NON-TRAUMATIC NON-COVID-19 RELATED FINDINGS IN EMERGENCY CHEST MULTIDETECTOR COMPUTED TOMOGRAPHY. A RETROSPECTIVE STUDY

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NON-TRAUMATIC NON-COVID-19 RELATED FINDINGS IN EMERGENCY CHEST MULTIDETECTOR COMPUTED TOMOGRAPHY: A RETROSPECTIVE STUDY (Abstract): This study **aims** to analyze the non-traumatic and non-COVID-19-related findings detected in patients presenting to the emergency department with acute chest pain who underwent chest multidetector computed tomography (MDCT) and the relationship with patient gender and treatment solutions. **Materials and methods:** We retrospectively selected and reviewed the radiological reports of a cohort of 378 patients who underwent chest MDCT in emergency at "Sf. Spiridon" County Clinical Emergency Hospital, Iasi, Romania, between January 1, 2021, and July 1, 2024. Exclusion criteria were recent trauma history, a positive PCR test for COVID-19, and acute myocardial infarction. MDCT examinations were performed using a 16-slice Siemens Somatom Emotion CT scanner and a 64-slice Philips Incisive CT scanner. **Results:** Among the 378 patients, 222 were males (58.7%) and 156 were females (41.3%), with a mean age of 73.8 years (SD 10.767; CI 72.55-75.06; range 35-94 years). We classified the lesions into four categories: pleuro-pulmonary (51.58%), cardiac (24.9%), vascular (16.55%), malignant (6.97%). Life-threatening findings were present in only 21.42% of cases, including pulmonary embolism (14.8%), acute pulmonary edema (2.3%), descending aorta dissection (0.7%), and massive pleural effusion (0.7%). The most common primary malignancy was lung cancer. **Conclusions**: This study underlines the importance of correctly identifying and managing the chest CT findings in the case of patients examined in emergencies. **Keywords:** CHEST EMERGENCY, COMPUTED TOMOGRAPHY, NON-TRAUMATIC, NON-COVID-19, ACUTE CHEST PAIN.

INTRODUCTION

Chest multidetector computed tomography (MDCT) became an essential tool in emergency departments due to its ability to provide fast, accurate, high-resolution diagnostic images and to evaluate the cause and extent of the disease (1, 2, 3, 4).

Chest pain and shortness of breath are determined only in a small percentage by acute coronary syndrome, even if ischemic heart disease is frequent and often clinically indistinguishable from other chest conditions (5-10); the differential diagnosis includes gastro-esophageal diseases, chest-wall syn-dromes,

and less frequent causes: pulmonary embolism, pleural and pericardial lesions, pneumonia, lung cancer, aortic dissection, and herpes zoster. Among them, there are several life-threatening causes: pulmonary embolism (PE), tension pneumothorax, pericardial tamponade, aortic dissection, and esophageal perforation, which can be confidently and rapidly diagnosed by chest CT (8, 9, 10). PE is the third most common cause of cardiovascular-related deaths, following myocardial ischemia and stroke (11-13), and for its diagnosis, the gold-standard investigation is computed tomography pulmonary angiography (CTPA) (13, 14), with a high sensitivity (96-100%) and specificity (97-98%) (14, 15).

Previous studies have established the efficacy of MDCT in evaluating thoracic emergencies (7, 8, 16, 17); however, regional data, particularly from Eastern Europe, remain limited (18, 19).

MATERIALS AND METHODS

We retrospectively searched and randomly selected from the hospital databases 378 patients who presented to the emergency department (ED) at "Sf. Spiridon" County Clinical Emergency Hospital, Iasi, Romania, between January 1, 2021, and August 31, 2024, with acute chest pain and undergone a chest MDCT. We reviewed all the reports and DICOM images of 191 non-enhanced chest CT (for evaluating lung lesions described on chest x rays) and 187 contrast-enhanced chest CT (to rule out mainly pulmonary embolism or a thoracic aortic dissection). The exclusion criteria from the study were: a recent traumatic history, a positive PCR test for COVID-19 or an acute myocardial infarction.

