

COMPUTED TOMOGRAPHY *VERSUS* PCR TEST: EVALUATING THE DIAGNOSTIC PRECISION OF CHEST COMPUTED TOMOGRAPHY IN COVID-19 PATIENTS

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COMPUTED TOMOGRAPHY *VERSUS* PCR TEST: EVALUATING THE DIAGNOSTIC PRECISION OF CHEST COMPUTED TOMOGRAPHY IN COVID-19 PATIENTS (Abstract): The **aim** of the study is to analyze the lesions detected on chest computed-tomography in case of patients with suspicion of COVID-19 infection in comparison with RT-PCR (+), exploring the correlation between demographic factors and disease progression. **Materials and methods:** We retrospectively studied 830 patients suspected to have COVID-19 infection, who underwent computed tomography at “Sf. Spiridon” County Clinical Emergency Hospital, Iasi, Romania, from January to December 2021, and found 108 patients with lung lesions consistent with COVID-19 infection. We explored the correlation between demographic factors and disease progression, established CO -RADS classification and the correlation with PCR test. **Results:** Among 108 patients who had chest CT lesions consistent with COVID-19 infection, 92 patients had a positive RT-PCR test. Our study found a slight male predominance (54.63%), with moderate to severe cases more common among males, and an increased incidence in patients over 50, peaking in the 50-59 age group (33.33%). Severe cases being prevalent in the 60-69 age group (9.26%), suggesting a higher risk in these age ranges. Ground glass opacity was the most common CT finding (96.30%), while less common findings included pericardial effusion and halo signs (2.78%). A significant correlation was observed between CO-RADS classification and disease severity, with 53.70% of the most severe cases associated with CO-RADS 5. These findings suggest that CO-RADS classification helps also in assessing COVID-19 severity. **Conclusions:** Patients above 50 years old have a high risk of developing pulmonary lesions in case of COVID-19 infection; most of the patients with severe course were between 50 and 69 years old suggesting this age range is a risk factor. Ground glass appearance was the most common finding depicted on CT, seen in a majority of the cases, the other findings (pericardial effusion, halo sign and reversed halo sign) being less frequent. In our study the majority of the patients that had positive RT-PCR test, as well as severe disease, had also CO-RADS 5, which may suggest a positive correlation between the CO-RADS classification and the severity and the likelihood of having COVID-19 infection. **Keywords:** COVID-19, COMPUTED-TOMOGRAPHY, PULMONARY LESIONS, PCR.

Human coronavirus was first described in the 1960s (1). It was considered a causative agent for intestinal and upper respiratory tract infection both in animals and humans. However, before the outbreak of severe acute respiratory syndrome (SARS) in 2003 in China, it was not considered to be highly pathogenic to humans (2). Coronavirus belongs to the family of *Coronaviridae*, with the subfamily *Coronavirinae*. This member of the family is known to infect a broad range of hosts, resulting in a disease ranging from the common cold to severe and sometimes even fatal illnesses, such as SARS, MERS and, presently COVID-19(3).

This highly contagious infectious disease caused more than 2.9 million deaths worldwide until to April 2021, becoming the most consequential global health crisis in the world had since the influenza pandemic of 1918 (4). Beside the fact that COVID-19 primarily attacks the respiratory system causing cough, sputum production and shortness of breath (which remain the most common symptoms, followed by fever), it also can affect multiple other organs like the pancreas and induce pancreatic injury (producing acute pancreatitis) or even diabetes mellitus in due time (5, 6, 7).

CT scan aided in establishing the diagnosis and determining the severity of the disease, sometimes pulmonary lesions being visible even before the onset of symptoms. Studies found that ground-glass opacity is the most frequent finding on chest CT in COVID-19 infection, accounting for about 86% of the cases, consolidation (29%), mediastinal lymphadenopathy, nodules, cystic changes, and pleural effusion%; other characteristic pattern of the disease is the presence of bilateral lesions (76%), and mostly with a peripheral distribution (33%) (8,9,10).The evaluation of the

lesions and CO-RADS staging can be easier if an artificial intelligence program is used (11).

Most of the times associated diseases like the cardio-vascular conditions (appearing frequently after the age of fifty) and the malignant tumors (which are encountered at any age) aggravate all the symptoms, knowing that the immune system is correlated with infections as well as in cancer (12, 13), Patients with diabetes mellitus have an increased risk of developing infections (14,15,16,17,18). Even though they had no prior history of diabetes, some COVID-19 patients acquired insulin resistance and raised blood glucose levels (14, 16, 19).

