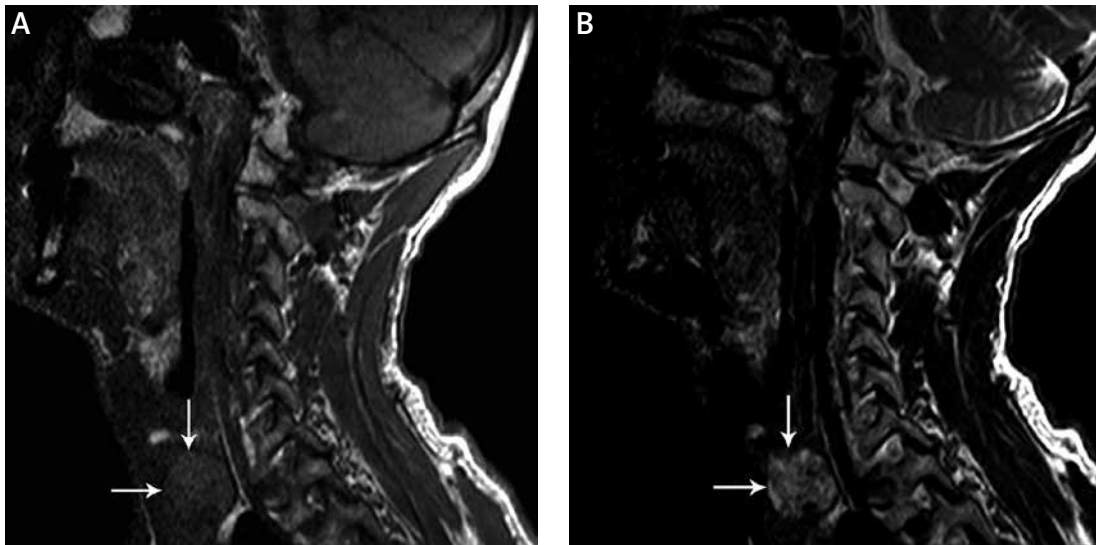


Figure 1. Nodule in the thyroid gland is hypointense on sagittal T1-weighted image (A) and hyperintense on sagittal T2-weighted image (B) (arrows)

SPSS software (version 16.0; SPSS Inc, Chicago, IL). The frequencies of incidental extraspinal pathological findings and congenital anomalies/anatomic variations were expressed as the number of cases/correspondent percentages and 95% CI for the percentages.

Results

In a total of 1106 MRI examinations, the percentages of incidental extraspinal pathological findings and congenital anomalies/anatomical variations were 16.6% (95% CI: 14.4–18.8) and 3.7% (95% CI: 2.6–4.3), respectively (Congenital anomalies/anatomic variations were detected only on lumbar spinal MRI). The percentage of incidental extraspinal pathological findings on all of the cervical spinal MRI ($n = 237$) was 25.7% (95% CI: 20.1–31.7). Thyroid nodules (Figure 1) were the most common incidental extraspinal pathological findings (17.3% of all cervical spinal MRI, 95% CI: 12.4–22.1). The other incidental extraspinal findings on cervical spinal MRI are given in Table I. On all of the thoracic spinal MRI ($n = 19$), only inferior pole thyroid nodules could be demonstrated as incidental extraspinal pathological findings, with a percentage of 10.5% (95% CI: 9.6–11.5). On all of the lumbar spinal MRI ($n = 850$) and incidental pathological findings related to kidney, liver (Figure 2), internal genital organs (in females), and vascular systems were detected with a percentage of 14.2% (95% CI: 11.9–16.6), while the percentage of congenital anomalies/anatomical variations was 4.8% (95% CI: 3.4–6.3). Cortical and parapelvic renal cysts (Figure 3) were the most common incidental extraspinal pathological findings on all of the lumbar spinal MRI ($n = 850$), with a percentage of 6.2% (95% CI: 4.6–7.8). On lumbar spinal

MRIs of female patients ($n = 558$), uterine myomas (Figure 4) were the most common incidental extraspinal pathological findings related to their internal genital organs, with a percentage of 3.1% (95% CI: 1.7–4.5). Incidental extraspinal congenital anomalies/anatomical variations were left renal vein variations including retroaortic left renal vein (RLRV) (Figure 5) and circumaortic left renal vein, retrovert uterus (in female patients), renal rotation anomalies, horseshoe kidneys (Figure 6), and kidney agenesis. Both incidental extraspinal pathological findings and congenital anomalies/anatomical variations detected on lumbar spinal MRI are shown in Tables II and III, respectively.