CT examinations were performed on a 16-slice Siemens Somatom Emotion CT scanner and a 64-slice Philips Incisive CT scanner using standard protocol settings. A non-contrast CT chest protocol was conducted on all patients. To rule out a life-threatening cause of acute chest pain, such as a pulmonary embolism or aortic dissection, the non-enhanced scan was followed by a contrast-enhanced CT with the administration of non-ionic iodinated contrast material (Iopromidum, Ultravist 370, 370 mg/mL, Bayer, Leverkusen, Germany).

Statistical analyses were conducted using *SPSS software for Mac version 29.0* (SPSS, Chicago, IL, USA). Continuous variables are provided as the mean ± standard deviation (SD), while nominal variables are shown as frequencies and percentages. There were six main categories for nominal variables: pleural and pulmonary findings, (non-coronary) cardiac findings, vascular findings, urgent findings, malignant findings, and other findings. To identify significant parameters in our population study, we used Pearson's chi-squared test (non-parametric analysis) for categorical variables. A p-value less than or equal to 0.05 was considered statistically significant.

RESULTS

Among the 378 patients, 222 were males (58.7%), and 156 females (41.3%), with a mean age of 73.8 years (SD 10.767, CI 72.55-75.06; range 35-94 years), and we discovered only 81 cases (21.42%) that needed immediate treatment (emergencies). We classified the non-emergency findings into four categories: pleuro-pulmonary lesions (51.48%) heart diseases (24.9%), vascular conditions (16.55%), malignant findings (6.97%). Most of the patients had several lesions present, and the most common findings were pleural effusion (n=156, 41.2%), valvular calcifications (n=84, 22.2%), cardiomegaly (n=73, 19.3%), pulmonary embolism (n=56, 14.8%).

Emergency findings. The most important discoveries were the emergency diagnostics, representing 21.42% (n=81),

the most frequent of all being pulmonary embolism, found on 14.8% of patients, followed by acute pulmonary edema (2.3%, n = 9), descending aorta dissection (0.7%, n = 3), and massive pleural effusion (0.7%, n = 3). These patients have been referred to specialists for immediate treatment.

In our study the localization of emboli was as following: in main pulmonary arteries (4.4%, n = 17), lobar (3.9%, n = 15), and segmental arteries (5%, n = 19), but the filling defects in subsegmental arteries are difficult to depict, probably that's why we detected them only in 5 cases (1.3%); nevertheless, subsegmental pulmonary embolism is not considered to be significant for the diagnosis (18,19). Pulmonary infarction was present in 2.1 cases (8%).

There was no significant gender association in either pulmonary embolism or pleural effusion, both having approximately equal distribution in both genders.

Pulmonary embolism was strongly correlated with pulmonary hypertension (dilated pulmonary trunk > 33 mm) ($p < 0.001$).

Pleural effusion often accompanies pulmonary embolism, due to the hemodynamic changes and increased pressure in the pulmonary circulation caused by emboli ($p<0.05$)

Patients presenting with acute pulmonary edema often had cardiomegaly, due to underlying heart conditions contributing to fluid accumulation in the lungs ($p<0.05$).

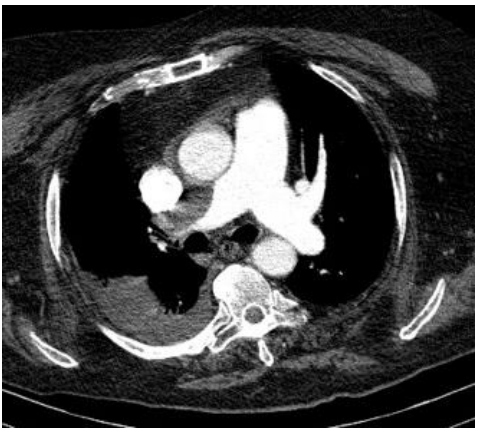

Fig. 1. CTPA-thrombus in the right pulmonary artery, enlarged main pulmonary artery, right pleural effusion, and adjacent lung collapse**.**

Descending aorta dissection was significantly correlated with hypertension ($p < 0.001$). There was a correlation between massive pleural effusion and underlying malignancies, such as bronchopulmonary cancer ($p= 0.04$).

Examining CT images, we depicted on the abdominal sections, beside chest emergencies, also some abdominal lesion worth mentioning (tab. I); for these diagnostics also an immediate treatment was done. These insights can be valuable for understanding the complexity of patient conditions and planning appropriate diagnostic and treatment strategies.

TABLE I.

