

# OPTIMIZATION OF DIAGNOSTIC AND DIFFERENTIAL DIAGNOSTIC STRATEGIES FOR COVID-19 AND COMMUNITY-ACQUIRED PNEUMONIA USING LOW-DOSE AND STANDARD CHEST COMPUTED TOMOGRAPHY

Authors

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## Abstract

**Background:** Since the emergence of coronavirus disease 2019 (COVID-19), caused by SARS-CoV-2, chest computed tomography (CT) has played a central role in detecting pulmonary involvement and guiding clinical decision-making. However, repeated imaging raises concerns regarding cumulative radiation exposure.

**Objective:** To evaluate the diagnostic performance of low-dose CT (LDCT) compared with standard-dose CT (SDCT) in differentiating COVID-19 pneumonia from community-acquired pneumonia (CAP), and to assess the feasibility of LDCT as a primary imaging modality in clinical practice.

**Methods:** A retrospective cohort study included 180 adult patients: 100 with RT-PCR–confirmed COVID-19 and 80 with clinically and microbiologically confirmed CAP. All patients underwent either LDCT or SDCT according to institutional protocols. Imaging findings were evaluated by two blinded thoracic radiologists. Sensitivity, specificity, interobserver agreement, and radiation dose parameters were analyzed.

**Results:** LDCT demonstrated a sensitivity of 93.4% and specificity of 89.1% for COVID-19 detection, compared to 96.2% and 91.4% for SDCT ( $p > 0.05$ ). The mean effective dose was  $1.7 \pm 0.5$  mSv for LDCT versus  $6.2 \pm 1.3$  mSv for SDCT ( $p < 0.001$ ). Typical CT findings of COVID-19 included bilateral peripheral ground-glass opacities (82%), crazy paving (60%), and vascular enlargement (48%). CAP more frequently showed lobar consolidation (76%), air bronchograms (71%), and pleural effusion (35%).

**Conclusion:** LDCT provides comparable diagnostic accuracy to SDCT while significantly reducing radiation exposure. It may be recommended as a first-line imaging modality for diagnosis and follow-up of viral pneumonia during pandemics.

**Keywords:** COVID-19; community-acquired pneumonia; low-dose CT; standard-dose CT; radiation dose; differential diagnosis.

## Introduction

The global spread of COVID-19, declared a pandemic by the World Health Organization in March 2020, significantly impacted diagnostic imaging strategies worldwide. While RT-PCR remains the reference standard for laboratory confirmation, imaging plays a critical complementary role, particularly in symptomatic patients with false-negative molecular testing.

Chest CT rapidly became an essential tool for:

Early detection of pulmonary involvement

Assessment of disease severity

Monitoring progression or complications

Differential diagnosis from other infectious pneumonias

Community-acquired pneumonia (CAP) remains one of the leading causes of morbidity and mortality globally. Differentiating viral pneumonia caused by SARS-CoV-2 from bacterial CAP is clinically important because management strategies differ substantially.

However, repeated CT examinations raise concerns about cumulative radiation exposure, particularly in young patients and those requiring serial monitoring. Low-dose CT (LDCT) protocols, widely used in lung cancer screening, have been proposed as a safer alternative for infectious disease imaging.

This study aims to comprehensively evaluate the diagnostic performance, radiation safety, and clinical applicability of LDCT compared to standard-dose CT (SDCT) in differentiating COVID-19 from CAP.

## **Materials and Methods**

### **Study Design**

This retrospective study was approved by the institutional ethics committee. Informed consent was waived due to anonymized data analysis.

### **Patient Population**

Between January 2022 and March 2024, 180 adult patients (age range: 19–82 years) were included:

100 patients with RT-PCR confirmed COVID-19

80 patients with confirmed community-acquired bacterial pneumonia

Exclusion criteria:

Chronic interstitial lung disease

Active pulmonary malignancy

Severe motion artifacts

### **CT Acquisition Protocols**

#### **Low-Dose CT (LDCT)**

Tube voltage: 100–120 kVp

Tube current: 30–70 mAs

Automatic exposure control

Iterative reconstruction algorithm

Slice thickness: 1–1.5 mm

Effective dose: 1–2 mSv

#### **Standard-Dose CT (SDCT)**

Tube voltage: 120 kVp

Tube current: 150–250 mAs

Filtered back projection reconstruction

Slice thickness: 1 mm

Effective dose: 5–7 mSv

Dose-length product (DLP) and effective dose were recorded for each examination.

