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Comparison of Chest Computed Tomography Findings between Pregnant and Non-Pregnant Women with COVID-19 Infection in Douala Gyneco-Obstetric and Pediatric Hospital, Cameroon

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Abstract

Introduction: Pregnancy is a physiologic state associated with decreased immunity, and the use of medical imaging modalities with ionizing radiation must be justified as potential benefits must outweigh the risk of any harm. However, in the wake of SARS-CoV-2 virus pandemic, chest computed tomography (CT) is necessary to assess the severity of the disease. The objective of this study was to compare the chest CT findings of pregnant and non-pregnant women with SARS-CoV-2 viral pneumonia at a tertiary hospital setting. **Materials and Methods:** This was a cross-sectional, retrospective, descriptive study of admission records of pregnant and non-pregnant patients aged 15 - 49 years during a three (3) months period (April-July 2020) in DGOPH. Logistic regression was used to search for predictors of lung involvement during COVID-19. **Results:** A total of 31 patient files were studied of which 9 (29%) were those of pregnant women. The pregnant women mostly had a combination of lung ground-glass opacities and consolidation on CT compared to the non-pregnant women (7 out of 9 cases, 77.8%, vs. 6 out of 22 cases, 22.7%; p = 0.01). The group of pregnant women had more than 3 affected lobes (50.0% vs. 22.7%, p = 0.04) with a middle lobe predilection (77.8% vs. 31.8%, p = 0.02). CT predictors of COVID-19 pneumonia in the group of pregnant women after the multivariable logistic regression analysis were the presence of nodules (aOR = 13.9; 95% CI: 1.25 - 134.2; p = 0.032) and linear bands of interlobular septal thickening (aOR = 17.8; 95% CI: 1.46 - 217.6; p = 0.024). **Conclusion:** In this study, the chest CT of pregnant women with COVID-19 pneumonia revealed mostly a combination of findings compared to non-pregnant women, with more affected lobes. These findings suggest the likelihood of a greater CT severity of COVID-19 pneumonia among pregnant women and therefore the need for timely and appropriate management.

Keywords

COVID-19 Pneumonia, Pregnancy, Computed Tomography

1. Introduction

More than one year after the declaration of the Coronavirus Disease-19 (COVID-19) pandemic [1], the number of confirmed cases continues to increase, estimated worldwide at 161,513,458 as of May 15, 2021, according to the World Health Organization (WHO) [2], and affecting, in particular, the various populations at risk.

Concerning pregnant women, a recently published study did not show any significant difference, in the absence of comorbidity, on the clinical, biological and radiological aspects related to COVID-19 in pregnant women [3]. This differs from other epidemics, including the Middle East Respiratory Syndrome coronavirus (MERS-CoV) in 2012, where significant complications had been described in pregnant women, compared to the general population [4]. In general, pregnancy is a physiological state that leads to a decrease in immunity [5] and limits certain explorations, such as medical imaging modalities with ionizing radiation. The use of this type of examination must be justified, as the potential benefits must outweigh the risk of any harm [6].

However, if it is established that the diagnosis of COVID-19, is made using the Real Time Polymerase Chain Reaction test (RT-PCR), which is the reference test and usually obtained by nasal or pharyngeal swab [7]. The contribution of medical imaging, through the thoracic scanner, is very important in the detection of pneumonia [8], and also in the follow-up of the evolution of the parenchymal damage [9].

At a time when several countries, including our own, are stepping up their efforts, in particular through the intensification of vaccination [10], it seemed important to us to highlight and compare the different thoracic CT characteristics of pregnant and non-pregnant patients, especially since few studies have been carried out on the subject in our context [5], and thus to present the experience of our hospital structure.

2. Materials and Methods

2.1. Type of Study

This is a retrospective, cross-sectional, descriptive study.

2.2. Sampling

The sampling technique is non-probability based on the consecutive recruitment of files from patients who meet the eligibility criteria.

The sample size is summed up to the study population itself according to pre-established criteria.

2.3. Location of the Study

This monocentric study was carried out in the radiology and medical imaging department of the DGOPH, which has a recent CT scan.

2.4. Patients

We retrospectively included admission records of pregnant and non-pregnant patients aged 15 - 49 years during the period from April to July 2020 at DGOPH. Patients were briefly briefed by a radiology technician on the examination procedure, and oral informed consent for the CT scan was obtained.

Data were obtained via their standardized reports, using a collection form.

The authors declare no conflicts of interest.

2.5. Variables

Variables of primary interest

The primary variable of interest for this study was the chest CT examination result related to the presence or absence of at least one of the following signs: Ground-glass opacities, parenchymal condensation, and the appearance of crazy paving.

Secondary variables

The data for our study were extracted from the survey sheets for the collection of information. The following information was collected.

Secondary variables were age, and clinical data such as symptoms (fever with temperature > 37.5˚C, fatigue, cough, sputum, dyspnea, nasal discharge, sudden anosmia, sore throat, headache, diarrhea, and loss of appetite).

2.6. Thoracic CT Protocols and CT Image Analysis

Patients were informed of the procedure, and informed consent for the scan was obtained. The abdominopelvic region was covered by a lead apron in pregnant women, and according to the date of the last menstrual period in some patients.

All examinations were performed using the same multi-barrier scanner (Supria 16 [HITACHI Supria 16]), in supine position, in apnea, without injection of contrast medium. The main acquisition constants were tube voltage: 120 kV; tube current modulation: 150 mAS; slice thickness from 1.250 to 2.500 mm. The dose-length product (DLP) was approximately 160 mGy·cm for one examination.