Summary of emergency diagnostics

Emergencies	No. of patients=81	21.42%
Acute pulmonary embolism	56	14.81
Acute pulmonary edema	9	2.38
Descending aorta dissection	3	0.79
Mesenteric ischemia	3	0.79
Massive pleural effusion	3	0.79
Tension pneumothorax	3	0.79
Small bowel obstruction	2	0.52
Acute pancreatitis	2	0.52

Pleuro-pulmonary findings (tab. II) were found in 195 patients (51.58%) with multiple findings for each patient; the most common are the following: pleural effusion (41.2 %, n = 156), fibrotic bands (33 %, n = 125), non-calcified pulmonary nodules (18.2 %, n = 69), pulmonary emphysema (17.9 %, n = 68), and pulmonary tuberculosis sequelae (12.4 %, n = 47).

Pleural effusion (causing pleuritic chest pain, dyspnea, and a dry cough) (20) was the most common finding in our study (41.2%, n = 156), but only in three cases (0.7%) with massive pleural effusion an immediate treatment was necessary. The study found no significant correlation with gender (p=0.52), but there was a significant association between pleural effusion and pulmonary hypertension (pulmonary trunk > 33 mm), pericardial effusion, and cardiomegaly ($p < 0.001$).

Pulmonary emphysema is one of the most frequent lung conditions (21), depicted in our study in 68 cases (17.9%). Males are more likely to be affected ($p < 0.001$). Patients with pulmonary emphysema have also fibrotic bands ($p < 0.01$).

Non-calcified pulmonary nodules were found in 69 patients (18.2%). According to updated Fleischner Society Guidelines for managing incidental non-calcified pulmonary nodules; were divided by structure in two groups (solid and subsolid) and by dimension in three groups (< 6 mm, 6-8 mm and > 8 mm).

TABLE II.

Summary of pleuro-pulmonary findings

Pleuro-pulmonary findings	No. of findings	Frequency (%)
Pleural effusion	156	41.26
Fibrotic bands	125	33
Non-calcified pulmonary nodule	69	18.2
Pulmonary emphysema	68	17.9
Pleural and pulmonary tuberculosis sequelae	140	36.9
Bronchiectasis	34	8.9
Pneumonia and Bronchopneumonia	28	7.2
tuberculosis	4	1
Lung cancer	9	2.3
Pulmonary infarct	8	2.1
Pulmonary metastases	4	1

A single solid nodule < 6 mm was found in 8 patients (2.1%), with no CT follow-up recommended. A single solid nodule > 8 mm was found in 3 patients (0.7 %), with recommendation for chest CT follow-up after 3 months.

Multiple solid nodules < 6 mm were found in 15 patients (3.9%) (no follow-up was recommended) and with diameters of 6-8 mm in 37 patients (9.7 %) with a recommendation for a further chest CT after 6 months.

Calcified nodules were considered sequelae of tuberculosis, and they don't need follow-up. There was a male predominance associated with calcified pulmonary nodules ($p < 0.01$).

The correlation matrix of diagnosis reveals significant relationships between various diagnoses (fig. 2), highlighting the interconnected nature of pleuro-pulmonary, cardiac, vascular, and malignant conditions.

The study found that: pulmonary emphysema was highly correlated with cardiomegaly (0.96) and valvular calcification (0.88); lung cancer was moderately correlated with pulmonary emphysema (0.33); cardiomegaly was highly correlated with pulmonary emphysema (0.96) and valvular calcifications (0.80), moderately correlated with fibrosis (0.70) and pericardial effusion (0.58); pericardial effusion was highly correlated with dilated pulmonary trunk(0.89), moderately correlated with valvular calcification(0.64) and cardiomegaly (0.58); dilated pulmonary trunk was highly correlated with pericardial effusion 0.89), moderately correlated with pulmonary emphysema (0.74), dilated pulmonary trunk is highly correlated with pericardial effusion (0.89).