During clinical evaluation and follow-up, fine-needle aspiration biopsy was performed in 9 out of 43 thyroid gland nodules of 41 patients. The cytopathological result in one case was suspicious, so surgery was performed. The histopathological result of this suspicious case was papillary carcinoma of the thyroid gland. Eventually, 6.5% (95% CI: 2.6–9.4) of all cases with incidental extraspinal pathological findings underwent surgery, including renal cysts causing persistent

Table I. The distribution of incidental extraspinal pathological findings on 237 cervical spinal MRI examinations

Extraspinal pathological findings	Patients, n (%)	95% CI
Thyroid nodule	41 (17.3)	12.4–22.1
Mucosal thickening in paranasal sinuses	11 (4.6)	1.9–7.3
Tornwaldt cyst	7 (3.0)	0.8–5.2
Lipoma	2 (0.8)	0.1–1.9
Total	61 (25.7)	20.1–31.3

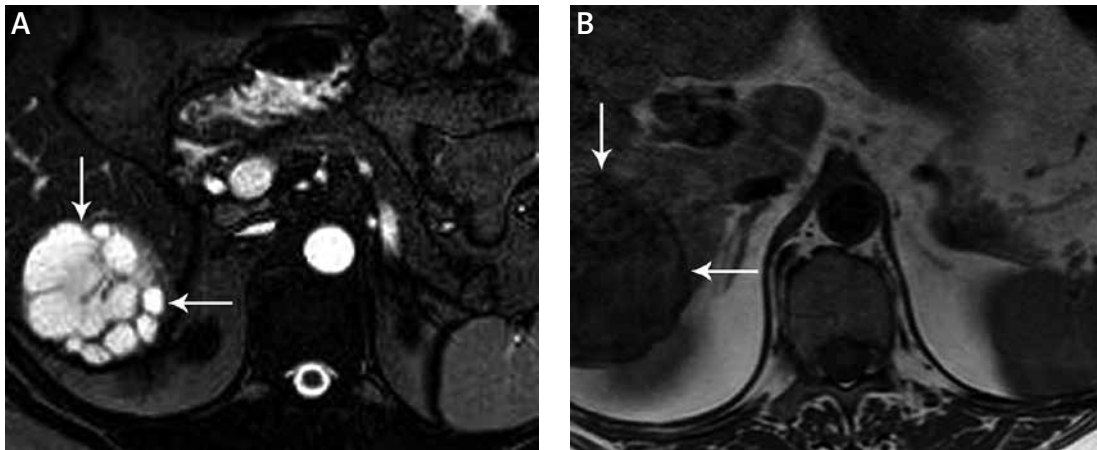


Figure 2. Lumbar MRI demonstrates hydatid cyst in the right lobe of the liver (arrows) on axial T2-weighted (A) and T1-weighted images (B), respectively

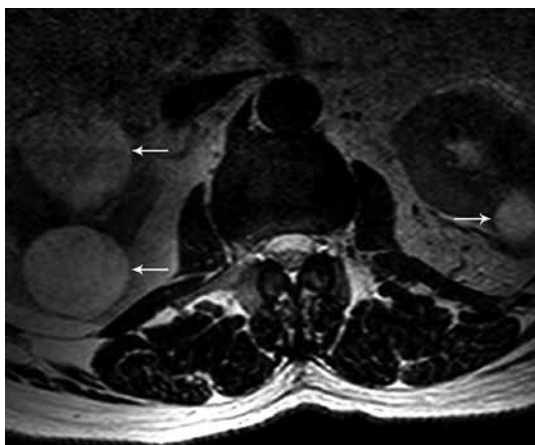


Figure 3. Lumbar MRI shows bilateral renal cysts (arrows) on axial T2-weighted TSE image

pain ($n = 4$), uterine myomas ($n = 3$), aneurysms of the abdominal aorta ($n = 2$) (Figure 7), papillary carcinoma of the thyroid ($n = 1$), ovarian dermoid ($n = 1$), and recurrent renal cell carcinoma ($n = 1$). No complications developed in the surgically treated patients during hospitalisation, and they were discharged in good health.

