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Extraspinal incidental findings on cervical vertebrae magnetic resonance imaging

Gökhan Tonkaz[1]
Esra Ibis[1]
Duygu Erkal[2]
Mehmet Tonkaz[1]
Tumay Bekci[1]

1. Department of Radiology, Faculty of Medicine, Giresun University, Giresun,Turkey.

2. Department of Radiology, Gumushane State Hospital, Gumushane, Turkey.

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Corresponding Author: Dr. Gökhan Tonkaz
Department of Radiology, Faculty of Medicine, Giresun University,
Giresun,Turkey
Email: gokhantonkaz@gmail.com

Abstract

Objective: Cervical magnetic resonance (MR) imaging is routinely employed for the assessment of cervical disc pathologies, the evaluation of the cervical spinal canal, and the detection of spinal lesions. The aim of this study was to determine the prevalence of extraspinal incidental findings in patients undergoing cervical MR imaging and to assess the reporting rates of these findings in archived radiologic reports.

Methods: A retrospective review was conducted of digital patient archives between January 2022 and December 2023, comprising 1,000 patients who underwent cervical MR imaging at our institution. Two radiologists jointly identified extraspinal incidental findings. This descriptive study analyzed images obtained using a 1.5 Tesla MR imaging system with standard neck coils, evaluating the prevalence and reporting frequency of incidental findings.

Results: Among 1,000 patients (580 males, 420 females, mean age: 49±31 years), extraspinal incidental findings were observed in 66.4% (n=664) of cases. The most frequent findings were thyroid nodules (13.8%, n=138), goiter (12.2%, n=122), and mucosal thickening of the paranasal sinuses (11.5%, n=115). Incidental findings were more prevalent in women and in the middle-aged group (35-59 years). Only 14.6% of the 664 incidental lesions were documented in radiology reports. These lesions exhibited variability in anatomical location.

Conclusions: This study demonstrates that extraspinal incidental findings are common in routine cervical MR imaging but are often overlooked in radiological reports. Given the potential clinical significance of these findings, their inclusion in reports is important for patient care and management.

Keywords: Incidental findings; cervical spine; extraspinal findings; magnetic resonance imaging; radiological reporting

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Introduction

Cervical vertebral magnetic resonance (MR) imaging is frequently employed in the diagnosis of patients presenting with neck and back complaints. These MR images primarily focus on the evaluation of spinal pathologies, including the vertebral bodies, intervertebral discs, spinal canal, neural elements, and associated ligaments. However, the extent of the evaluation may vary depending on the clinical information provided. Many radiologists limit their assessments to the areas relevant to the clinical query, often excluding the examination of anatomical structures outside the spine.

Incidental findings refer to previously undetected abnormalities that are discovered unexpectedly during imaging and are unrelated to the initial purpose of the examination. In some cases, these findings may even provide insight into the patient's symptoms. The retrospective identification of incidental findings, particularly those with implications for survival, raises significant practical and ethical concerns in clinical management. The literature contains several reports highlighting missed opportunities for the early detection of potentially life-threatening conditions, such as malignancies or aneurysms [1].

Despite the use of signal saturation bands in standard international protocols aimed at reducing artifacts and their negative impact on image quality in cervical vertebra MR imaging scans [2], a wide range of incidental pathologies in the head and neck regions may still be detected, with considerable variability in the types of encountered conditions. The images typically used for reporting are magnified around the vertebra, revealing most of the neck structures. While this approach ensures optimal identification of spinal pathologies, it often results in the exclusion of potentially significant extraspinal pathologies from the final dataset [3]. Additionally, technological advancements such as digital archiving systems and the ability to evaluate regions within the imaging field using high-magnification zoom have substantially improved the detection limits of incidental findings [1].

In our study, we aimed to determine the prevalence of incidentally detected extraspinal findings in cervical vertebra MR imaging scans and their reporting rates in radiology reports.