### **Image Analysis**

Two board-certified thoracic radiologists (10 and 15 years of experience) independently evaluated CT images, blinded to clinical diagnosis.

### **Assessed Imaging Features:**

Ground-glass opacities (GGO)

Consolidation

Crazy paving pattern

Air bronchogram

Pleural effusion

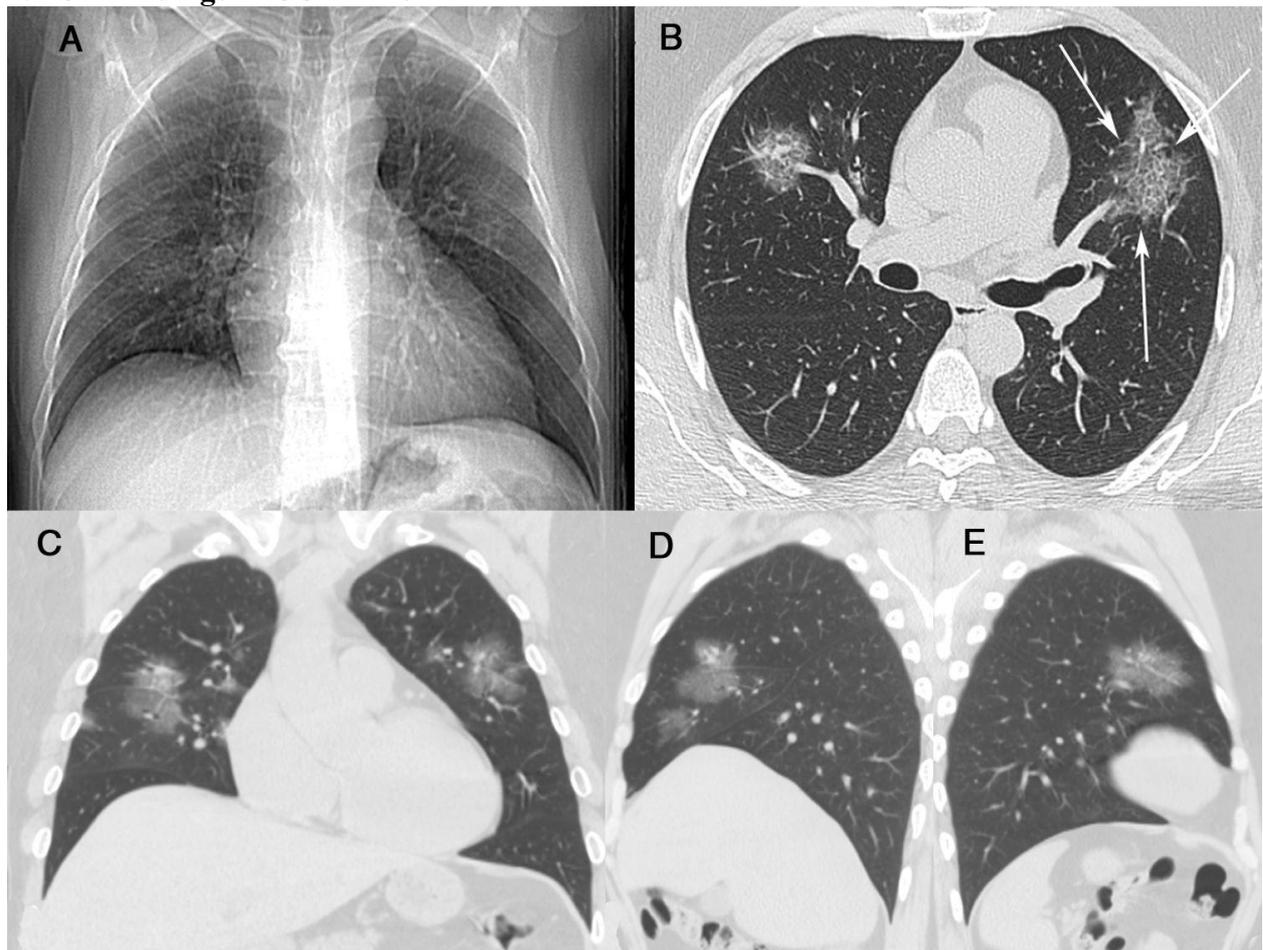
Lymphadenopathy

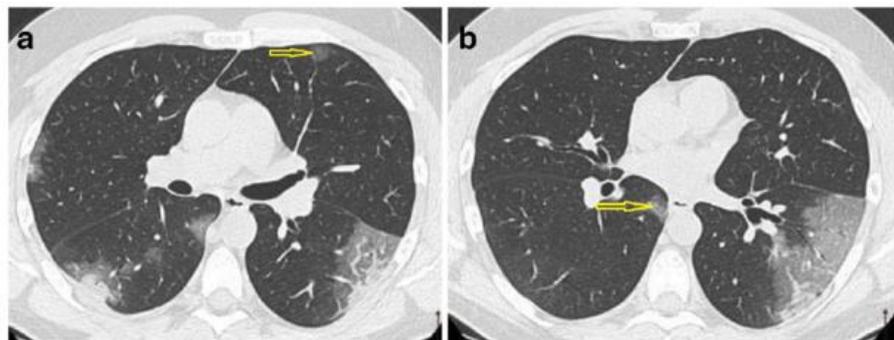
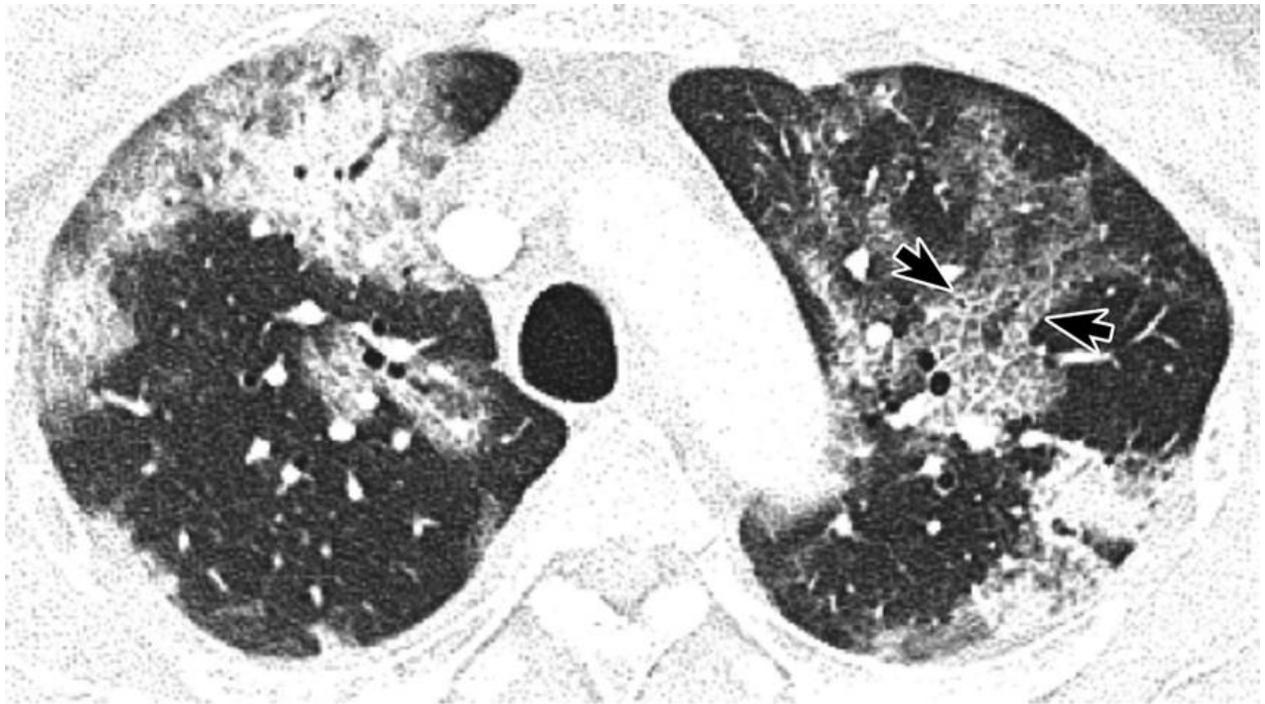
Distribution (peripheral vs central)

Laterality (unilateral vs bilateral) Discrepancies were resolved by consensus.

