PREVALENCE AND CLINICAL SIGNIFICANCE OF INCIDENTAL EXTRACARDIAC FINDINGS ON CARDIAC MAGNETIC RESONANCE IMAGING

Kardiyak Manyetik Rezonans Görüntülemede İnsidental Ekstrakardiyak Bulguların Yaygınlığı ve Klinik Önemi

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ABSTRACT

Objective: The purpose of this study is to discuss the prevalence and potential outcomes of incidental extracardiac findings (IEF) identified on cardiac magnetic resonance imaging (MRI) and also explore the age implications of these findings.

Material and Methods: Eight hundred twelve MRIs cardiac MRI were evaluated retrospectively by two radiologists. IEFs were examined in three groups as mild or no clinical significance (group 1), probable clinical significance (group 2) and clinically significant (group 3). In addition, the patient group was divided into 2 groups as over and under 65 years of age and the prevalence of extracardiac involvement was evaluated.

Results: Our study consisted of 812 individuals (432 males (52.96%), median age 54 years, range 19-76 years), we identified a total of 187 IEFs in 176 patients. Of these IEFs; 74 (9.1%) belonged to group 1 were of mild or no clinical significance, 70 (8.6%) belonged to group 2 were of probable clinical significance, and 32 (3.9%) belonged to group 3 were clinically significant. 507 (62.4%) were ≤65 years old and 305 (37.6%) were over 65 years old. IEFs were seen significantly more frequently in patients over 65 years of age (n=100, 56.8% p<0.001).

Conclusion: When reporting cardiac MRI findings, particular attention should be paid to extracardiac findings in patients over 65 years of age, and clinically significant findings should be reported.

Keywords: *Incidental Findings; Extracardiac Findings; Cardiac Imaging; Magnetic Resonance Imaging; Radiology*

ÖZET

Amaç: Kardiyak Magnetik rezonans görüntülemede (MRG) tespit edilen insidental ekstrakardiyak bulguların (EKB) yaygınlığını ve olası sonuçlarını tartışmak ve ayrıca bu bulguların yaşla ilişkilerini araştırmaktır.

Gereç ve Yöntemler: Kardiyak MRG çekilen 812 hastanın MRG'leri retrospektif iki radyolog tarafından değerlendirildi. EKB'lar hafif veya klinik önemsiz (grup 1), potansiyel önemli (grup 2) ve klinik olarak önemli (grup 3) olmak üzere üç grupta incelendi. Ayrıca hasta grubu 65 yaş üstü ve altı olarak 2 gruba ayrılarak ekstrakardiyak bulguların yaygınlığı değerlendirildi.

Bulgular: Çalışmamız 812 kişiden oluşmakta olup 432 erkek (%52,96), medyan yaş 54 yıl (aralık 19-76 yıl), 176 hastada toplam 187 EKB tespit ettik. Bu EKB'larden; 74'ü (%9,1) hafif veya hiç klinik öneme sahip değildi, 70'i (%8,6) potansiyel önemli ve 32'si (%3,9) klinik olarak önemliydi. 507 (%62,4) kişi ≤65 yaşında ve 305 (%37,6) kişi 65 yaş üstündeydi. EKB'lar 65 yaş üstü hastalarda anlamlı derecede daha sık görüldü (n=100, %56,8 p<0,001).

Sonuç: Kardiyak MRI bulguları raporlanırken, 65 yaş üstü hastalarda ekstrakardiyak bulgulara özellikle dikkat edilmeli ve klinik olarak anlamlı bulgular raporlanmalıdır.

Anahtar Kelimeler: *İnsidental Bulgular; Ekstrakardiyak Bulgular; Kardiyak Görüntüleme; Manyetik Rezonans Görüntüleme; Radyoloji*

INTRODUCTION

Cardiac magnetic resonance (CMR) is increasingly used for noninvasive evaluation of heart-cardiovascular system and related pathologies (1). Technological advances have led to the development of magnetic resonance imaging (MRI) techniques that enable imaging of the heart and its pathologies, reducing imaging acquisition time and providing a significant increase in spatial and temporal resolution. The main applications of CMR are the assessment of myocardial ischemia and viability, cardiomyopathies, myocarditis, pericardial pathologies and congenital heart diseases. Additionally, CMR enables imaging of the chest cavity, upper abdomen and neck and can play an important role in detecting incidental pathologies in these regions. The significance of these findings may vary depending on the individual's general health status and clinical history (2).