Materials and methods

Patients

Between January 2022 and November 2023, digital patient archives were randomly reviewed, and 1,022 patients aged 18 years and older who had undergone cervical vertebra MR imaging at our hospital were retrospectively re-evaluated. Two patients with a known history of extraspinal pathology (extraspinal malignancy) documented in the hospital system were excluded from the study. Additionally, 18 patients were excluded due to motion artifacts, and 2 patients were excluded due to surgical materials causing significant magnetic susceptibility artifacts. Extraspinal incidental findings in the cervical MR images of 1,000 patients were identified by two radiologists through consensus.

In this descriptive study, the images were acquired using a 1.5 Tesla MR imaging system with standard neck coils, and each image was individually evaluated. The prevalence of the detected findings and the reporting rates were determined. Ethical approval for this study was obtained from our university's ethics committee. Since this was a retrospective study, informed patient consent was not required.

MR Imaging technique:

Examinations were performed on 1.5 Tesla (Magnetom Symphony, Siemens Medical Solutions, Erlangen, Germany) at Giresun training and research hospital (GTRH) with a neck coil. All patients were put in supine position. The routine cervical spinal MR imaging protocol in GTRH hospital includes a three-plane localizer series. Sagittal T1-weighted Fast spin-echo (TSE) images (Repetition Time (TR) / Echo Time (TE), 600-700/9-10 ms; slice thickness, 4 mm, field of view (FOV), 25 cm and NEX, 2), sagittal T2-weighted FSE images (TR/TE, 3000/108 ms; slice thickness, 4 mm, field of view (FOV), 25 cm and NEX, 2) and axial T2-weighted GE (TR/TE, 350-400/9-10 ms; slice thickness, 4 mm, field of view (FOV), 20 cm and NEX, 2).

Image Analysis:

The MR images were interpreted by two radiologists with 8 and 2 years of experience, respectively, in consensus. The radiologists evaluated the MR images for the presence of extraspinal incidental findings. The frequency of incidental findings was calculated based on gender and age groups, and the collected data were presented as percentages. Additionally, the radiology reports were re-examined to determine whether these

Table 1. Demographic characteristics and reporting percentages of incidental lesions

Incidental findings	Female	Male	RRF	n (incidence %)
Thyroid nodule	84	54	34 (24.6%)	138 (13.8%)
Goiter	91	31	10 (8.1%)	122 (12.2%)
Mucosal thickening in paranasal sinuses	41	74	13 (11.3%)	115 (11.5%)
Partial empty sella / empty sella	60	32	10 (10.8%)	92 (9.2%)
Mega cisterna magna/arachnoid cyst	38	40	5 (6.4%)	78 (7.8%)
Retention cyst in paranasal sinuses	10	23	10 (30.3%)	33 (3.3%)
Thornwaldt's cyst	14	13	3 (11.1%)	27 (2.7%)
Nasopharyngeal mucosal thickening	10	15	5 (20%)	25 (2.5%)
Cerebellar tonsillar herniation	6	5	2 (18.1%)	11 (1.1%)
Cervical lymphadenopathy	7	3	1 (10%)	10 (1%)
Posterior soft tissue lesion	4	2	1 (16.6%)	6 (0.6%)
Pituitary gland lesion	3	1	2 (50%)	4 (0.4%)
Arteriovenous malformations	1	0	1 (100%)	1 (0.1%)
Calcific meningioma	0	1	0 (0%)	1 (0.1%)
Arachnoid granulation	0	1	0 (0%)	1 (0.1%)
TOTAL			**97 (14.6%)**	**664 (66.4%)**

RRF: Reporting rate of findings, n: Number of people

incidental findings were mentioned. The reporting rates for each incidental finding were calculated and presented as percentages. In cases where multiple instances of the same type of lesion were observed, only one was recorded as an incidental finding. The incidental findings were recorded in order of frequency **(Table 1)**.

Regions within the thyroid parenchyma with well-defined borders or signal properties distinct from the parenchyma were classified as thyroid nodules **(Figure 1, star)**. Enlargement of the thyroid gland, with an anteroposterior diameter exceeding 2 cm, was diagnosed as goiter **(Figure 1, arrows)** [4].

