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Radiology

The Contribution of Thoracic CT Scan in the Diagnosis of COVID-19 Pneumonia

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Abstract		Original Research Article

Our study is of a retrospective type involving 230 patients with Covid-19 pneumonia hospitalized at the HMA in Marrakech, in the various Covid-19 departments and explored in the medical imaging and radiodiagnostic department by a chest scanner over a period of approximately 04 months from September 01, 2020 to December 31, 2020. The median age of the patients was 58.41 with an interval between 17 and 88 years. The male sex was predominant with 78.26% and a sex ratio M/F of 3.6. Diabetes was the most frequent antecedent with a percentage of 33.04%. The predominant clinical situation was the moderate form with a percentage of 64.8%. On a biological/analytical level, the PCR displayed a positive result in 203 cases (88.26%). The CRP was more than 50mg / L in 63.91% of our cases. Furthermore, a predominant percentage of lymphopenia <1500 / mm3 in 69.6% of patients should be highlighted. On a radiology level, the sensitivity of chest CT scan in our study was of 91.74%. The most frequent lesion found was the ground glass opacities in 170 cases with a percentage of 73.91%, followed by Crazy Paving in 161 cases (70%). Regarding the extent of lung involvement between (25-50%), it was the most common with a percentage of 23.04%. Thoracic CT also revealed peripheral under pleural, and inferior involvement (Basal) with a percentage of 45.21% and 75.21%, respectively. Recovery-wise, the majority of patients recovered clinically with 184 cases (80%) of cures. Transfer to the intensive care unit followed by death was recorded in 23 cases (10%).
Keywords: Covid-19, CT Scan, Diagnostic.

INTRODUCTION

At the end of December 2019, a series of cases of viral pneumonia caused by a new coronavirus emerged in Wuhan, China, and quickly spread across all continents. This coronavirus, identified from respiratory samples, was named SARS-CoV-2 by the ICTV (International Committee on Taxonomy of Viruses).

The outbreak was declared a public health emergency of international concern at the end of January 2020.

Infection with SARS-CoV-2 is characterized by its high transmissibility and unusual potential lethality. Understanding the mechanisms underlying the worsening of COVID-19 is important so that the management of these patients can be prompt, even proactive, with the goal of reducing morbidity and mortality.

OBJECTIVE

To assess the contribution of chest CT in the diagnosis and management of this disease through a retrospective study reporting the experience of the Avicenne Military Hospital in Marrakech, particularly the COVID-19 inpatient services and the medical imaging and radiodiagnosis department in response to this pandemic, along with a literature review.

Type of Study:
- Retrospective, comparative, and descriptive: from September 1 to December 31, 2020.
- It includes 230 hospitalized patients treated at the Avicenne Military Hospital in Marrakech for COVID-19 pneumonia, who underwent chest CT imaging.

Inclusion Criteria:
- All patients admitted to the Avicenne Military Hospital in Marrakech with a strong suspicion of COVID-19 pneumonia who underwent a PCR test and chest CT, after which a positive

diagnosis of viral pneumonia due to SARS-CoV-2 was established.

Exclusion Criteria:
- Patients who did not undergo chest CT imaging or for whom the results were not received.

Data Collection and Analysis:
- Request forms for CT scans CT scan reports Previously established exploitation sheet Microsoft Excel Professional Plus 2019. 30 COVID-positive patients were included in our study:

Distribution According to Clinical Data:
1. Age:
- The age of patients ranged from 17 to 88 years, with a median of 58.41 years.

2. Sex:
We recorded a male predominance with:
- 180 men (78.26%).
- 50 women (21.74%).

A male-to-female ratio of 3.6.

3. Comorbidities:
Our patients had a history of:
- Diabetes: in 76 cases (33.04%)
- Heart disease: in 28 cases (12.17%)
- Hypertension: in 27 cases (11.74%)
- Lung disease: in 9 cases (3.91%)
- Active cancer: in 5 cases (2.17%)
- Others: in 54 cases (23.5%)

However, 126 (44.21%) of our patients had no particular medical history.