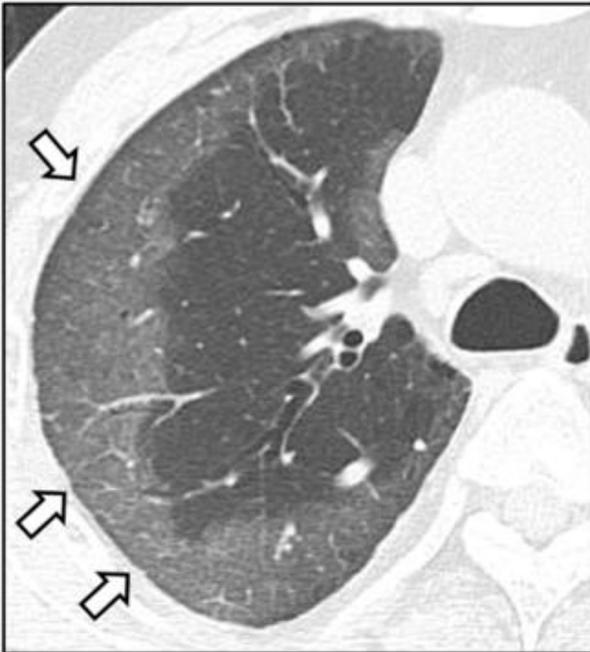
## Results

### 4.1 CT Findings in COVID-19

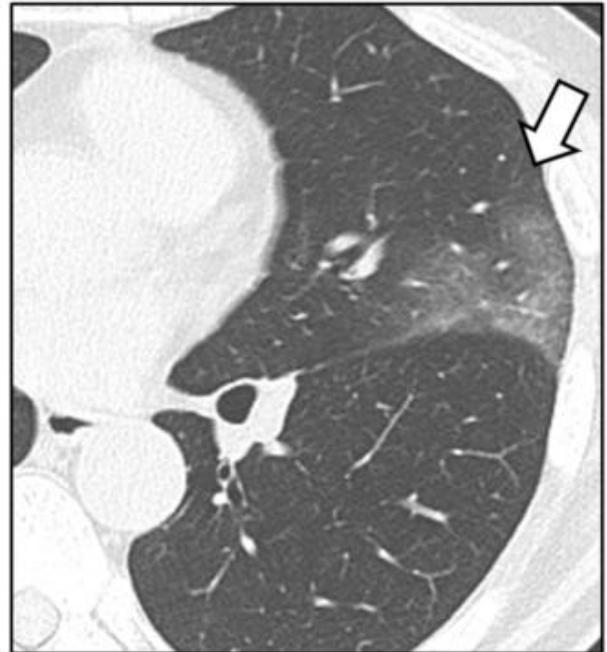




**(a) extended GGOs**



**(b) segmental GGOs**



**(c) extended OP-like**



**(d) segmental OP-like**



Common findings:

Bilateral GGO: 82%

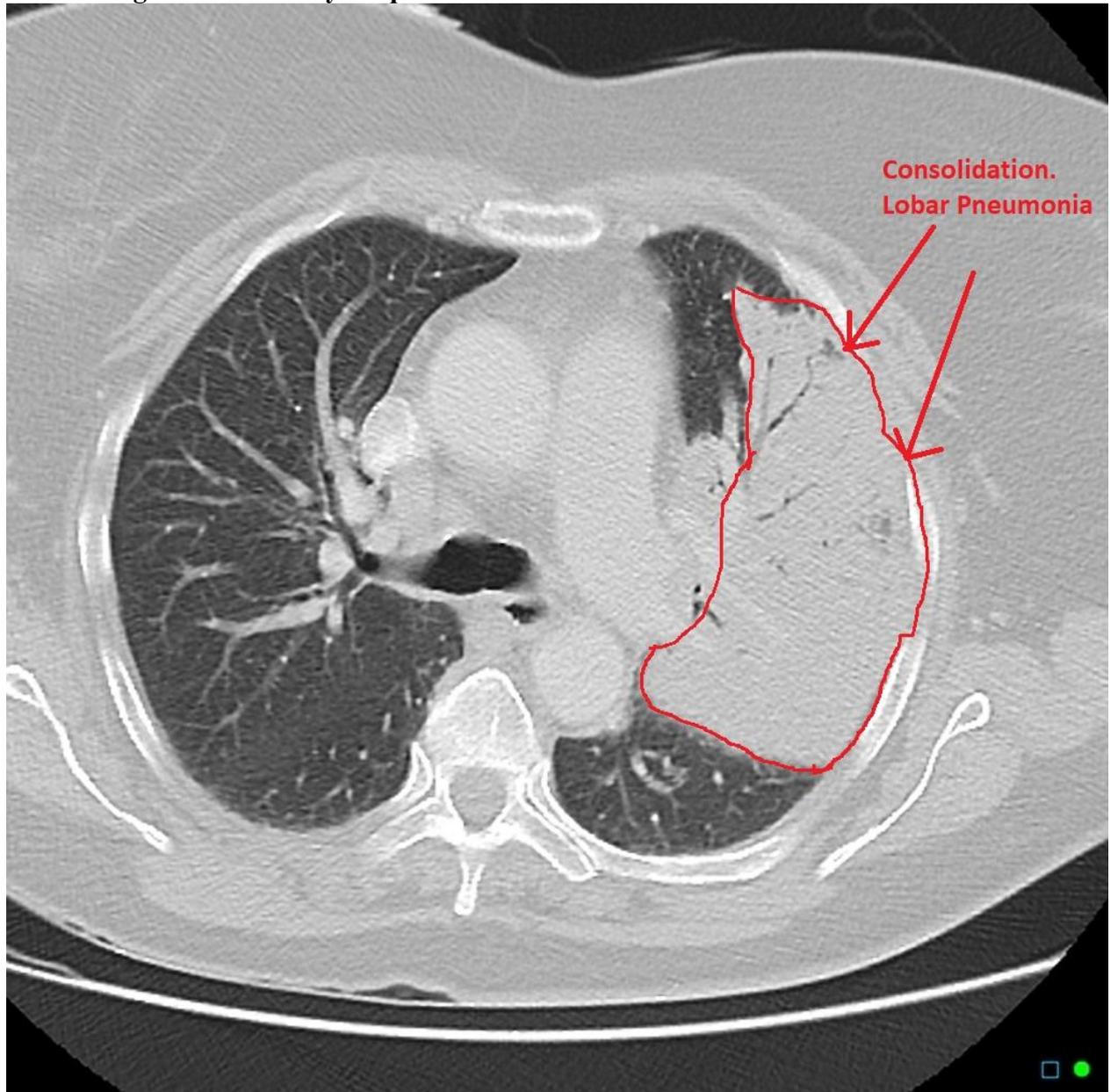
Peripheral distribution: 79%