The mucosa lining the paranasal sinuses is respiratory epithelium, typically about 1 mm thick. Mucosal thickening exceeding 3 mm in the maxillary sinuses, 2 mm in the ethmoid sinuses and 1 mm in the sphenoid sinuses is considered pathological. In T2-weighted images, a high signal beyond the aforementioned thicknesses along the periphery of the paranasal sinus was classified as mucosal thickening [5]. In T2-weighted images, when the sella turcica is filled with cerebrospinal fluid (CSF) and the pituitary gland measures less than 3 mm, it is classified as partial empty sella and less than 2 mm as empty sella [6]. Mega cisterna magna is a focal enlargement of the subarachnoid space filled

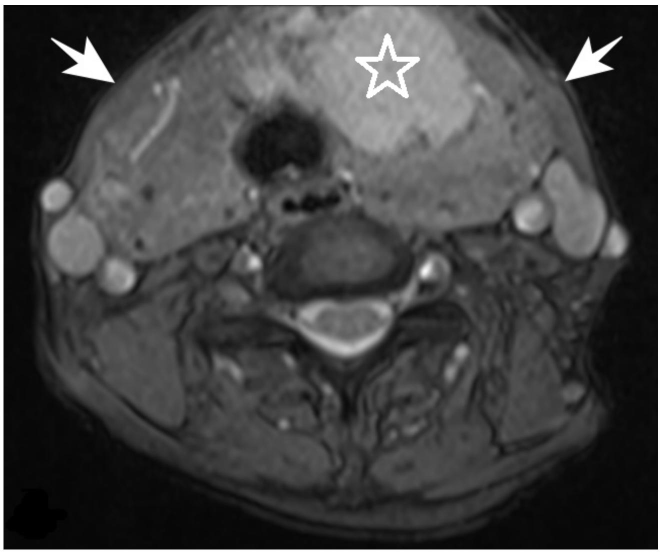

Figure 1. Axial T2-weighted image shows thyroid gland enlargement consistent with goiter (arrows) and a well-circumscribed thyroid nodule (star).

with CSF located in the posterior and lower parts of the posterior cranial fossa. Distinguishing mega cisterna magna from arachnoid cysts, which are also CSF-filled and located similarly, can be challenging on cervical MR images. Therefore, in T2-weighted midsagittal images, a measurement greater than 10 mm was classified as either mega cisterna magna or arachnoid cyst [7]. In T2-weighted images, round or dome-shaped hyperintense lesions in the paranasal sinuses were classified as retention cysts [8]. In T2-weighted images, midline, hyperintense lesions with thin walls located in the nasopharyngeal mucosa were classified as Tornwaldt cysts [9]. In T2-weighted sagittal images, nasopharyngeal mucosa exceeding 3 mm in thickness was classified as nasopharyngeal mucosal thickening [10] **(Figure 2A-B, arrow)**.

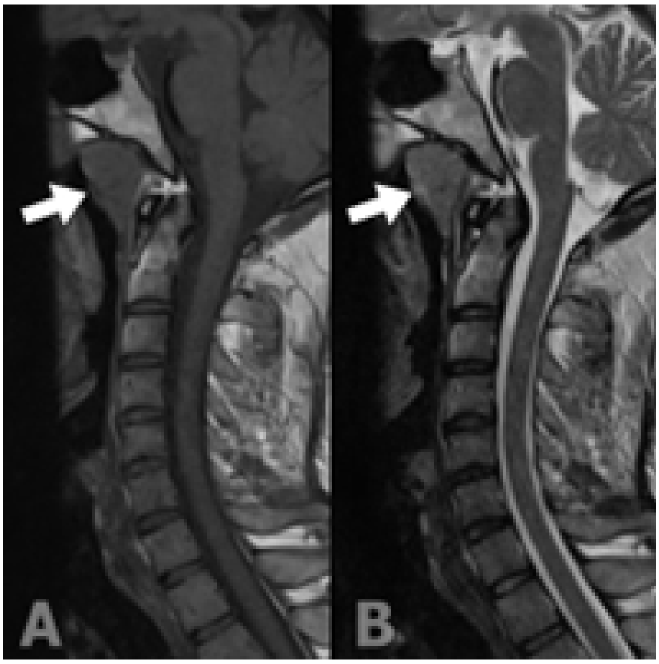

Figure 2. Sagittal T1(A) and T2(B) weighted images show nasopharyngeal mucosal thickening (arrow) in the posterior wall of the nasopharynx.