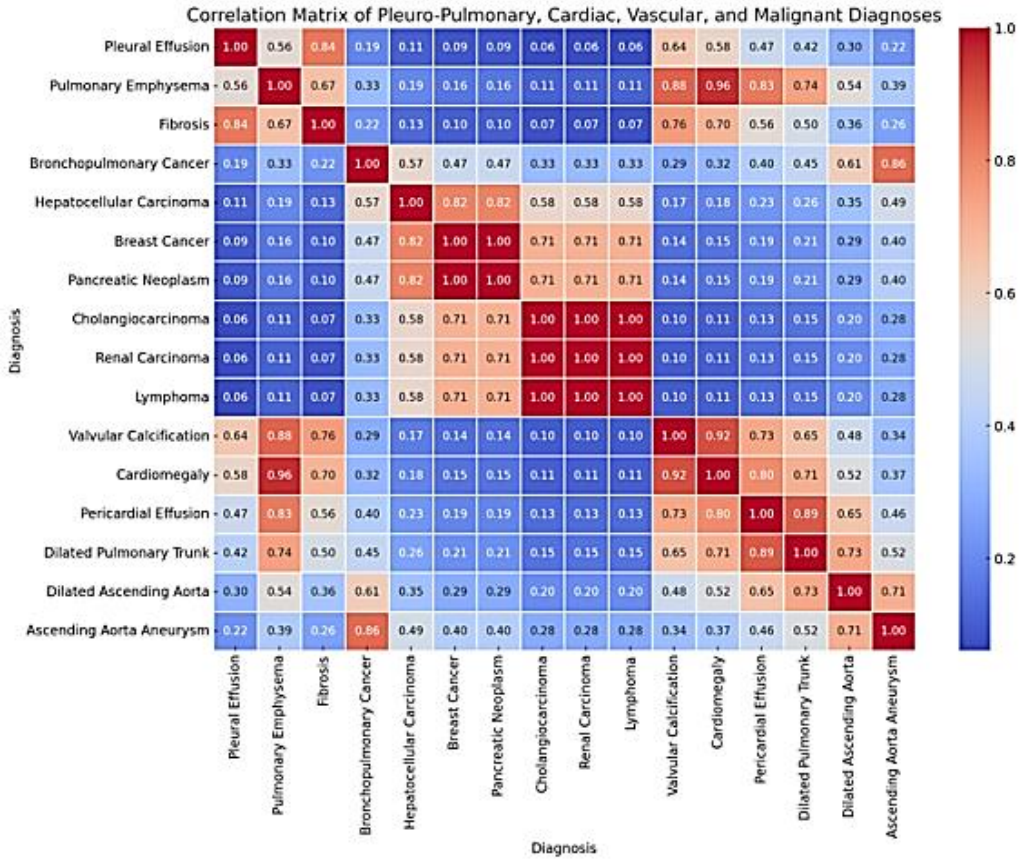

Fig. 2. Correlation matrix revealing significant relationships between various diagnoses

Heart diseases. We found heart diseases in 24.9% patients: valvular calcification (22.2%, n = 84 divided between aortic valve calcification 14.5%, n=55 and mitral valve calcification 7.6%, n = 29), cardiomegaly (19.3%, n=73), pericardial effusion (13.2%, n = 5), pericardial cyst (0.2%, n=1). 21 patients had cardiomegaly and pericardial effusion all together. Cardiomegaly was associated with female gender ($p < 0.05$).

Vascular findings (tab. III) were found in 16.55% of patients. In descending order, we found the fallowing: dilated pulmonary trunk > 33 mm (10.8 %, n=41), dilated ascending aorta > 40 mm (6 %, n=23), descending aorta dissection (0.7%, n=3), ascending aorta aneurism (3.1 %, n=12).

According to studies, main pulmonary artery has normally less than 33 mm. Above this level (with a sensitivity of 58% and a specificity of 95%), pulmonary arterial hypertension should be suspected. There was a significant association between pulmonary hypertension and acute pulmonary embolism, between pulmonary hypertension and pericardial effusion, and between pulmonary hypertension and cardiomegaly ($p < 0.05$).