Discussion

Chronic nonspecific neck or back pain is very common. Most normal connective tissues heal within 6–12 weeks unless instability or malignant or inflammatory tissue destruction is present. Therefore, in any prolonged pain, aetiologies should be ruled out. It is crucial to differentiate



Figure 4. Lumbar MRI shows uterine myoma as hypointense lesion on sagittal T2-weighted (A) and T1-weighted images (B) (arrows)



Figure 5. Lumbar MRI shows retroaortic left renal vein on axial T2-weighted image (arrows)



Figure 6. Lumbar MRI demonstrates horseshoe kidney on axial T2-weighted image (arrows: components of horseshoe kidney on right and left sides; arrowheads: connecting bridge of renal parenchyma anterior to abdominal aorta)

nonspecific pain from specific pain because the therapeutic techniques differ considerably. Computed tomography and MRI are the diagnostic tools for pain evaluation. In the literature there are a number of studies concerning incidental findings demonstrated with these modalities [10–14]. In the evaluation of the images of this study, we used PACS, which provides more information in the evaluation of images, increases efficiency, and decreases the time required for evaluation in radiology departments, and through the use of which the numbers of incidental findings and follow-up examinations have increased [15–17].

The most frequently observed incidental extraspinal pathologies on cervical spinal MRI are thyroid nodules [18], which was the case in the present study. The histopathological diagnosis of one such case who underwent surgery was papillary carcinoma of the thyroid. To our knowledge, in most institutes the patients are infrequently referred for thoracic spinal MRI examinations for the imaging of intervertebral discs, which is also true for our institute. Although we expected to find thoracic incidental extraspinal findings such as the ones reported in literature, including masses, pleural effusion, fibrous dysplasia and lymph-

adenopathy, we found two inferior pole thyroid nodules [19]. Incidental extraspinal pathologies and congenital anomalies/anatomic variations are more frequent on MRI of the lumbar region because liver, ovaries, uterus, kidneys, and vascular structures are located in this region [17]. In two separate studies carried out using MRI of the lumbar spine, the rates of incidental findings were reported as 8.1% [16] and 8.3% [17]. In the present study, this rate was 19% for all of the lumbar spinal MRI, which is higher than the studies reported previously. This might be due to the inclusion of all of the minor findings related to internal genitalia of females, such as nabothian cyst and all of the left renal vein variations. As was the case in the present study, renal cysts were reported to be the most frequent incidental pathological findings related with the urinary system in both males and females [20]. Dilli *et al.* identified RLRV and circum-aortic left renal vein by using routine lumbar

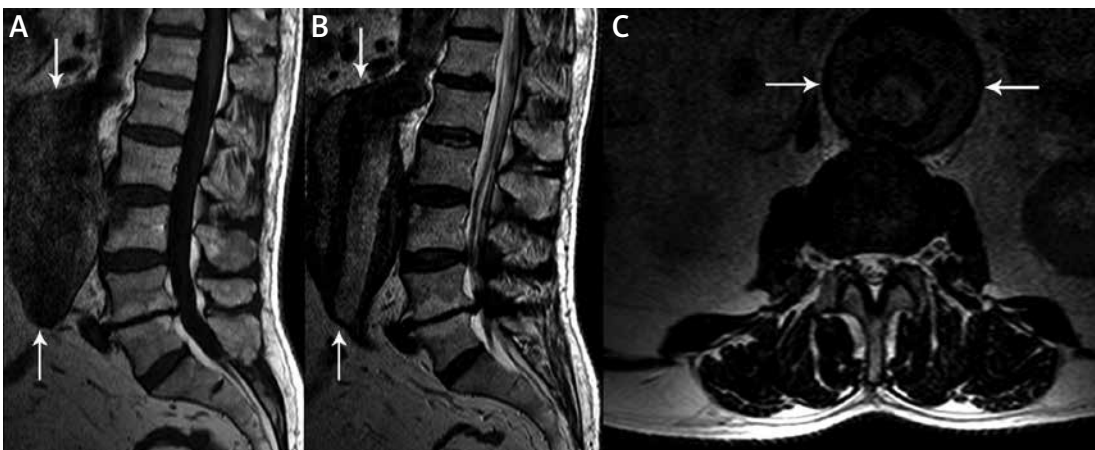


Figure 7. Lumbar MRI demonstrates aneurysm of abdominal aorta on sagittal T1-weighted (A), sagittal T2-weighted (B), and axial T2-weighted (C) images (arrows)

Table II. The distribution of incidental extraspinal pathological findings on 850 lumbar MRI examinations (558 females, 292 males)