In T2-weighted images, the descent of the cerebellar tonsils more than 3 mm below the level of the foramen magnum (McRae line) was classified as cerebellar tonsillar herniation [11]. Lymphadenopathy in the cervical chain was defined by a short-axis diameter of 10 mm or greater or a cortical thickness of 3 mm or more. T2-weighted images showing high-signal cystic or necrotic areas were also used to identify lymphadenopathy [12, 13]. Any cervical lymph node with a long-to-short axis ratio of less than two was also classified as lymphadenopathy [14]. In T1 and T2-weighted images of the posterior cervical region, foci

Figure 3. Sagittal T1(A) and T2(B) weighted images show a posterior soft tissue lesion with regular borders (arrow) within the soft tissue in the posterior cervical region.

with different signal characteristics compared to adjacent structures were classified as posterior soft tissue lesions **(Figure 3A-B, arrow)**.

Pituitary gland lesions were classified as lesions located in the suprasellar, parasellar, or intrasellar regions with distinct signal characteristics in T1 and T2-weighted sagittal images **(Figure 4A-B, arrow)** [15].

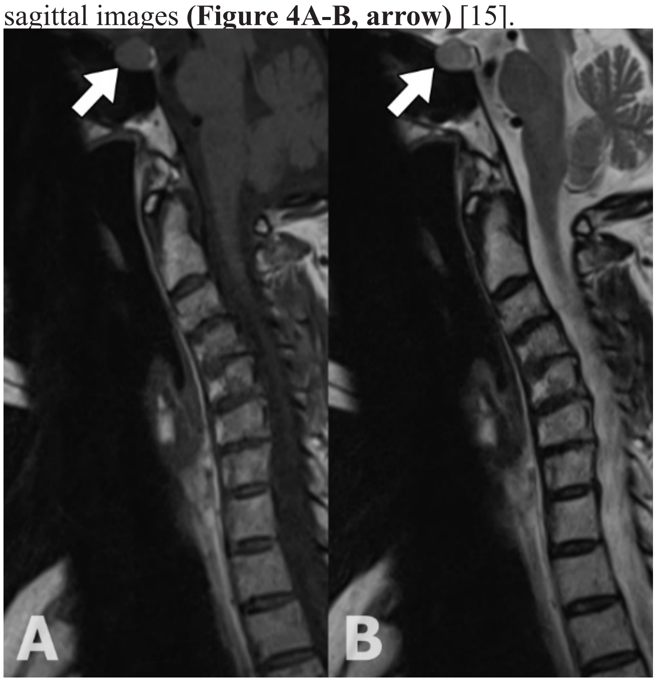

Figure 4. Sagittal T1(A) and T2(B) weighted images show a pituitary gland lesion (arrow) located in the intra-suprasellar region.

A lesion located in the cranial extra-axial region, containing calcified foci and having different signal characteristics compared to adjacent tissues was classified as calcific meningioma **(Figure 5A-B, arrow)** [16].