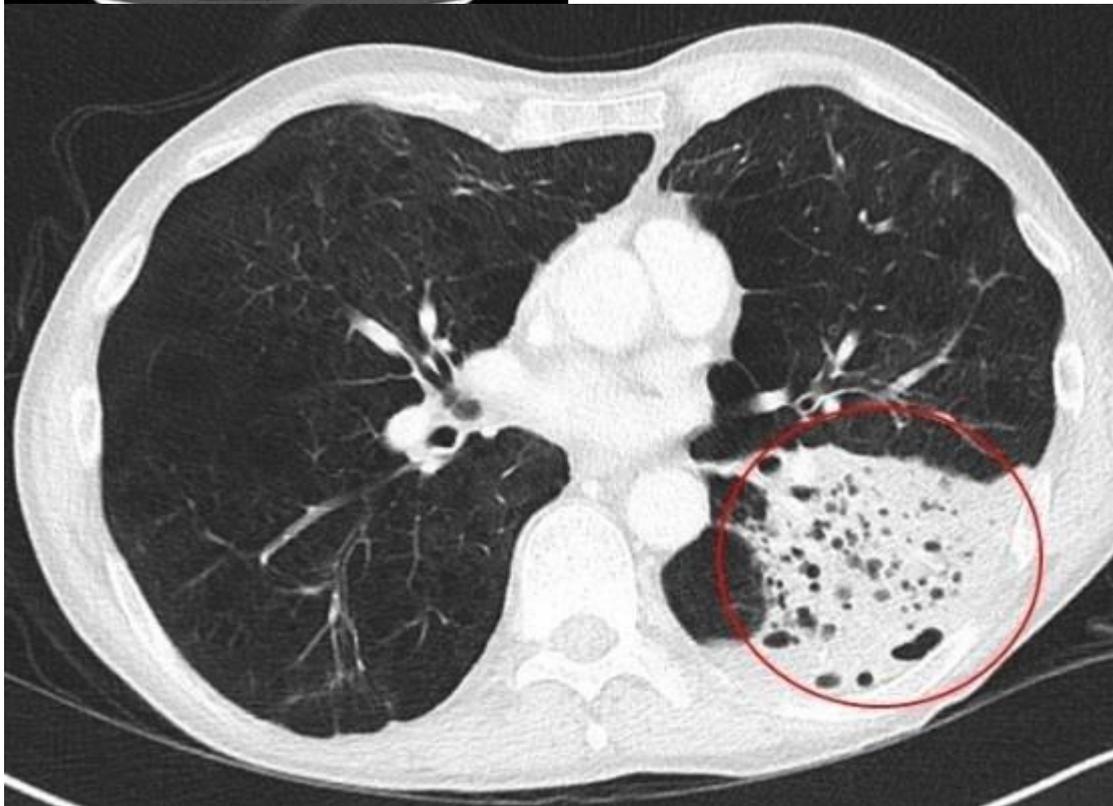
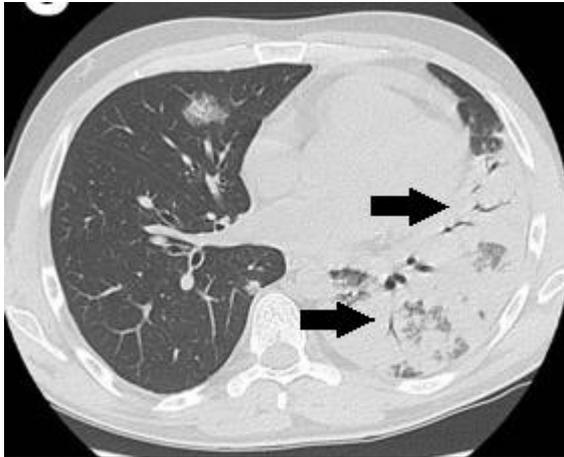
Crazy paving: 60%