MATERIALS AND METHODS

Our retrospective study included 830 patients suspected to have a COVID-19 infection because they presented weakness, fever, and a new cough, and underwent computed tomography at “Sf. Spiridon” County Clinical Emergency Hospital, Iasi, Romania, from January to December 2021. Among the analyzed patients, we discovered 108 with age ranges from 19 to 92 years who had on CT pulmonary lesions consistent with SARS-CoV-2 infection; 92 of them were confirmed to have COVID-19 by positive RT-PCR tests.

The patient's data, including the computed tomography images, were collected from the medical records of Sf. Spiridon, Iasi. The CT scan images were reviewed by a radiologist with over 20 years of experience in the field.

For all patients, we analyzed the following demographic characteristics and CT scan findings: gender, age, location, and pattern of the pulmonary lesions. We established a CO-RADS classification, quanti-

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fied the severity of the disease (mild, moderate, and severe) and correlated CT images with PCR test.

Computed tomography findings we considered included lung consolidation, ground glass appearance, halo sign, reversed halo sign, crazy paving, pleural effusion, and pericardial effusion.

The majority of the subjects (98) performed a non-enhanced chest CT, and therefore, no special preparation of the subjects was needed.

RESULTS

We evaluated 108 cases (average age 60.2 years), 59 males (54.63%) and 49 females (45.73%) who presented with chest CT lesions consistent with being determined by COVID-19 infection; among them, 92 patients had a positive RT-PCR test, 6 patients had a negative RT-PCR test, and 10 patients had no RT-PCR test documented (N/A). The patients in the study were divided into groups according to age and gender (tab. I).

TABLE I.
Prevalence of the disease correlated to age and gender

Age group	N	Fr (%)	Male	Fr (%)	Female	Fr (%)
19-29	1	0.93%	0	0.00%	1	0.93%
30-39	5	4.63%	3	2.78%	2	1.85%
40-49	14	12.96%	9	8.33%	5	4.63%
50-59	36	33.33%	20	18.52%	16	14.81%
60-69	25	23.15%	11	10.19%	14	12.96%
70-79	18	16.67%	10	9.26%	8	7.41%
80-89	8	7.41%	5	4.63%	3	2.78%
90-99	1	0.93%	1	0.93%	0	0.00%

RT-PCR results according to gender

Among the male patients, 48 patients (44.44%) had a positive RT-PCR test, 4 patients (3.70%) had a negative RT-PCR test, and 7 (6.48%) patients had no RT-PCR test documented. Among the female patients, 44 (40.74%) patients had a positive RT-PCR test, 2 (1.85%) patients had a negative RT-PCR test, and 3 patients (2.78%) had no RT-PCR test documented.

The disease severity according to the CT findings

The severity of the disease was assessed by examination of the chest CT images, evaluating the extension of pulmonary lesions. Accordingly, the patients were

divided into 3 groups of severity: mild (30%), moderate (60%), and severe (more than 60%). In some patients, the severity could not be assessed (N/A). 27 patients (25.00%) had mild disease, 29 patients (26.85%) had moderate disease, and 32 patients (29.63%) had severe disease. In 20 patients (18.52%), the severity could not be assessed (N/A). In table II, we summarized the relationship between disease severity and age.

The severity of the disease in relation to the gender of the patients

Analyzing the severity of the disease for each gender revealed that only in cases of mild severity did we encounter more fe-

males (M/F = 10/17 patients); instead, when counting the moderate and severe cases, there were more males involved (M/F = 35/26) (tab. III).

TABLE II.
Disease severity according to the age groups

Age group	Mild N	Mild %	Moderate N	Moderate %	Severe N	Severe %	N/A-N	N/A %
19-29	0	0.00%	0	0.00%	0	0.00%	1	0.93%
30-39	1	0.93%	1	0.93%	2	1.85%	1	0.93%
40-49	6	5.56%	4	3.70%	3	2.78%	1	0.93%
50-59	10	9.26%	12	11.11%	9	8.33%	5	4.63%
60-69	5	4.63%	6	5.56%	10	9.26%	4	3.70%
70-79	3	2.78%	5	4.63%	7	6.48%	3	2.78%
80-89	2	1.85%	0	0.00%	1	0.93%	5	4.63%
90-99	0	0.00%	1	0.93%	0	0.00%	0	0.00%

TABLE III.
Correlation between the severity of the disease and the gender of the patient