Evaluation of CMR by an experienced radiologist is important to detect incidental extracardiac findings (IEF) that may be clinically significant. These findings located in the cardiac MRI report will have a significant impact on patient health.

The purpose of this study is to discuss the prevalence and potential outcomes of IEFs identified on cardiac MRI and also explore the age implications of these findings.

MATERIAL AND METHODS

Between October 2022 and December 2023, we included the patient population aged ≥ 18 years who underwent cardiac MRI for suspected or known cardiac pathologies at a tertiary academic hospital. 904 cardiac MRI examinations performed on patients referred to our department for various indications were evaluated and randomly selected using the hospital Picture Archiving and Communication System (PACS). Excluded from the study were 92 patients due to poor imaging quality (n=42), artifacts preventing imaging analysis (n=28), or incomplete studies due to patient intolerance (n=22).

All patients were scanned with a 1.5 T magnetic resonance device (Philips Achieva; Philips Healthcare, Amsterdam, The Netherlands) for cardiac evaluation. CMR protocols included cine sequences with steady-state free precession (SSFP)–oriented 2-chamber vertical long-axis view, 4-chamber horizontal long-axis view, 3-chamber view, and short axis, phase-contrast images to review valvular flow, phase-sensitive inversion recovery (PSIR) images for studying late gadolinium enhancement performed 10 to 15 minutes after intravenous administration of gadolinium (0.1-0.2 mmol/kg) and also native and post-contrast T1 mapping, T2 mapping in three short axis slices (basal, middle, and apical).

Two radiologists with 7 and 5 years of experience in reporting and cardiovascular MRI, respectively, reinterpreted the CMR examinations without prior knowledge of their objectives. All non-cardiac findings, unrelated to cardiac pathology were recorded as incidental findings, forming the basis for diagnosis. Incidental imaging findings are defined as any incidental mass, lesion, or abnormality detected by any imaging technique for an unrelated reason and and also not directly related to pathology (3).

The prevalence and locations of IEFs were assessed and reported. To assess the clinical implications of IEFs, clinical data were analyzed by reviewing the hospital's electronic medical record database.

IEFs were classifed into three groups according to clinical signifcance as reported in prior studies (4):

Group 1: mild or no clinical significant findings, no further evaluation or treatment required.

Group 2: potentially significant findings, may benefit from further diagnostic evaluation or follow-up but did not require changes in the treatment plan or primary diagnosis.

Group 3: clinically significant findings, requiring immediate treatment and changes in the patient's prognosis.

In addition, when we divided these incidental extracardiac findings into groups of major and minor clinical significance, we evaluated groups 2 and 3 as major findings. In cases of disagreement, a consensus was reached.

Evaluation of previous imaging findings and clinical diagnosis were also assessed to ensure that important and potentially important findings were not missed and that patients were eligible for changes in prognosis. The study population was also divided into patient groups aged ≤65 years and >65 years to assess differences in the prevalence of IEFs in these two age groups.

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Statistical analysis was performed using SPSS 24.0 (IBM, Armonk, NY, USA). Quantitative variables were expressed as mean and standard deviation, and categorical variables were presented as frequencies and percentage. Age ≤ 65 years old and gender differences in distribution of incidental findings were were assessed using Pearson's χ^2 or Fisher's exact test. A p value of < 0.05 was considered statistically significant.

Ethical approval for this study wasobtained from the local ethics committee of (approval no. AESH-EK1-2023-823). This study was conducted in accordance with the principles of the Declaration of Helsinki, and written informed consent was obtained from all patients.

RESULTS

In our retrospective analysis, the study sample consisted of 812 individuals (432 males (52.96%), median age 54, range 19-76), we identified a total of 187 IEFs in 176 patients.

