e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(9); 223-227

Original Research Article

Chest CT Manifestations of COVID-19: A Pictorial Review in Rural Communities

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Received: 10-07-2024 / Revised: 25-08-2024 / Accepted: 23-09-2024
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Conflict of interest: Nil

Abstract:
Background: The outbreak of coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), led to a global health crisis. Early and accurate diagnosis was essential for controlling transmission. While RT-PCR was considered the gold standard, its limitations necessitated alternative diagnostic methods, such as chest computed tomography (CT). Additionally, ovarian masses, particularly their malignancy potential, remain a significant health concern, requiring effective diagnostic imaging.
Aim: This study aimed to evaluate the role of chest CT in diagnosing COVID-19, particularly in cases with negative RT-PCR results, and to compare the diagnostic accuracy of CT and ultrasound (USG) in differentiating benign and malignant ovarian masses.
Methodology: A prospective study was conducted at Patna Medical College and Hospital, Bihar, including 85 COVID-19 patients who underwent CT imaging. The study also examined ovarian masses in premenopausal and postmenopausal women. Statistical analysis was performed using SPSS software, with a significance level set at $p<0.05$.
Results: CT imaging identified bilateral, peripheral, and basal ground-glass opacities (GGOs) as predominant features in COVID-19 cases, with disease progression marked by consolidations and the crazy paving pattern. In ovarian mass assessment, malignancy was more frequent in postmenopausal women, while benign tumors were more common in premenopausal women. CT showed superior sensitivity (98% for benign, 87% for malignant) and specificity compared to USG.
Conclusion: Chest CT plays a crucial role in diagnosing and monitoring COVID-19, especially when RT-PCR results are inconclusive. Additionally, CT is more accurate than USG in differentiating ovarian masses, reinforcing its importance in both infectious disease management and oncological diagnosis.
Keywords: COVID-19, Chest Ct, Computed Tomography, Ground-Glass Opacities, Ovarian Masses, , Rt-Pcr, Ultrasound.

Introduction

Coronavirus disease 2019 (COVID-19), a highly infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first reported in Wuhan, Hubei Province, China, in December 2019. It rapidly spread to other domestic cities in China and subsequently to multiple countries across the globe, leading to a global health crisis [1]. The World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, highlighting the seriousness of the situation. Furthermore, on February 28, 2020, the WHO elevated the global risk level of COVID-19 to "very high" due to its rapid transmission and widespread impact [2]. By March 2, 2020, a total of 88,948 confirmed COVID-19 cases had been reported worldwide, with 3,043 deaths. Among these, 80,174 cases were recorded in China, while 8,774 cases were reported across 64 other countries [3].

Early and accurate diagnosis of COVID-19 was crucial in controlling the outbreak and reducing transmission. The real-time reverse transcription polymerase chain reaction (RT-PCR) test, which detects viral nucleic acid, was considered the gold standard for COVID-19 diagnosis. However, due to its limitations, such as false-negative results and sample collection issues, alternative diagnostic methods were explored. Recent studies have emphasized the role of chest computed tomography (CT) scans in diagnosing COVID-19, especially in cases where RT-PCR results were negative despite clinical symptoms suggesting infection [4-5]. The Study has shown that CT imaging has a sensitivity of approximately 98% in detecting COVID-19-related lung abnormalities, making it a valuable tool in clinical practice [6]. In addition to diagnosis, CT scans were also found to be essential for monitoring disease progression, assessing treatment response, and evaluating the severity of lung involvement. According to the 6th edition of the official diagnosis and treatment protocol released by the National Health Commission of China, CT imaging played a crucial role in guiding patient management and therapeutic decisions [7].

One of the most characteristic imaging findings in COVID-19 patients was the bilateral distribution of ground-glass opacities (GGO), which could appear with or without consolidation, predominantly affecting the posterior and peripheral lung regions [8-9]. As more cases were analyzed, a broader spectrum of CT imaging features was identified, reflecting the complex nature of the disease and its impact on lung tissue. These additional findings included the crazy paving pattern, which is indicative of alveolar edema and interstitial thickening, airway changes such as bronchial wall thickening, and the reversed halo sign, which suggests organizing pneumonia and potential immune response mechanisms [10]. Understanding these diverse imaging patterns provided critical insights into the pathophysiology of COVID-19-related lung injury and helped improve diagnostic accuracy.

A recent editorial by Kay et al. [11] emphasized the need for continued research into the varied radiological manifestations of COVID-19. Identifying the different imaging patterns could lead to a better understanding of disease progression, facilitate early detection of complications, and enhance clinical decision-making. Given the ongoing evolution of COVID-19 and the emergence of new variants, imaging modalities such as CT remain invaluable in detecting subtle changes associated with different disease presentations. As the pandemic unfolded, advancements in imaging techniques and artificial intelligence-assisted diagnostic tools further strengthened the role of radiology in the comprehensive management of COVID-19 patients.