Functional Signs and Clinical Forms:
Among the functional signs found:
- Flu-like syndrome.
- Headaches.
- Cough.
- Fever.
- Dyspnea.

These signs were associated with four clinical situations:
- Benign: in 66 cases (28.7%)
- Moderate: in 149 cases (64.8%)
- Severe: in 11 cases (4.8%)
- Critical: in 4 cases (1.7%)

I. Distribution According to Biological Data:
PCR:
- Positive: in 203 cases (88.26%)
- Negative: in 27 cases (11.74%)

CRP:
- Normal (0-6 mg/l): in 29 cases (12.6%)
- Elevated 6-12 mg/l: in 12 cases (5.22%)
- Elevated 12-25 mg/l: in 20 cases (8.7%)
- Elevated 25-50 mg/l: in 22 cases (9.57%)
- Elevated over 50 mg/l: in 147 cases (63.91%)

II. Distribution According to Tomographic Data:
1. **Lesions Indicative of Covid:**
They were dominated by the presence of ground-glass opacities:
- Ground-glass: in 170 cases (73.91%).
- Crazy paving: in 161 cases (70%).
- Condensation: in 61 cases (26.5%).
- Reverse halo: in 20 cases (8.6%).

Other lesions:
- Pleural effusion: in 10 cases (4.34%)
- Cavitary lesions: in 6 cases (2.6%)
- Lymphadenopathy: in 5 cases (2.1%)
- Emphysema: in 5 cases (2.17%)
- Bronchiectasis: in 3 cases (1.3%)
- Pulmonary nodules: in 2 cases (0.8%)
- Fibrous lesions: in 1 case (0.4%)
- Atelectasis: in 1 case (0.4%).
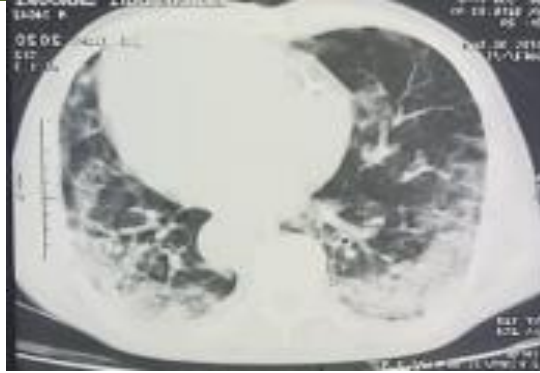