TABLE III.
Summary of vascular findings

Vascular findings	No. of findings	%
Pulmonary trunk > 33 mm	41	10.8
Dilatation of the ascending aorta (40-50 mm)	23	6.0
Significant Superior mesenteric artery stenosis > 50 %	18	4.7
Ascending aorta aneurism (> 50 mm)	12	3.1
Significant Celiac trunk stenosis >50 %	7	1.8
Descending aorta dissection	3	0.7

Malignant lesions. Among chest malignant lesions (n=19, 6.97%), the most frequent primary tumor in both genders was lung cancer (2.3%, n = 9), followed by breast cancer (1.2%, n=2). Important incidental findings were depicted at the abdominal level and were reported within the limits of the performed protocol. Therefore, we discovered hepatocellular carcinoma (0.79%, n = 3), pancreatic cancer (0.53%, n = 2), cholangiocarcinoma, renal carcinoma, lymphoma (0.2%, n = 1 each). We depicted also secondary lesions with several localizations: liver (1.8%, n = 7), bones (1.5%, n = 6), lungs (1%, n = 4), adrenal glands (1%, n = 4), peritoneum (0.3%, n = 1). Patients with these incidental malignant findings were referred for an oncology consultation to establish disease management (20, 21, 22).

DISCUSSION

This retrospective study on non-traumatic, non-COVID-19-related CT findings in case of patients presenting with acute chest pain demonstrates the critical role of MDCT in diagnosing a wide array of conditions, differentiating the emergencies from non-emergency cases, and establishing an appropriate case management (23, 24).

The mean age in population study was 73.8 years, indicating a significant proportion of old patients. This demographic is particularly relevant because older individuals are more likely to present with multiple comorbidities and complex medical conditions, which can complicate the diagnosis and management of acute chest pain.

This study reveals that pleuropulmonary and vascular findings are prevalent, with pleural effusion and pulmonary embolism being particularly frequent.

Thoracic emergencies were found on only 21.4% of patients. The most frequent one was pulmonary embolism. There were no significant gender differences for most

conditions except pulmonary emphysema, which was more common in males ($p < 0.001$), and cardiomegaly, which was associated with females ($p < 0.05$).

Malignant tumors (25, 26) and cardiovascular disorders (27) were incidental findings which were depicted frequent enough among our patients and were referred for treatment in dedicated departments.

CONCLUSIONS

Given that we encountered mainly elder patients, our findings emphasize the importance of an accurate diagnostic and therapeutic approach in cases presented with chest acute pain in order to ensure rapid and correct identification of a potentially life-threatening condition.

This study is conducted on a limited number of patients, but it can fill a gap in the Romanian healthcare context by providing useful data about the diagnosis depicted by chest CT for patients with acute chest pain, which can be useful for local practitioners.

CONFLICT OF INTEREST AND FUNDING

The authors declare that there is no conflict of interest, and they received no specific funding regarding this scientific research.

REFERENCES

1. Bicci E, Grazzini G, Cozzi D, D *et al*. Non-traumatic non-cardiovascular thoracic emergencies: role of imaging. *Eur Rev Med Pharmacol Sci* 2022; 26: 3249-3260.
2. Pescatori LC, Brambati M, Messina C, *et al*. Clinical impact of computed tomography in the emergency department in nontraumatic chest and abdominal conditions. *Emerg Radiol* 2018; 25: 393-398.
3. Palumbo P, Cannizzaro E, Bracci A, *et al*. Thoracic non-traumatic cardiovascular diseases: current perspective and multi-detectors Computed Tomography protocols optimization in the emergency setting *Eur Rev Med Pharmacol Sci* 2022; 26: 3621-3641.
4. Cairns C, Kang K. *National Hospital Ambulatory Medical Care Survey*: 2019 Emergency Department Summary Tables, 2022.
5. Seidel J, Bissell MB, Vatturi S, Hartery A. Retrospective Analysis of Emergency Computed Tomography Imaging Utilization at an Academic Centre: An Analysis of Clinical Indications and Outcomes. *Canad Assoc Radiol J* 2019; 70(1): 13-22.
6. Kocher KE, Meurer WJ, Fazel R, Scott PA, Krumholz HM, Nallamothu BK. National trends in use of computed tomography in the emergency department. *Ann Emerg Med* 2011; 58(5): 452-462.
7. Morsbach F, Hinzpeter R, Higashigaito K, *et al*. Chest pain CT in the Emergency Department: evaluating the coronary arteries even when not specifically asked for? *Acta Radiol* 2018; 59(11): 1309-1315.
8. Fruergaard P, Launbjerg J, Hesse B, *et al.* The diagnoses of patients admitted with acute chest pain but without myocardial infarction. *Eur Heart J* 1996; 17(7): 1028-1034.
9. Magadan GJ, Hickham DH. Noncardiac causes of angina- like chest pain. *Progr Cardiovasc Dis* 1986; 29: 65-80.
10. Dandan OA, Hassan A, AbuAlola H, *et al*. Clinical and imaging profiles of pulmonary embolism: A single-institution experience. *Int J Emerg Med* 2020; 13: 47.
11. Henzler T, Barraza JM Jr., Nance JW Jr, *et al.* CT imaging of acute pulmonary embolism. *J Cardiovasc Comput Tomogr* 2011; 5: 3-11.