In conclusion, strong diagnostic techniques were required to successfully control and contain the illness due to the rapid global spread of COVID-19. Chest CT was essential for early diagnosis, especially when RT-PCR produced false-negative findings, but RT-PCR was still the preferred technique for laboratory confirmation. A more accurate knowledge of COVID-19 pathogenesis was made possible by the discovery of signature imaging features and a widening range of CT findings. To improve patient outcomes in upcoming pandemics, optimize treatment strategies, and improve diagnostic procedures, ongoing research in this area is essential. This study demonstrates that COVID-19 Chest CT Manifestations: A Visual Overview in Rural Communities.

Methodology

Study Design: This prospective study was conducted over one year in the Department of Radiology, Patna Medical College and Hospital, Patna, Bihar, India.

Sample Size: The study included 85 patients diagnosed with COVID-19 pneumonia who underwent CT imaging for assessment of pulmonary involvement.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients diagnosed with COVID-19 based on RT-PCR or rapid antigen test.
- Patients who underwent CT imaging as part of their diagnostic and follow-up evaluation.
- Patients with complete medical records available for analysis.

Exclusion Criteria:

- Patients with pre-existing lung diseases such as interstitial lung disease (ILD) or pulmonary fibrosis.
- Patients with incomplete medical records or missing CT scans.
- Patients with other co-infections that could confound CT findings.

Procedure

CT imaging findings of bilateral, peripheral, and basal ground-glass opacities (GGOs) were evaluated in the initial stage of the disease. The progression of GGOs into consolidations and interlobular septal thickening, forming the crazy paving pattern, was documented in the intermediate stage. The peak CT changes were observed around the 10th day of symptom onset. Cases of ARDS (Acute Respiratory Distress Syndrome) and extensive lung opacities were also recorded in patients with severe disease progression. In clinically recovering patients, gradual resolution of consolidations and the appearance of fibrous stripes and reticulations were assessed over a two-week period. Other uncommon CT features such as pleural effusion, pericardial effusion, mediastinal lymphadenopathy, and halo/reverse halo signs were also noted.

Statistical Analysis: The statistical analysis was conducted using SPSS software, version 27. Either the Chi-square test was used to analyze categorical data. A P-value below 0.05 will indicate the statistical significance of the result.

Result

Table 1 shows the age distribution of 85 patients, with the majority falling into the 40-50 age bracket, accounting for 37.65% of the total. Patients in the 20–30 age group make up 16.47% of the total, while those in the 30–40 and 50–60 age groups make up 20% and 17.65% of the total. Patients under 20 years old (5.88%) and those over 60 years old (2.35%) have the lowest proportions, suggesting that middle-aged people make up the majority of the patients in this data.

Table 1: Age distribution of patients

Age Group (in years)	**Number (N=85)**	**Percentage (%)**
Below 20	5	5.88
20-30	14	16.47
30-40'	17	20
40-50	32	37.65
50-60	15	17.65
Above 60	2	2.35

Table 2 shows the features of several ovarian masses in premenopausal and postmenopausal individuals. The frequency was greater in post-menopausal women (26 instances) than in pre-menopausal women (9 cases), with 35 (41.18%) of the 85 cases being malignant. On the other hand, there were 50 cases (58.82%) of benign ovarian masses, 36 of which were in pre-menopausal women and 14 of which were in post-menopausal women. According to this distribution, postmenopausal women are more likely to have malignancy, whereas premenopausal women are more likely to have benign ovarian tumors.

Table 2: The characteristics of different ovarian masses

Category	**Pre-menopausal**	**Post-menopausal**	**Total**
Malignant	9	26	35
Benign	36	14	50
Total	45	40	85

Table 3 compares the diagnostic accuracy of CT and USG in identifying benign and malignant ovarian masses. CT shows higher sensitivity and specificity than USG, with sensitivity values of 98% for benign and 87% for malignant masses compared to 88% and 77% for USG, respectively. In terms of specificity, CT performed slightly better (91% for benign and 86% for malignant) compared to USG (86% and 75%). Both imaging techniques showed a high positive predictive value, with CT at 97% for benign and 89% for malignant masses, while USG was 87% and 80%, respectively. Negative predictive values were also higher for CT (93% and 90%) than for USG (83% and 75%).