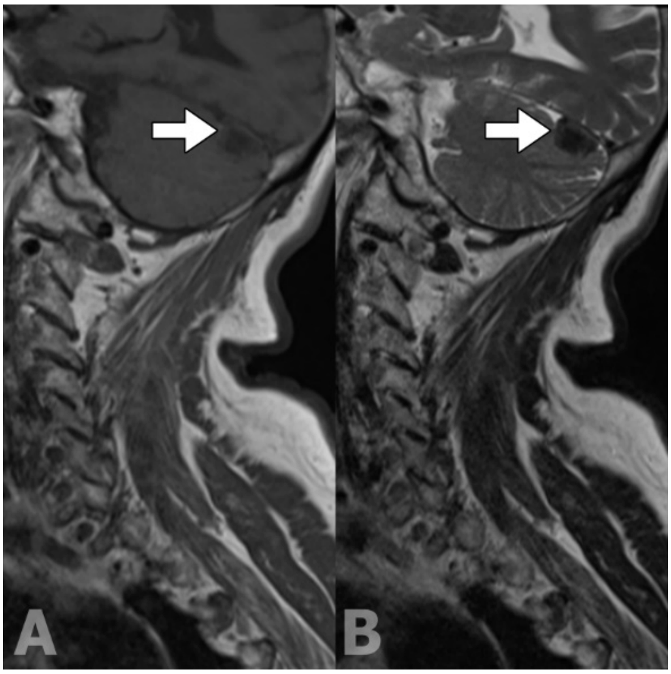

Figure 5. Sagittal T1(A) and T2(B) weighted images show a calcific meningioma (arrow) with calcified foci located extra-axially and with different signal characteristics compared to adjacent tissues.

Brain arteriovenous malformation (AVM) was identified by observing enlarged feeding arteries, nidus closely associated with brain parenchyma, and draining veins with flow voids on T2-weighted sagittal images [17]. Foci with different signal characteristics forming a filling defect at the calvarium or dural venous sinus in T1 and T2-weighted sagittal images were classified as arachnoid granulations [18].

Results

This study included 1,000 patients, comprising 580 males and 420 females, who underwent cervical vertebra MR imaging for the evaluation of spinal pathologies. The percentage of extraspinal incidental findings was 66.4% (n=664). The mean age of the study population was 58.7 years (49±31). The distribution of incidental findings by age group and gender is listed in Table 1. The most common incidental findings were thyroid nodules, goiter, and mucosal thickening in the paranasal sinuses. Other incidental findings and their demographic characteristics are also provided in Table 1. Incidental findings were identified in 36.9% of females (n=664) and 29.5% of males (n=295). In our study, we observed that the prevalence of incidental findings was higher in the middle-aged group (35-59 years) compared to other age groups **(Table 1)**. It was determined that only 14.6% (n=97) of the extraspinal incidental findings were mentioned in the radiology reports **(Table 1)**. Additionally, no lesions were detected in categories such as thyroglossal duct cysts, other vascular lesions such as aneurysms, esophageal lesions, or cerebral and cerebellar mass lesions.

Size and location characteristics of thyroid nodules are shown in **Table 2.**

Discussion

Incidental findings, which are a part of medical practice, are abnormalities detected during investigations performed for reasons unrelated to the primary examination. The impact of detecting incidental findings on patient health is uncertain [19], but identifying such findings may lead to the discovery of more serious conditions requiring treatment [20]. In this study, 1,000 patients were evaluated, and incidental findings were identified in 664 patients, as shown in Table 1. The most common incidental findings were observed in the thyroid gland and paranasal sinuses.

In our study, the prevalence of thyroid nodules was 13.8% (n=138), with 68.1% (n=94) of these nodules measuring larger than 1 cm (Table 2).

It was noted that only 24.6% (n=34) of patients with thyroid nodules were noted in radiology reports. In a study by Ottonello et al., thyroid nodules were detected in 33% of adults undergoing ultrasound screening [21].

Table 2. Size and location characteristics of thyroid nodules

Incidental findings	RL (F / M)	LL (F / M)	I (F / M)	SIZE >1CM	n (incidence %)
Thyroid nodule	82 (52/30)	43 (23/20)	13 (9/4)	94	138 (13.8%)
RL: Right thyroid lobe, LL: Left thyroid lobe, I: Isthmus lobe, F: Female, M: Male, n: Number of people					

In another study, multiple thyroid nodules were detected in 37.3% of those who underwent random autopsies [4]. The lower prevalence of thyroid nodules in our study compared to the literature may be due to undetected nodules located outside the imaging field. In addition, incidental thyroid nodules may sometimes represent thyroid cancer, a clinically significant condition [22]. It is very important that this condition is noted in radiology reports as it will affect the patient's life.