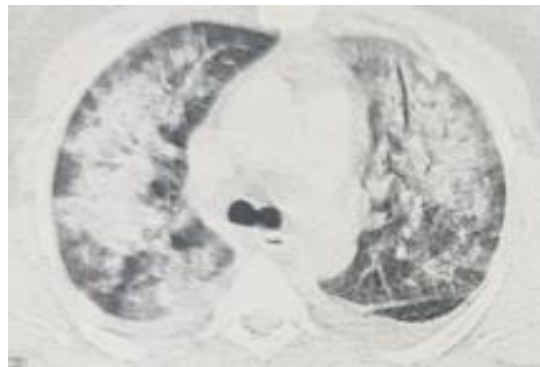**Figure: Ground-glass bilatérale sign**

Figure: Crazy paving sign

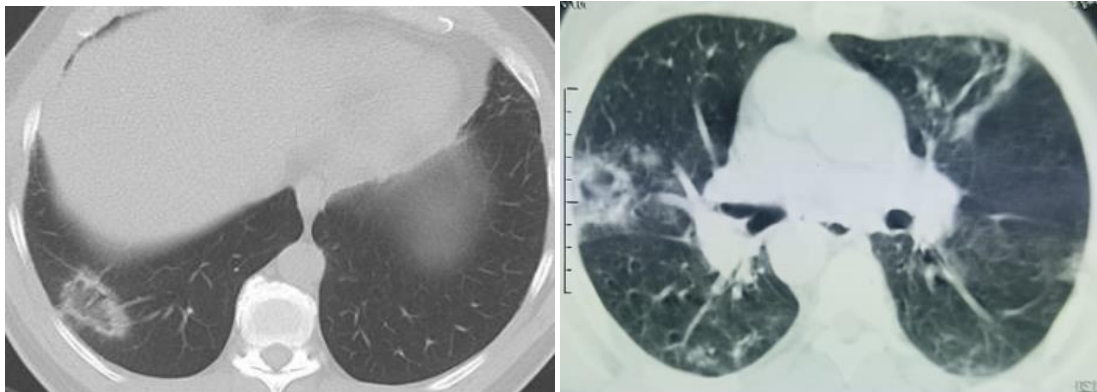
Figure: Condensation sign

Figure: Reverse halo sign

Figure: Pulmonary embolism

1. **Extent:**
   - Absent: 19 cases (8.26%)
   - Minimal (less than 10%): 47 cases (20.43%)
   - Moderate (10-25%): 52 cases (22.6%)
   - Extensive (25-50%): 53 cases (23.04%)
   - Critical (more than 75%): 16 cases (6.95%)

2. **Overall Lesion Topography:**
   - Peripheral subpleural: 104 cases (45.21%)
   - Mixed: 83 cases (36%)
   - Central: 43 cases (18.7%)
   - Lower predominance: in 173 cases (75.21%)

II. Distribution According to Patient Progression:
   - Improvement: 184 cases (80%)
   - Deterioration followed by improvement: 14 cases (6.05%)
   - Deterioration followed by transfer to intensive care and then improvement: 6 cases (2.60%)
   - Deterioration followed by transfer to intensive care and then death: 23 cases (10%)

   - Death in the service: 3 cases (1.30%)

DISCUSSION
Age and Sex:
   - The incidence of the disease is higher in men than in women. Studies have confirmed that older individuals, men, and those with comorbidities are more vulnerable to COVID-19. A British survey involving 17,278,392 subjects found that 10,926 died from COVID-19 or virus-related complications. This series of surveys confirmed that the risk of death can exceed 11% among those over 75 years old and is nearly twice as high for men compared to women.
   - In our series, the male predominance was also evident with a male-to-female ratio of 3.6. This male predominance may be related to the recruitment of military personnel. The median age in our series was 58.41 years, with patient ages ranging from 17 to 88 years.

Table: Comparison between our study and other studies in median age

	Median age
Our study	58.41
Rodilla *et al.,* 2020 Espagne [1]	67,5
Alvarez-Garcia *et al.,* 2020 États-Unis [2]	63,5
University of Health Sciences, Istanbul, Turkey [3]	65

Table: Comparison between our study and other studies in sex rate H/F

	Sex rate H/F
Our study	3.6
Michalakis *et al.,* 2020 France [4]	2.7
Guo *et al.,* 2020 Chine [5]	0,92
Williamson *et al.,* 2020 UK [6]	1.78

Biologic Data
Molecular tests for detecting the SARS-CoV-2 coronavirus genome by RT-PCR:

This is the reference examination with high specificity but a sensitivity of 60-70%, varying depending on the collection method (around 75% for nasopharyngeal samples, 95% for bronchoalveolar lavage). This technique allows for the identification of SARS-CoV-2 RNA and the detection of viral genome in the upper airways. In the laboratory, we use the "Berlin protocol," developed and made available worldwide in mid-January 2020 by Professor Christian Drosten, director of the Institute of Virology at Charité Hospital in Berlin. This test targets the E gene and RdRp of SARS-CoV-2. RT-qPCR allows for quantification of viral load in a sample and monitoring changes over time. False negatives can result not only from the sensitivity of the test but also depend on the quality of the sample, symptoms, and age (these false negatives are more common in the elderly). RT-PCR tests on saliva samples have also been described, but their performance has not yet been sufficiently evaluated to recommend them. In our series, the test was negative in 27 cases among our patients, with diagnosis made by thoracic CT scan.