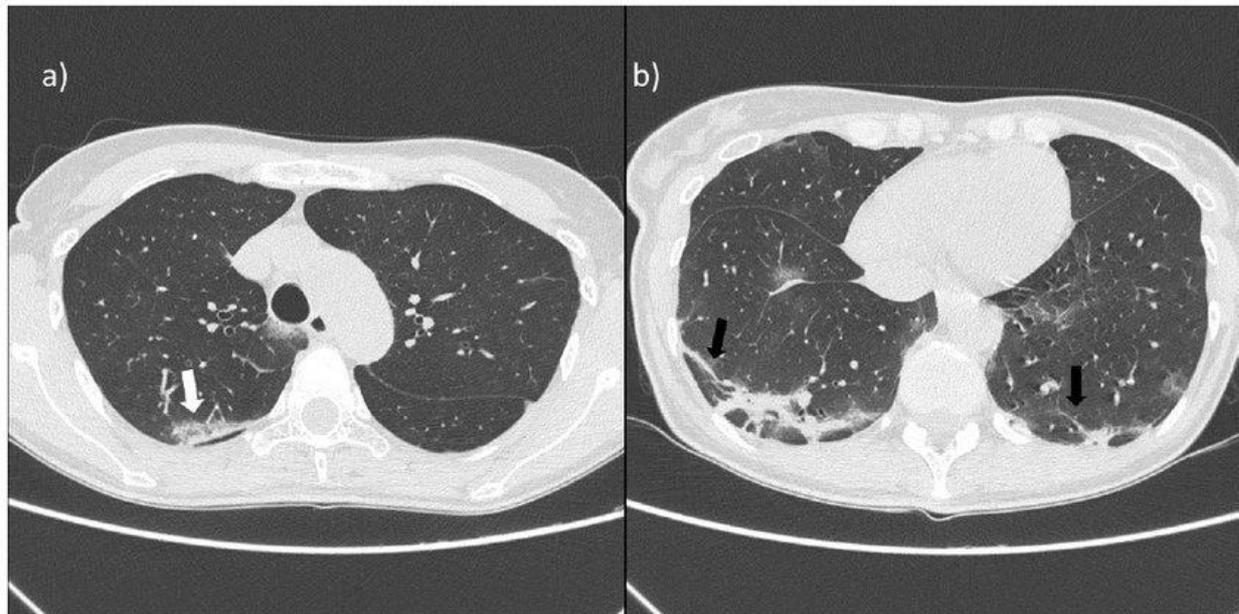
Vascular enlargement: 48%

Pleural effusion: 7%

### CT Findings in Community-Acquired Pneumonia







Common findings:

Lobar consolidation: 76%

Air bronchogram: 71%

Unilateral involvement: 68%

Pleural effusion: 35%

**Diagnostic Performance**

Parameter	LDCT	SDCT
Sensitivity	93.4%	96.2%
Specificity	89.1%	91.4%
PPV	92.0%	94.3%
NPV	90.3%	93.1%

Mean Effective Dose 1.7 mSv 6.2 mSv

No statistically significant difference in diagnostic accuracy ( $p > 0.05$ ).

Significant difference in radiation exposure ( $p < 0.001$ ).

Interobserver agreement ( $\kappa = 0.86$ ) indicated excellent reliability.

**Discussion**

**Diagnostic Value of CT in Viral Pneumonia**

Chest CT demonstrates high sensitivity for detecting viral pneumonia, often preceding RT-PCR positivity. The characteristic peripheral bilateral ground-glass opacities reflect diffuse alveolar damage and interstitial inflammation.

**Differential Diagnostic Considerations**

Key distinguishing features include:

Feature	COVID-19 CAP	
Distribution	Peripheral	Lobar/segmental
Bilaterality	Common	Less common
Pleural Effusion	Rare	Frequent

**Feature COVID-19 CAP**

Lymphadenopathy Rare Possible

The presence of lobar consolidation with air bronchograms and pleural effusion strongly favors bacterial CAP.

**Radiation Safety**

Repeated CT scanning increases cumulative radiation exposure. LDCT reduces dose by approximately 70–75% compared to SDCT without compromising diagnostic performance.

This reduction is particularly important for:

Younger patients

Pregnant women (with strict indication)

Patients requiring serial follow-up

**Clinical Implications**

LDCT may serve as:

First-line imaging modality in pandemic settings

Tool for follow-up assessment

Screening tool in resource-limited settings

SDCT remains useful when:

Complications (e.g., pulmonary embolism) are suspected

High-resolution detail is required

**Limitations**

Retrospective design Single-center study

Limited pediatric population

Absence of long-term outcome correlation. Future multicenter prospective trials are recommended.

**Conclusion**

Low-dose CT demonstrates diagnostic accuracy comparable to standard-dose CT in differentiating COVID-19 from community-acquired pneumonia. Its significant reduction in radiation dose makes it a safe and effective primary imaging modality for infectious pulmonary diseases.

Implementation of optimized LDCT protocols can improve patient safety without sacrificing diagnostic confidence.

**Declarations**

**Funding:** No external funding.

**Conflict of Interest:** None declared.

**Ethical Approval:** Approved by institutional ethics committee.

**Data Availability:** Available upon reasonable request.

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