In our study, the prevalence of goiter was found to be 12.2% (n=122). The prevalence of goiter was significantly higher in the female population ($p < 0.005$), with a female-to-male ratio of 3:1, and its occurrence decreased with age. Goiter was mentioned in 8.1% (n=10) of the radiology reports of patients with goiter. A study by Ottonello et al. similarly reported a decrease in the prevalence of goiter with age, with a female-to-male ratio of at least 4:1, and the highest prevalence observed in premenopausal women [21]. The findings of our study regarding goiter are consistent with the literature.

In our study, the prevalence of mucosal thickening in the paranasal sinuses was 11.5% (n=115). It was observed more frequently in males than in females, and its prevalence increased with age. Mucosal thickening was mentioned in 11.3% (n=13) of the radiology reports. The data on paranasal sinus mucosal thickening in our study are in line with the existing literature [23].

The prevalence of empty sella in our study was 9.2% (n=92). It was more commonly observed in females compared to males, and its prevalence increased with age. Empty sella was noted in 10.8% (n=10) of the radiology reports of patients with this finding. A study by Foresti et al. identified incidental empty sella in 38% (n=140) of 500 patients who underwent brain MR images. In that study, empty sella was more frequently observed in females (72/68) and was detected in 39.9% of individuals aged 40 years and older [24]. Apart from the lower prevalence of incidental empty sella in our study, the other findings are consistent with the literature. The lower prevalence in our study may be attributed to the fact that incidental findings are more frequently identified in cranial MR scans performed for intracranial pathologies, and empty sella is more commonly associated with such pathologies. Apart from this, empty sella, which refers to the filling of the sella turcica with CSF, is usually an incidental finding with no clinical significance. However, although rare, it may be associated with idiopathic intracranial hypertension. Noting this condition in the radiology report may allow patients with headaches to be guided and receive the correct diagnosis and treatment.

In our study, the prevalence of mega cisterna magna/arachnoid cyst was found to be 7.8% (n=78). It was noted that only 6.4% (n=5) of patients with mega cisterna magna/arachnoid cyst had this finding mentioned in their radiology reports. It is estimated that mega cisterna magna is present in approximately 1% of brains imaged postnatally [25]. In a study of 48,417 patients who underwent neuroimaging, 1.4% (n=661) were diagnosed with arachnoid cysts [26]. The higher prevalence of mega cisterna magna/arachnoid cyst in our study compared to the literature may be due to the diagnosis being made solely based on sagittal slices, without axial images, leading to potential misdiagnosis as a result of partial volume effects.

In our study, the prevalence of retention cysts was 3.3% (n=33), with a higher frequency in males compared to females. Retention cysts were mentioned in 30.3% (n=10) of the radiology reports. Retention cysts are found in 1.4–9.6% of the general population, with most being asymptomatic [27]. In contrast, a study by Tarp et al. reported a slightly higher prevalence of 15% [28]. The lower prevalence in our study may be due to the fact that the imaging was not specifically targeted at the paranasal sinuses, and only partial sections of the paranasal sinuses were included in the imaging field.

In our study, the prevalence of tornwaldt cysts was 2.7% (n=27). A study by Alper Dilli et al. reported a tornwaldt cyst prevalence of 3% [29]. Our findings are consistent with the literature, and tornwaldt cysts were mentioned in 11.1% (n=3) of the radiology reports.

In our study, the prevalence of nasopharyngeal mucosal thickening was 2.5% (n=25). Nasopharyngeal mucosal thickening was mentioned in 20% (n=5) of the radiology reports. In a study in the literature, nasopharyngeal mucosal thickening was detected in 44.2% (n=442) of 1000 patients who underwent cervical MR imaging [30]. The lower prevalence of nasopharyngeal mucosal thickening in our study may be attributed to a lower prevalence of diseases causing such thickening in our region compared to other areas.