Severity	M (n)	Male %	F (n)	Female %
Mild	10	9.26%	17	15.74%
Moderate	17	15.74%	12	11.11%
Severe	18	16.67%	14	12.96%
N/A	14	12.96%	6	5.56%

The pattern of the disease

CT describes the pattern of the lung lesions (ground glass lesions, pulmonary consolidation, reversal halo sign, halo sign, crazy paving) and the associated lesions pleural, and pericardial spaces (pleural effusion, pericardial effusion). The dominant lesion found was the ground glass opacity, present in 104 patients' CT (96.30%), and the second lesion was consolidation (38 patients, 35.19%). Other lesions in descending order are pleural effusion (13 patients (12.04%)), crazy paving (6 patients (5.56%)), pericardial effusion, halo sign pattern, and reversal halo sign pattern, which were seen only in 3 patients for each of them (2.78%).

GGO being the dominant lesion seen on CT scans, all the other lesions found were combined with the ground glass appearance (fig. 1):

- 38 patients (35.19%) also had pulmonary consolidation, while the rest, 66 patients (61.11%), had no consolidation.
- 13 patients (12.04%) also had pleural effusion, while 91 patients (84.26%) with a ground glass appearance had no pleural effusion.
- 6 patients (5.56%) also had crazy paving, while 98 patients (90.74%) with a ground glass appearance had no crazy paving.
- 3 patients (2.78%) also had pericardial effusion, a reversed halo sign, and a halo

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sign, respectively, while 101 patients (93.52%) with a ground glass appearance did not have such lesions.



Fig. 1. Chest computed tomography: bilateral lung ground glass opacities

CO-RADS classification

The COVID-19 Reporting and Data

System (CO-RADS) is a computerized tomography (CT)-based system that assesses the suspicion of lung involvement in COVID-19 pneumonia patients. It should be noted that the confirmation of COVID-19 depends on an RT-PCR test. The CO-RADS classification provides a degree of suspicion for pulmonary involvement depending on the findings seen on a non-contrast enhanced chest CT. The grades range from very low (CO-RADS 1) to very high (CO-RADS 5). In addition, technically insufficient examination is stated as CO-RADS 0, and RT-PCR-proven SARS-CoV-2 infection is stated as CO-RADS 6.

In our study, applying the patients' CO-RADS classification revealed results ranging from CO-RADS 1 to CO-RADS 5. Most of them (58 patients, or 53.70%) had chest CT findings correlated with CO-RADS 5 (fig. 2).

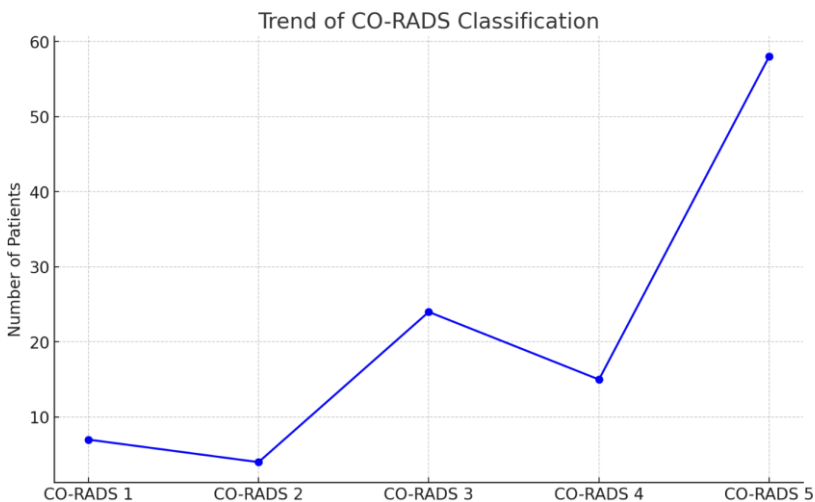


Fig. 2. Line chart illustrates the trend of patient numbers across different CO-RADS classifications

All the patients with CO-RADS 1 and CO-RADS 2 had positive RT-PCR tests.

Most of the patients with CO-RADS 3, 4, and 5 had positive RT-PCR tests (23 pa-

tients, 16 patients, and 53 patients, respectively). One patient with CO-RADS 3, one from the group of CO-RADS 4, and six patients with CO-RADS 5 had a negative RT-PCR test. The correlation between CO-RADS score and RT-PCR test results are summarized in tab. IV.

The correlation between CO-RADS score and the severity of the disease

Among the 58 patients with a CO-RADS score of 5, 11 patients (10.19%) had mild disease, 19 patients (17.59%) had moderate disease, and 28 patients (25.93%) had severe disease (tab. V).