Extraspinal pathological findings	Patients, n (%)	95% CI
Cortical and parapelvic renal cyst	53 (6.2)	4.6–7.8
Uterine myoma	17 (3.1)	1.7–4.5
Ovarian cyst	15 (2.7)	1.4–4.0
Nabothian cyst	7 (1.3)	0.4–2.2
Atrophic/hypoplastic renal change	9 (1.1)	0.2–2.0
Subendometrial cyst	5 (0.9)	0.1–1.7
Hydronephrosis	6 (0.7)	0.1–1.3
Hepatic masses	5 (0.6)	0.1–1.1
Aneurysm of abdominal aorta	2 (0.2)	0.1–0.6
Ovarian dermoid cyst	1 (0.2)	0.1–0.5
Recurrent renal cell carcinoma	1 (0.1)	0.1–0.2
Total number of patients	121 (14.2)	11.9–16.6

spinal MRI examinations and reported that RLRV was the most frequent left renal vein variation, with a rate of 1.66% [21], which was also true for the present study (rate: 1.7%). Many hepatic cysts and hepatic haemangiomas are found incidentally and do not require any treatment or further evaluation [22, 23]. In the present study, we detected hepatic masses including haemangiomas, simple liver cysts, and hydatid cyst in 5 cases. After detection of these lesions, our patients were followed-up without performing any interventional procedures, and no complications occurred. The most frequent pathologies incidentally detected in the female internal genital system in the present study were uterine myomas ($n = 17$), and three of these patients underwent surgery.

Some of the incidentally detected extraspinal findings have significant clinical importance and require immediate treatment. Early recognition and treatment of some incidentally detected urological pathologies, such as hydronephrosis, symptomatic renal cysts, and recurrent renal cell carcinoma, are important in order to avoid the long-term risk of renal damage. Aneurysm of abdominal aorta can cause complications that may be life-threatening [24]. We were able to incidentally diagnose some serious disorders in asymptomatic patients. In 1106 MRI examinations we carried out, the percentage of incidental extraspinal pathological findings was 16.6%. Of these patients, 6.5% ($n = 12$) underwent surgery. The percentage of congenital anomalies/anatomical

Table III. The distribution of incidental extraspinal congenital anomalies/anatomic variations on 850 lumbar MRI examinations (558 females, 292 males)

Congenital anomalies/ anatomic variations	Patients, n (%)	95% CI
Left renal vein variations	20 (2.4) (retroaortic 1.7; circumaaortic 0.7)	1.3–3.4
Retrovert uterus	10 (1.8)	0.9–2.7
Renal rotation anomalies	6 (0.7)	0.1–1.3
Horseshoe kidney	3 (0.3)	0.1–0.7
Kidney agenesis	2 (0.2)	0.1–0.6
Total number of patients	41 (4.8)	3.4–6.3

variations was 3.7%. Although invasive procedures were performed for none of these cases up to now, radiological recognition of these congenital anomalies/anatomical variations is still clinically important since unawareness of them may cause severe haemorrhage and organ damage when a renal or retroperitoneal surgery is considered in the future [21, 25].

Whether or not reporting incidental extraspinal findings by the radiologists has positive or negative results in terms of patient health, reporting might cause unnecessary further examinations or might help save the patient's life, whereas not reporting may cause jeopardy in patient's health resulting in medical malpractice litigation [8]. We believe that it is one of the duties of the radiologist to report the incidental findings with scientifically sufficient differential diagnosis.

In any hospital where MRI is performed with an available PACS system or even with hard-copy archiving, any radiologist can retrospectively evaluate and analyse extraspinal incidental findings on the spinal MRI of their patients. As mentioned above, some studies related to incidental findings on MRI have already been performed and published [10, 15–17, 19, 21]. If we again perform a similar retrospective study in our hospital with similar numbers of patients, it is probable to get results close to those of the present study, although some different, minor results may also be obtained. Hence, despite its limitations, we believe that our study is reproducible. Since spinal MRI is directed towards only the intervertebral discs, axial images encompass solely the intervertebral disc interval. This, in turn, might have caused a lower than expected percentage of incidental findings. Also, we could increase the number of our patients by two or three fold in order to increase statistical power. Besides, cost-effectiveness is one of the issues that should be addressed, although we did not consider it in this study.

In conclusion, on MRI examination of intervertebral discs, paying attention to incidentally detected pathological extraspinal findings and congenital anomalies/anatomical variations is very important due to the fact that they can alter the treatment of the patient or affect the patient's life. Therefore, they should be included in the reports since they will give additional and valuable information.

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