

Prognostic Value of Pulmonary Computed Tomography in Pregnant Women with SARS-Cov-2 Infection

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Abstract

Background

The global Sars-Cov-2 infection has been growing at an accelerating rate¹. Pregnant women, particularly in third trimester are a high-risk population of developing severe acute respiratory syndrome². Early identification of pregnant women at high risk of rapid worsening might help improve obstetrical management.

Objective

The aim of the present study was to evaluate radiological lung damage caused by SARS-Cov-2 in pregnant women and correlate it with clinical severity and ICU admission.

Study design

We performed a prospective observational study in our reference center, Bichat Hospital in Paris including all pregnant women with local follow-up and clinical suspicion of SARS-Cov-2 infection. Positive diagnosis of SARS-Cov-2 infection was confirmed by positive nasopharyngeal Reverse Transcriptase Polymerase Chain Reaction (RT-PCR). A low-dose CT-scan of the chest was performed in all patients who were at more than 20 weeks of amenorrhea (WA).

Results

Thirty-two pregnant women tested positive (RT-PCR) for SARS-Cov-2, of which 18 had a chest CT-scan. Three patients were transferred to the ICU. They all presented with severe pulmonary involvement with high dissemination scores above 12. Patients with a dissemination score below 12 had a significantly lower risk of ICU transfer ($p=0.0245$).

Conclusion

These preliminary results suggest that the radiological score of lung involvement in chest CT is efficient, simple and easy to reproduce in order to determine pregnant women who are at higher risk of ICU transfer.

Keywords: Sars-cov-2 infection, Pregnancy, Lung dissemination, Covid 19 infection, Radiological score, Intensive care unit

Abbreviations: CT-scan: Computed tomography; RT-PCR: Reverse Transcriptase Polymerase Chain Reaction; BMI: Body Mass Index; ICU: Intensive Care Unit; WA: Weeks of amenorrhea

Introduction

With more than 41 million individuals infected and 1 million deaths¹, the global pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) has been growing at an accelerating rate.

Pregnant women, especially in the third trimester, are at high risk of developing a severe SARS-Cov-2 infection². Early identification of pregnant women at high risk of rapid worsening might help improve obstetrical management. Computed tomography (CT) has been largely used in addition to nasopharyngeal swabs for the positive diagnosis of SARS-Cov-2 and has been proved useful in discriminating among non-pregnant patients those who will need intensive care unit (ICU) support. This result was based on a score on CT lung scan. The cut-off was set at 12 out of 13 to define patients at higher risk of admission to the ICU³. The aim of the present study was to evaluate radiological lung damage caused by SARS-Cov-2 in pregnant women and correlate it with clinical severity and ICU admission.

Materials and Methods

We performed a prospective observational study from March 14th until April 27th 2020 in our reference center, Bichat Hospital in Paris. All pregnant women with local follow-up and clinical suspicion of SARS-Cov-2 infection were included in the study. Positive diagnosis of SARS-Cov-2 infection was made upon classical clinical signs and confirmed by positive nasopharyngeal Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) and suggestive findings on CT-scan.

A low-dose CT-scan of the chest (double sequential acquisition of 16 cm with a mean DLP of 52 mGy.cm) was performed in all patients who were at more than 20 weeks of amenorrhea (WA). We adhered to the hospital protocol regarding the indication for CT-scan during pregnancy and the specific technical recommendations.

In severe cases, CT-scan was repeated after the beginning of symptoms in order to assess radiological progression and to correlate it with clinical state. The severity of lung extension was assessed with a dissemination score as well as the pattern and distribution of lesions. All CT-scans were independently scored by two radiologists blinded to clinical data. The CT dissemination score (range 0–25) was defined as the sum of lung involvement (0: 0%, 1: < 5%, 2: 5–25%, 3: 25–50%, 4: 50–75%, 5: > 75%) of each lobe, including ground-glass opacity, crazy paving and consolidation.

Oral consent was obtained from all patients. All procedures were performed according to our current care protocols and no invasive procedure was done solely for research purposes.

We used Fisher's exact test for statistical analysis.

Results

During the study period, 32 pregnant women tested positive (RT-PCR) for SARS-Cov-2. Eighteen had a chest CT-scan. The remaining 14 had no CT-scan because they refused or did not meet the criteria for the exam (Table 1).

All patients had a CT-scan before day 10 after onset of symptoms. Thirteen had a second CT scan, 3 had a third CT-scan and one patient had a fourth CT (Table 2).

The median age of the women was 31 years (19–39). Thirteen patients (72%) were infected with SARS-CoV-2 during the third trimester, 5 (28%) during the second trimester, and no patient during the first trimester of pregnancy. Most common symptoms were cough (61%), fever (50%), and shortness of breath (22%). Other symptoms such as anosmia or ageusia (28%) were also present in many patients.

Thirty-one percent of patients presented with a Body Mass Index (BMI) greater than 30 kg/m².

No other comorbidity was noted (Table 1).