12. Wazzan MA, Abduljabbar A, *et al*. Trends in the utilization of computed tomography chest for acute pulmonary embolism in the emergency department and the yield in treatment. *Saudi J Health Sci* 2014; 13(1): 21-27.
13. Whiting P, Singatullina N, Rosser JH Computed tomography of the chest: I. Basic principles. *BJA Education* 2015; 15(6): 299-304.
14. Valente T, Rossi G, Lassandro F, *et al*. MDCT evaluation of acute aortic syndrome (AAS). *Br J Radiol* 2016; 89: 1061.
15. de Jong CMM, Kroft LJM, van Mens TE, Huisman MV, Stöger JL, Klok FA. Modern imaging of acute pulmonary embolism. *Throm Research* 2024; 238: 105-116.
16. Huisman M.V, Klok FA Diagnostic management of acute deep vein thrombosis and pulmonary embolism. *J Thromb Haemost* 2013; 11(3): 412-422.
17. Hesse B, Jørgensen F, Petri A, Eiken P, Aggestrup S, Elsborg L, Mellemgaard K. The diagnoses of patients admitted with acute chest pain but without myocardial infarction. *Eur Heart J* 1996; 7(7): 1028-1034.
18. Timpau AS, Miftode RS, Costache II, *et al*. An Overview of the Impact of Bacterial Infections and the Mortality Predictors in Patients with COVID-19 Admitted to a tertiary Center from Eastern Europe *Antibiot Chemother* 2023; 12 (1): 144.
19. Galesanu C, Buzduga C, Florescu A, Moisii L, Ciubotaru V. Diabetes mellitus, chronic complication in patients with acromegaly: case report and review of the literature. *Med Surg J-Rev Med Chir Soc Med Nat Iasi* 2015; 119(1): 92-96.
20. Ursaru M, Jari I, Gheorghe, Naum AG, Scripcariu V, Negru D. Bilateral breast cancer: diagnosis and prognosis. *Med Surg J-Rev Med Chir Soc Med Nat Iasi* 2016; 120(2): 316-320.
21. Manafu EG, Filimon RM, Jari I, *et al.* Clinical epidemiological study on the incidence of Escherichia coli infections in the cancer patients admitted to Surgery Department II of the Iasi Regional Oncology Institute. *Med Surg J-Rev Med Chir Soc Med Nat Iasi* 2018; 118(3): 796-800.
22. Jari I, Naum AG, Moisii LG, *et al*. Comparative Study by Analytical Multidisciplinary Methods and Oxidative Stress in Breast Cancer Diagnosis. *Rev Chim* 2018; 69(8): 2254-2259.
23. Gheorghe L, Jari I, Naum AG. Neuroendocrine tumors: Choosing the appropriate imaging methods. *Med Surg J-Rev Med Chir Soc Med Nat Iasi* 2018; 122(1): 16-22.
24. Jari I, Ursaru M, Naum AG, Gheorghe L, Moisii P, Negru D. Pancreatic cancer CT imaging: comparison with surgery *Med Surg J-Rev Med Chir Soc Med Nat Iasi* 2016; 120(2): 371-375.
25. Savin ML, Mihai F, Gheorghe L, *et al*. Proposal of a Preoperative CT-Based Score to Predict the Risk of Clinically Relevant Pancreatic Fistula after Cephalic Pancreatoduodenectomy. *Medicina Lithuania* 2021; 57(7): 650.
26. Volovat SR, Ursulescu-Lupascu CV, Gheorghe ML, *et al*. The landscape of nanovectors for modulation in cancer immunotherapy. *Pharmaceutics* 2022; 14(2): 397.
27. Moisii P, Jari I, Ursu AM, *et al*. The Relationship between Job Strain and Ischemic Heart Disease Mediated by Endothelial Dysfunction Markers and Imaging. *Medicina Lithuania* 2024; 60(7): 1048.