In our study, the prevalence of cerebellar tonsillar herniation was 1.1% (n=11), consistent with the literature [30]. It was noted that 18.1% (n=2) of the patients with cerebellar tonsillar herniation had this finding mentioned in their radiology reports.

In our study, the prevalence of lymphadenopathy was 1%

(n=10). Lymphadenopathy was mentioned in 10% (n=1) of the radiology reports in our study. In a retrospective study by Frager et al., lymphadenopathy was identified in 1.45% (n=22) of cases with extraspinal pathology found in CT scans [31]. The prevalence of lymphadenopathy in our study was close to the reported rates in the literature.

Posterior neck soft tissue lesions include all outgrowths, both benign and malignant, originating from tendons, muscles, ligaments, cartilage, nerves, blood vessels, fat, and other tissues [15, 16]. The exact prevalence of posterior neck soft tissue lesions is unknown, but the majority of these lesions are benign pathologies [32]. In our study, the prevalence of posterior neck soft tissue lesions was 0.6% (n=6). It was mentioned in 16.6% (n=1) of the radiology reports.

The prevalence of pituitary gland lesions in our study was 0.4% (n=4). The prevalence of pituitary tumors is approximately 1 in 1,000 [33]. Pituitary gland lesions were mentioned in 50% (n=2) of the radiology reports.

The prevalence of calcific meningioma, AVM, and arachnoid granulation in our study was 0.1% (n=1). AVM was mentioned in the radiology report, whereas calcific meningioma and arachnoid granulation were not reported.

There are few studies that examine incidental lesions in cervical MR imaging and discuss the reporting rates in radiology reports. A study conducted in 2018 found that 29.1% of 192 cervical MR images contained incidental findings, with lesions in the paranasal region being the most frequently encountered, followed by thyroid lesions. The study also reported that the reporting rate for incidental findings in cervical MR image was 29.5% [34]. In a study by Zidan et al., 266 cervical MR images were re-evaluated, and incidental findings were detected in 16.9% of cases. The most common incidental findings were thyroid nodules (6.3%), goiter (4.6%), and mucosal thickening in the paranasal sinuses (2.68%). This study also examined the distribution of incidental findings by age group, with the highest prevalence of incidental lesions observed in patients aged 41-60 years [25]. In a study by Kaya et al., 300 cervical MR images were re-evaluated, and incidental findings were detected in 13.7% of cases, with thyroid nodules being the most common incidental finding [35]. In a 2024 study by Kızılgöz et al., at least one incidental finding was present in 72.6% of the cervical MR images reviewed, with the nasopharyngeal and thyroid regions being the most frequently affected areas. Additionally, the reporting rate for incidental findings in this study was recorded at 5.29% [30]. In a study by Kamath et al., meningiomas, thyroid, salivary gland lesions, and nasopharyngeal tumors were frequently encountered incidental findings in cervical MR imaging [20].

There are several limitations in interpreting the results of this study that must be considered. First, this study relied on radiological findings for the detection of incidental lesions, without histopathological correlation. Second, as the patients were not followed up, the radiological findings were not correlated with clinical data, which could lead to incomplete or inaccurate interpretations. Third, the clinical significance of these incidental findings was not assessed. Fourth, there was no evaluation of the incidental findings from the perspectives of patients, radiologists, healthcare economics, or medicolegal aspects. Fifth and finally, to determine more accurate prevalence numbers and reporting rates, larger populations must be studied, and additional research is required to contribute to the body of literature.

This study highlights the high prevalence and variability of incidental lesions encountered in cervical MR imaging, despite the low reporting rates in daily radiology practice. The omission of these lesions from radiology reports may be a result of the focus on the primary purpose of the imaging technique.

Conclusion

In conclusion, extraspinal incidental findings detected in cervical vertebra MR imaging are more common than expected, yet they are rarely reported in radiology reports. These incidental findings are important because they may affect the patient's treatment or life. Therefore, incidental findings should be included in radiology reports, as they provide valuable additional information.

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