	Cases (n, %)
Age	19-39 (median 31) yrs/old
Mean BMI	25.2
Time at diagnosis	
- 1 st trimester (0 to 14 WA)	0
- 2 nd trimester (14 to 28 WA)	5 (all over 20 WA)
- 3 rd trimester (28 WA to term)	13
Clinical symptoms	
-Cough	11
-Shortness of breath	4
-Fever	9
-Anosmia and/or ageusia	5
-Other symptoms	0
RT-PCR	18 (100%)
O ₂	6 (33%)
Noninvasive ventilation	3 (17%)
Invasive ventilation	3 (17%)
ICU transfer	3 (17%)
Anticoagulant treatment	9 (50%)
Delivery during infection	7
-Vaginal delivery	3 (43%)
-C-section	4 (57%)

Table 1: Clinical Characteristics.

Regarding lung abnormalities found on CT-scans, 5 (28%) patients had no lesions, 9 (50%) had a predominance of ground-glass opacities, and 4 (22%) had alveolar condensation. Fifty-two percent of patients had bilateral involvement. Minimal to moderate involvement was observed in 73% of patients. Only 28% of patients had severe involvement (Table 2).

<u>CT-scans (n)</u>	
0	0
1	18
2	13
3	3
4	1
<u>Major findings on CT-scan</u>	
- ground-glass opacities	9
- alveolar condensation.	4
-other	0
<u>Involvement</u>	
-unilateral	3
-bilateral	10
<u>Change between 1st and 2ndCT-scan</u>	
Stable	2
Improvement	4
Worsening	6
<u>Dissemination</u>	
Minimal to moderate (score 0-10)	13
Severe (score 10-25)	5

Table 2: Radiological Findings.

Overall, three patients were transferred to the ICU. All of these patients had severe pulmonary involvement with high dissemination scores above 12. Patients with a dissemination score below 12 had a significantly lower risk of ICU transfer ($p=0.0245$) (Table 3). Imaging follow-up showed improvement between the first and second CT-scans for all patients except for one patient who showed worsening of the lesions and was transferred to the ICU.

	ICU transfer	Traditional care unit
Dissemination score \geq 12	3	3
Dissemination score $<$ 12	0	12

Table 3: Dissemination score on first or second CT-scan and ICU transfer; $p = 0.0245$.

Discussion

Due to their young age, pregnant women seem to develop mild to moderate symptoms of SARS-Cov-2, but it has been shown recently that the third trimester itself is a risk factor for severe presentation⁴. Regarding lung abnormalities found on CT-scans, ground-glass opacities predominated, followed by alveolar condensation. More than a half of our patients had bilateral involvement. Compared to the general population, there was no significant difference in the general pattern and distribution of lesions in pregnant women^{5,6}. Nevertheless, it is worth noticing that, in our cohort of pregnant women, most had minimal to moderate involvement.

In our population of 18 pregnant women, the three patients who went to the ICU had severe lung involvement with a dissemination score more than 12. In other words, we observed that patients who had a low score (less than 12) had a minimal likelihood of ICU transfer. Our results are consistent with those of Mahdjoub et al, who found that a CT-score \geq 13 in the general population was related to poor 5-day outcome³.

In terms of the progression of lung abnormalities, all patients had complete resorption of the lesions on follow-up CT-scans as well as a positive outcome in all cases. One patient showed initial worsening of lesions, but then complete resorption, perhaps because the CT-scan was performed too early.

These results suggest that the radiological score of lung involvement in chest CT could be used to determine pregnant women who are at higher risk of ICU transfer. These results should be confirmed with larger prospective cohort in order to be validate.

There is to our knowledge no such previous score described in pregnant women in order to predict clinical outcome. Nevertheless, the main limitation of our study is its observational design as well as its small number of included patients.

Conclusions

These preliminary results suggest that the radiological score of lung involvement in chest CT is efficient, simple and easy to reproduce in order to determine pregnant women who are at higher risk of ICU transfer. Women with a score less than 12 seem to have a better outcome, with minimal risk of ICU transfer.

Acknowledgements

We are indebted to all the staff of the Maternity Unit and of the Bichat Hospital (with a special mention for the anesthesiology/reanimation and infectious department). We especially thank the following members of our staff: Morgane Valentin MD, Agnès Bourgeois Moine MD, Allal Lahcene, Pablo Estevez MD, Marc Siffert MD, Martin Koskas MD PhD, Laura Bellon MD, Elise Larouzée MD, Solene Gricourt MD, Adele Cantaloube MD, Alix Tordjman, Hortense Didier, Sophie Legendry, Anais Dugas, Valérie Vivier, Houhou Fidouh

Authors contribution: Theresa Israel, Clement de Givry and Dominique Luton designed and organized the study. Eleonora Salakos and Margaux Camus collected and gathered the data. Teresa Israel and Eleonora Salakos wrote the manuscript which was analysed, amended and accepted by all the authors. Dr. Houhou-Fidouh analysed virological samples.

Ethical Statement

Although announced in China and then in Italy, the COVID-19 outbreak surprised us and we had less than one week to reorganize our health management system. Therefore, while collectively setting up a large, multicenter, cohort study, we were dealing with emergency cases in our reference center and decided to collect samples from our patients with their approval. These samples were always collected within the framework of our current care procedures and no invasive procedure was performed solely for research purposes. In coping with SARS-CoV-2 cases, we felt that the first data collected on the front line of care should not be wasted.

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