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Saliva RT-PCR tests have also been described, but their performance has not yet been adequately evaluated to warrant recommendation. In our series, the test was negative in 27 cases of our patients, with diagnosis made by thoracic CT scan.

Table: Comparison between our study in other studies in PCR results

Studies	RT-PCR: Sensitivity %
Notre étude	88.26%
Ai / journal: Radiology [11]	65%
Kim H, Hong H, Yoon SH. china 2020 [8]	89%
A. Bakebe Mbaku *et al.,* Longjumeau, France [9]	84.4%

a. Results of the CT Scan:

The contribution of thoracic CT in the management of COVID-19 primarily lies in the early detection of pulmonary lesions. Indeed, although the RT-PCR test remains the reference diagnostic tool, it has a certain delay in results and can yield false negatives, which can pose challenges for triaging or the immediate management of patients. Typical pulmonary lesions have been described in CT scans, and it is important to specify their extent, as it correlates with the current or future clinical severity of the disease. A wide variety of pulmonary lesions have been documented for COVID-19 in thoracic CT.

Table: Comparison between sensitivity of PCR test and CT scan

Notre étude	Sensitivity
CT scan	91,74 %
PCR	88,26 %

Table: sensitivity of the CT scan in Our study vs others

	TDM: Sensitivity and Resultats
Our study	91.74%
Caruso *et al.,* 2020 Italie [10]	97%.
Ai *et al.,* 2020 Chine [11]	96-97%
Kim H, Hong H, Yoon SH, China 2020 [12]	94%

Typical Lesions:

Several phases of the disease have been described. Pan *et al.,* classified the evolution of pulmonary abnormalities into four phases:

- An early phase (0 to 4 days of symptoms) where ground-glass opacities dominate;
- A progressive phase (5 to 8 days) with the appearance of reticulations within the ground-glass opacities (crazy paving);
- A peak phase (9 to 13 days) with a mixed appearance combining consolidations and ground-glass opacities;
- Finally, an absorption phase ($\geq$ 14 days) with progressive resolution of the lesions.

Table: CT scan lésion fond in Our study vs other studies

	Ground glass	Condensation	Crazy paving	Inversed hallo
Our Study	73.91%	26.5%	70%	8.6%
Zhao *et al.,* china [13]	86.1%	64.4%	48.5%	---------
Li *et al.,* china [14]	97.6%	63.9%	36.1%	---------
Tshienda *et al.,* RDC [15]	61.53%	57.7%	19.2%	---------

Table: Comparison of the Extent of Pulmonary Lesions Between Our Study and Data from the Literature

Extent of pulmonary lésions / Pourcentage %	Our Study	A. Bakebe Mbaku *et al.,* Longjumeau, France [16]	Ibrahima Niang *et al.,* Dakar, Sénégal [17]
None	8.26%	----	00%
Minimal (moins de 10 %)	20,43%	----	18.7%
Moderate (10-15 %)	22.60%	39,5%	50%
Extended (25-50 %)	23.04%	32,4%	25%
Severe (plus de 50 %)	18.69%	14,7%	6.3%
Critical (plus de 75 %)	6.95%	3,4%	00%

CONCLUSION

The thoracic CT scan plays a key role in the management of COVID-19 pneumonia, especially in light of false negatives and the insufficient sensitivity of the PCR test, along with its limited availability to certain specialized laboratories and the delay in obtaining results. In fact, based on the results of our study and various literature findings, CT scans have demonstrated a clear superiority over RT-PCR in the positive diagnosis of viral pneumonia due to SARS-CoV-2. This enables rapid triage of dyspneic patients, allowing us to assess severity and ensure appropriate monitoring of patients undergoing treatment to detect complications early.

Therapeutic management is medical and not yet standardized, with clinical trials still ongoing. The best treatment remains prevention (vaccination + social distancing measures).

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