TABLE IV.

Summarize CO-RADS score in correlation with the RT-PCR test results

CO-RADS score	n	Freq (%)	Positive RT-PCR	Freq (%)	Negative RT-PCR	Freq (%)	Without RT-PCR test	Freq (%)
1	7	6.48%	2	1.85%	0	0.00%	5	4.63%
2	4	3.70%	2	1.85%	0	0.00%	2	1.85%
3	24	22.22%	19	17.59%	2	1.85%	3	2.78%
4	15	13.89%	14	12.96%	1	0.93%	0	0.00%
5	58	53.70%	55	50.93%	3	2.78%	0	0.00%

TABLE V.

CO-RADS score in correlation with the severity of the disease

CO-RADS score	1	2	3	4	5
N	7	4	24	15	58
Freq (%)	6.48%	3.70%	22.22%	13.89%	53.70%
Mild disease	0	0	10	6	11
Freq (%)	0%	0%	9.26%	5.56%	10.19%
Moderate disease	0	0	3	7	19
Freq (%)	0%	0%	2.78%	6.48%	17.59%
Severe disease	0	0	2	2	28
Freq (%)	0%	0%	1.85%	1.85%	25.93%
N/A	7	4	9	0	0
Freq (%)	6.48%	3.70%	8.33 %	0%	0%

DISCUSSION

The patients' age appears to play an important role, with a clear peak in the age group 50-59, which included 36(33.33%) patients. Studying the relationship between age and the severity of the disease shows that the majority of patients with severe disease are between 50 and 79 years old

(26 patients from a total of 32 patients with severe disease), with only 1 patient with severe disease above 80 years old and 4 patients below 50 years old. The age groups 30-39, 50-59, and 70-79 included patients with the three levels of severity, and the distribution of the patients between the levels of severity was almost equal

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without a predominant course. While the age group 40-49 had a peak of mild course, the age group 70-79 had a peak of severe course.

The study found a slight male predominance (54.63%), with moderate to severe cases more common among males, whom according to previous studies are considered a risk group. With regard to the severity of the disease in relation to gender, there is a little increase in the severe and moderate cases among the male gender, with 18 male patients (16.67%) versus 14 female patients (12.96%) in the severe course and 17 male patients versus 12 female patients in the moderate course. Furthermore, in the mild course, there is a small peak in the female gender when compared to the male gender, with 17 female patients, representing 15.74% of the total patients, and 10 male patients, representing 9.26% of the total patients.

Evaluating CT scan images in order to determine diseases' severity, we didn't depict notable differences among the three categories: mild, moderate, and severe disease, which represented 27 (25%), 29 (26.85%), and 32 patients (29.63%), respectively, but we also had 20 (18.52%), for whom the severity could not be assessed.

GGO was the most dominant lesion involving the lungs, appearing in 104 patients out of the total 108 patients. The second dominant lesion is pulmonary consolidation, which appears in 38 patients. Next was pleural effusion, seen in 13 patients; a crazy paving pattern was seen in 6 patients; while the other lesions - pericardial effusion, reversal halo sign, and halo sign-were seen in only 3 patients each.

Most of the patients had CO-RADS 5, accounting for 58 (53.7%) from the total 108 patients. The majority of the patients

with CO-RADS 5 had positive RT-PCR tests and are 55 in number out of a total of 92 patients with positive RT-PCR tests.

CONCLUSIONS

COVID-19 infection has a slight prevalence among the male gender, most of the patients with moderate and severe courses are males, while the majority of the patients with mild courses are female.

There is a higher incidence in patients above 50 years, and a severe disease appeared above 60 years old, confirming that these age ranges are a risk factor.

Ground glass appearance was the most common finding seen in the CT scan of these patients, seen in a majority of the cases. Less common findings were pericardial effusion, the halo sign, and the reversed halo sign. Our findings show that the majority of the patients who had positive RT-PCR tests as well as severe disease also had CO-RADS 5, which may suggest a positive correlation between the CO-RADS classification, disease severity, and likelihood of having a COVID-19 infection.

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

ADDITIONAL INFORMATION

Patient consent was obtained for presenting this case in a medical publication to contribute to the expansion of the database on this pathology.

The ethics committee of the medical unit has approved the presentation of the case in a medical article in a medical publication while respecting personal data.

Financial relationships: All authors

Other information: All authors have declared that there are no other relationships or activities that have influenced the appearance of the published work.

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