The most frequent indication for CMR was myocarditis (either suspected or known myocarditis) (30.5%), followed by non-ischemic cardiomyopathy (24.3%) and right ventricular evaluation (10.1%), respectively. Patients demographics and clinical indications for cardiac magnetic resonance imaging are listed in Table 1.

Overall, 166 patients had only one IEF, 9 patients had two IEFs, and only one patient had three incidental findings. Of these IEFs; 74 (9.1%) belonged to group 1 were of mild or no clinical significance, 70 (8.6%) belonged to group 2 were of probable clinical significance, and 32 (3.9%) belonged to group 3 were clinically significant. On the other hand, according to major and minor clinical significance grouping, the prevalences of major and minor IEFs were found to be 12.7% (Group 2 and 3) and 9.1 % (Group 1), respectively. In Group 1 IEFs with prevalence 9.1%: the most common were simple renal cyst (28/74, Figure 1), hepatic cyst (18/74), liver hemangioma (12/74) and subcentimeter thyroid nodule (10/74). In Group 2 IEFs with prevalence: 8.6%: the most common were pleural effusion (20/70, Figure 2), thyroid goitre (17/70) and splenomegaly (12/70). 32 patients in Group 3 IEFs with prevalence: 3.9% were classified as significant and monitored clinically by further diagnostic methods and short intervals. The most common among these Group 3 IEFs were mediastinal lymphadenopathy/mass (10/32, Figure 3), pulmonary consolidation (7/32), and vascular anomaly (6/32) (Table 2).

Of the patients included in the study, 507 (62.4%) were ≤65 years old and 305 (37.6%) were over 65 years old. IEFs were seen significantly more frequently in patients over 65 years of age (n=100, 56.8% p<0.001). The mild group and the potentially life-threatening incidental findings group were shown to be more common in patients over 65 years of age (p<0.001) (Table 3). Simple renal cysts were most commonly observed as mild IEFs in patients aged >65 years. Among clinically significant IEFs, the most common were mediastinal lymphadenopathy/mass and pulmonary consolidation.

DISCUSSION

Cardiac MRI has become one of the standard non-invasive methods for evaluating heart functions with technological advancements in recent years. Especially with the development of quantitative mapping techniques such as T1, T2, and T2 star, it has the potential to replace biopsy as a non-invasive diagnostic method for diseases such as myocarditis, amyloidosis, thalassemia, and myocardial fibrosis (5-7). Therefore, the use of cardiac MRI has increased, making it essential to report extracardiac findings that may be clinically significant in addition to cardiac pathologies.

In our study, we found the prevalence of IEFs to be 21.6%. There is significant variability in the literature regarding the prevalence of IEFs. Dunet et al. reported a prevalence of 35%, Sokolowski et al. 34%, Mantini et al. 21.6%, and Gravina et al. 14.7% (4, 8-10). The most frequently observed organs with IEFs are the liver, lung parenchyma, and kidneys (8). In our study, incidental extracardiac findings were most commonly detected in the liver and kidneys. There is no standardization regarding the classification of incidental extracardiac findings detected in cardiac MRI. In our study, we used the classification proposed by Gravina et al., categorizing IEFs into three groups: mild or no clinical significant, possible clinical significance, and clinically significant findings. Gravina et al. reported the prevalence of mild or no clinical significant IEFs as 9.7%, with simple renal cysts and hepatic cysts being the most common findings (4). In our study,

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Table 1. Patients demographics and clinical indications for cardiac magnetic resonance imaging.

	n(%)
Number of patients	812
Age, median (range- years)	54 (19-76)
Gender	
Female	380 (47.04%)
Male	432 (52.96%)
Clinical indications for cardiac MRI	
Myocarditis	248 (30.5%)
Non-ischaemic cardiomyopathy	197(24.3%)
Right ventricular evaluation	82 (10.1%)
Myocardial viability	75 (9.2%)
Congenital heart disease	72 (8.9%)
Cardiac masses	65 (8%)
Valvular disease	57 (7%)
Arythmia-Atrial fibrillation	5 (0.6%)
Pericardial disease	5(0.6%)
Coronary artery assesment	3(0.4%)
Others	3(0.4%)