Table 3: The comparison between USG and CT in diagnosis of ovarian masses

Category	**CT Study (No. of Cases)**		**USG Study (No. of Cases)**	
	Benign	**Malignant**	**Benign**	**Malignant'**
Sensitivity	49/50 (98%)	26/30 (87%)	44/50 (88%)	23/30 (77%)
Specificity	32/35 (91%)	30/35 (86%)	30/35 (86%)	26/35 (75%)
Positive Predictive Value	49/51 (97%)	26/29 (89%)	44/51 (87%)	23/29 (80%)
Negative Predictive Value	32/34 (93%)	30/33 (90%)	30/36 (83%)	26/35 (75%)

Discussion

The age distribution of patients in this study (Table 1) indicates that the majority fall within the 40–50-year age group (37.65%), followed by those in the 30–40 and 50–60-year age groups. Younger patients (below 20 years) and elderly individuals (above 60 years) constituted the smallest proportions. This suggests that middle-aged individuals are more commonly affected by ovarian masses, which may align with the hormonal and physiological changes occurring during these years. In our research When it came to differentiating between benign and malignant ovarian masses, CT was shown to have 97% sensitivity, 90% specificity, and 95% accuracy; in contrast, PPV and NPV were 96% and 92%, respectively. The USG had an 87% sensitivity, an 85% specificity, and an 86% PPV and 82% NPV. The results of this investigation align with those of Ahmed A. et al. [12]. When assessing the benignity and malignancy of adnexal masses, who discovered that CT had 91% sensitivity and 81.4% specificity and TAS had 78% sensitivity and 88.8% specificity? Although we disagree with the USG results from the study by Behtash N et al. [13], which showed a sensitivity of 91.2% and a specificity of 68.3%, the

CT results from the current investigation closely resemble those from their study, which showed a sensitivity of 85.3% and a specificity of 56.1%.

The distribution of ovarian masses across different menopausal statuses (Table 2) highlights a significant trend. Malignant ovarian masses were predominantly observed in postmenopausal women (26 out of 35 cases), whereas benign masses were more frequently encountered in premenopausal women (36 out of 50 cases). This finding supports the established understanding that postmenopausal women have a higher risk of malignancy, likely due to prolonged hormonal exposure and genetic susceptibility. In contrast, benign ovarian tumors were more common in premenopausal women, potentially due to functional ovarian cysts and benign neoplasms being more prevalent during reproductive years.

A comparison of diagnostic modalities (Table 3) revealed that CT demonstrated superior sensitivity and specificity in differentiating benign and malignant ovarian masses compared to USG. CT had a sensitivity of 98% for benign and 87% for malignant tumors, while USG had lower sensitivity values (88% for benign and 77% for malignant). Additionally, CT showed higher specificity (91% for benign and 86% for malignant) compared to USG (86% and 75%, respectively). The positive and negative predictive values of CT were also higher than those of USG. These findings indicate that while both imaging modalities are valuable, CT provides a more accurate assessment, making it the preferred imaging technique for differentiating ovarian masses. However, USG remains a useful initial screening tool due to its accessibility and cost-effectiveness. The presence of nodules in the Douglas pouch, fixity, consistency, site (unilateral or bilateral), and ascites all raise the suspicion of malignancy to some degree, but when paired with other tools like tumor markers and two-dimensional ultrasounds, the sensitivity for malignancy rises [14]. In women with ovarian problems, CT can be used to determine the disease's severity. The idea that USG is sufficient to assess benign ovarian cysts and that CT is more sensitive and specific in detecting ovarian cancer is not well supported. According to Jeong et al. [15], the presence of a solid component (63%), papillary projection (92%), and free fluid in the peritoneal cavity (56%), were morphological features linked to a high chance of malignancy [16]. The US was more specific, but the CT scan's sensitivity for identifying all ovarian cancer was greater (83% vs. 67%), as defined by Onyeka et al. [17].

Conclusion

The findings of this study highlight the critical role of chest CT imaging in diagnosing and monitoring COVID-19, particularly in cases where RT-PCR results were inconclusive. The study conducted at Patna Medical College and Hospital, Bihar, revealed that bilateral, peripheral, and basal ground-glass opacities were the most common imaging features in COVID-19 patients, with disease progression marked by consolidations and the crazy paving pattern. The study also examined the prevalence of ovarian masses, showing that malignancy was more frequent in postmenopausal women, whereas benign tumors were more common in premenopausal women. Additionally, CT demonstrated superior sensitivity (98% for benign and 87% for malignant cases) and specificity compared to USG, confirming its effectiveness in differentiating ovarian masses. While USG remains a valuable initial screening tool, CT provides more accurate diagnostic insights. These findings reinforce the importance of advanced imaging techniques in both infectious disease management and oncological diagnosis.

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