Figure 1. Group 1-Mild or no clinical significant incidental extracardiac findings. Simple renal cyst (black arrow)

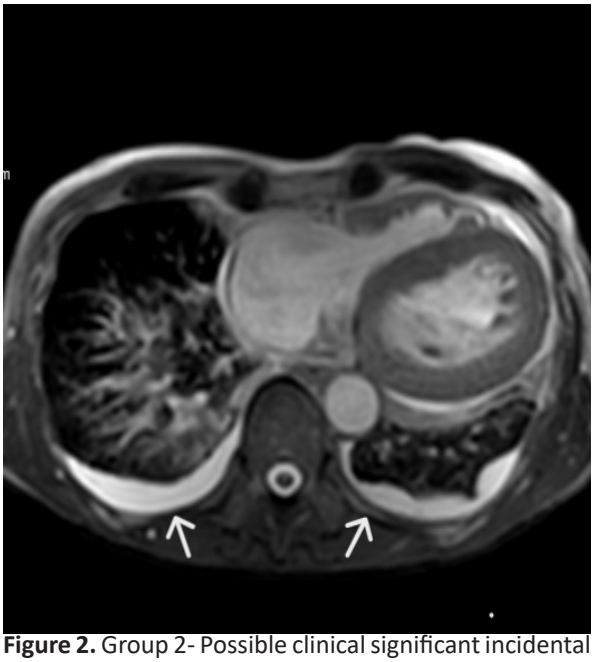


Figure 2. Group 2- Possible clinical significant incidental extracardiac findings. Pleural effusion (white arrows).

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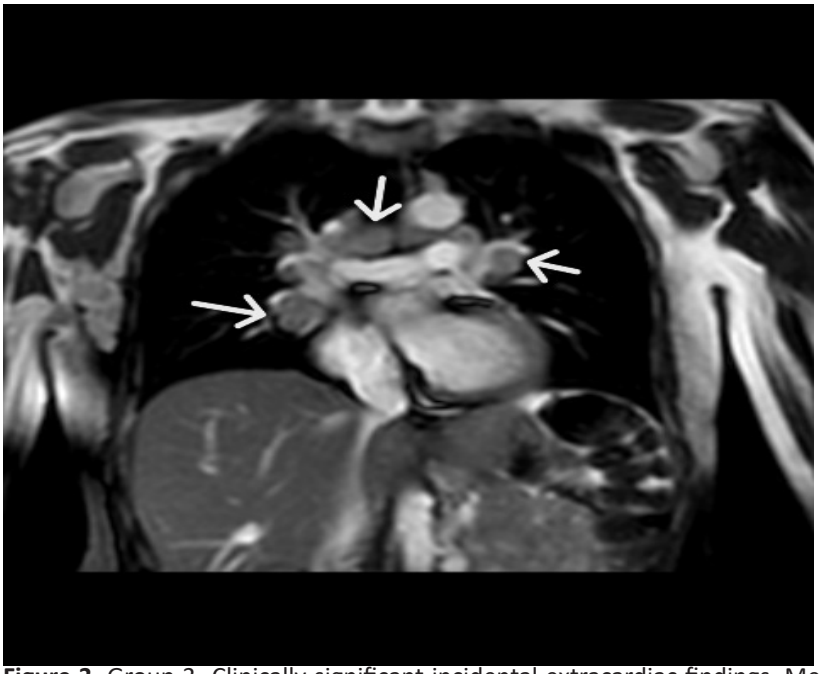


Figure 3. Group 3- Clinically significant incidental extracardiac findings. Mediastinal lymphadenopathies (white arrows).

Table 2. Incidental extracardiac findings according to clinical significance at cardiac magnetic resonance imaging.

Incidental extracardiac findings	Number of patients	Prevalance n=812 (%)
Group 1-Mild or no clinical significance	74	9.1%
Simple renal cyst	28	3.5%
Hepatic cyst	18	2.2%
Liver haemangioma	12	1.5%
Thyroid nodule < 1 cm	10	1.2%
Hiatal hernia	6	0.7%
Group 2- Possible clinical significance	70	8.6%
Pleural effusion	20	2.5%
Thyroid goiter	17	2.1%
Splenomegaly	12	1.5%
Gallbladder lithiasis	6	0.7%
Hydronephrosis	6	0.7%
Pleural thickening	4	0.5%
Axillary lymphadenopathy	3	0.4%
Thymic hyperplasia	2	0.2%
Group 3- Clinically significant	32	3.9%
Mediastinal lymphadenopathy/mass	10	1.2%
Pulmonary consolidation	7	0.9%
Vascular anomaly	6	0.7%
Lung nodule/mass	3	0.4%
Pulmonary embolism	2	0.2%
Pleural mass	2	0.2%
Breast nodule	1	0.1%
Aortic coarctation	1	0.1%

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Table 3. Comparison of incidental extracardiac findings between patients aged ≤65 years and >65 years

	≤65 years old (n=507)	>65 years old (n=305)	p value
Mild or no clinical significance (n=74)	28	46	<0.001
Possible clinical significance (n=70)	38	32	0.14
Clinically significant (n=32)	10	22	<0.001
Total IEFs (n=176, n,%)	76 (%43.2)	100(56.8%)	<0.001

IEFs: incidental extracardiac findings

the prevalence of mild or no clinical significant IEFs was 9.1%, with simple renal cysts and hepatic cysts also being the most frequently detected. Rahman et al. frequently identified pleural effusion (21.4%) and axillary lymphadenopathy (17.6%) (11). Ufuk et al. reported minimal pleural effusion (7.4%) and vertebral hemangiomas (6.9%) as the most common insignificant incidental extracardiac findings (5).

Gravina et al. reported a 3% prevalence of the possible clinical significance group, with pleural effusion being the most commonly detected finding (4). In our study, the prevalence was 8.6%, with pleural effusion and goiter being the most common findings. The overall prevalence of IEFs was higher in our study, which may explain the greater proportion of possible clinical significance findings, though the most frequently detected findings were similar. Mantini et al. also found pleural effusion as the most common clinically significant finding but reported a higher prevalence of 15.2% for this group (10). In both the study by Gravina et al. and our study, the majority of patients undergoing cardiac MRI had myocarditis or non-ischemic cardiomyopathy. In the study by Mantini et al., the high prevalence of the possible clinical significance group may be due to the fact that cardiac MRI was most frequently performed for myocardial viability assessment (4, 10).

The prevalence of clinically significant IEFs has been reported to be between 2-5% (2, 4). Gravina et al. reported the prevalence of this group as 2%, with mediastinal lymphadenopathy/mass being the most common finding (4). Mantini et al. reported severe pleural effusion, while Rahman et al. most frequently observed pulmonary consolidation (10, 11). In our study, the prevalence of clinically significant findings was 3.9%, with mediastinal lymphadenopathy/mass and pulmonary consolidation being the most frequently observed findings.

Sokolowski et al. reported that the prevalence of IEFs increases after the age of 60. They found the prevalence of clinically significant IEFs to be 4.4% in patients aged 61-75 years and 5% in patients aged 76-90 years (9). In our study, both clinically insignificant and clinically significant IEFs were statistically significantly more common in patients over 65 years of age ($p < 0.001$). Additionally, the overall prevalence of IEFs was also significantly higher in this age group ($p < 0.001$). Therefore, when reporting cardiac MRIs, specialattention should be given to extracardiac findings in patients over 65 years old. Our study has some limitations, including its retrospective nature, single-center design, and limited patient follow-up. For these reasons, the relationship between variables may not be fully established, and the results may not reflect the entire patient population.

CONCLUSION

When reporting cardiac MRI in patients over 65 years of age, extracardiac findings should be given special attention because of their potential clinical significance. In daily reporting practices, radiologists should pay particular attention to potentially important or clinically significant findings.

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