All the images of the selected patients were analyzed in mediastinal (width: 350 HU; level: 40 HU) and pulmonary (width: 1500 HU; level: −550 HU) windows, by 3 radiologists, in a collegial way, via the Evolucare Imaging system, which is a PACS system (Pictures Archiving and Communication System) The main CT characteristics of COVID pneumonia were defined by the Fleischner Society [11], and included the type of lesions, such as lung ground-glass opacities (increased lung density respecting the pulmonary blood vessels and bronchial walls), parenchymal condensation (higher hyperdensity erasing the blurred margins of the pulmonary blood vessels and bronchial tubes), and the appearance of crazy paving (fine reticulations associated with ground glass). The axial distribution of the lesions was considered to be peripheral (including the peripheral third of the lung), central (peribronchovascular), or mixed, the upper, middle, or lower lobar topography, and bilaterality. Other less frequent abnormalities such as pulmonary artery trunk dilatation (diameter > 30 mm), pleural and pericardial effusions, and mediastinal adenomegaly (minor axis diameter > 10 mm) were also retained. At the end of this analysis, and according to the visual classification recommended by the Society of Thoracic Imaging (SIT), we retained 5 stages of parenchymal involvement, based on the percentage of lung injured: absent or minimal (<10%), moderate (10% - 25%), extensive (25% - 50%), severe (50% - 75%) or critical (>75%) involvement [3].

2.7. Statistical Analysis

Statistical analyses were performed with SPSS 23 - 0 (IBM, New York, NY).

Quantitative variables were described as mean (standard deviation, SD) or median (interquartile range, IQR). Categorical data were expressed as frequency (percentage).

3. Results

3.1. Clinical Characteristics of the Study Population

Of the 31 patients selected for our study, 9 (29%) were pregnant, and 22 (71% were non-pregnant. The median age [25th 75th percentile (IIQ)] was 26 (25 - 32) years with extremes ranging from 23 to 39 years for pregnant women, and 40 (34 - 44) years with extremes ranging from 30 to 49 years for non-pregnant women, respectively (**Table 1**).

Table 1 shows the clinical data of pregnant and non-pregnant women, the most common symptoms were asthenia (77.77% and 54.54%), fever (77.77% and 40.90%), headache (66.66% and 54.54%), and dyspnea (66.66% and 31.81%) respectively. Other symptoms were much less common such as cough, anosmia, sore throat, sputum, and rhinorrhea.

3.2. The Scanographic Characteristics of COVID-19 of the 2 Groups

Concerning the CT characteristics of the 31 patients in our study population.

Table 1. Socio-demographic and clinical profile of patients.

	PREGNANT WOMEN (n = 9)		NON PREGNANT WOMEN (n = 22)	
Variables	Number	Percentage%	Number	Percentage%
	n = 9		n = 22	
AGE	29 ± 5.74 (23 - 39) (26) [25 - 32]	100.00	39.32 ± 6.33 (30 - 49) (40) [34 - 44]	100.00
Headache	6/9	66.66	12/22	54.54
Anosmia	4/9	44.44	7/22	31.81
Fever	7/9	77.77	9/22	40.9
Dyspnea	6/9	66.66	7/22	31.81
Asthenia	7/9	77.77	12/22	54.54
Nasal discharge	2/9	22.22	4/22	18.18
Expectoration	2/9	22.22	3/22	13.63
Cough	4/9	44.44	4/22	18.18
Sore throat	3/9	33.33	5/22	22.72

The most frequent parenchymal lesions in the 2 groups were the combination of lung ground-glass opacity and parenchymal condensation, encountered in pregnant women (7 out of 9 patients, *i.e.* 77.78%) and in non-pregnant women, (6 out of 22 patients, *i.e.* 27.27%), followed by ground-glass opacities only in 2 pregnant women (22.22%) and in 5 non-pregnant women (27.73%) Pseudo-nodular lesions were the most frequent type of lesion in pregnant women (7 out of 9 patients, *i.e.* 77.78%), whereas beach-like lesions were predominant in non-pregnant women (7 out of 22 patients, *i.e.* 31.82%). Lesions were more likely to be bilateral in pregnant women (6 out of 9 patients, *i.e.* 66.67%), whereas they were unilateral in non-pregnant women (8 out of 22 patients, *i.e.* 36.36%). Similarly, in pregnant women, the axial lesion distribution was more predominantly mixed (6 out of 9 patients, *i.e.* 66.67%), than in non-pregnant women (3 out of 22 patients, *i.e.* 13.64%). Regarding the craniocaudal lesion topography, the middle and lower right lobes were the most frequently affected in pregnant women (7 out of 9 patients, *i.e.* 77.78%), whereas in non-pregnant women, the right lower lobe was predominant (9 out of 22 patients, *i.e.* 40.91%). Concerning the degree of involvement, the thoracic CT scan found mostly extensive parenchymal involvement in pregnant women (3 out of 9 patients, *i.e.* 33.33%), and rather minimal involvement in non-pregnant women (6 out of 22 patients, *i.e.* 27.27%). On the other hand, no lesion related to COVID-19 was found in one pregnant woman (11.11%), against 10 non-pregnant women (45.45%).

Other abnormalities, less frequently specific, were found, such as pericardial effusion in pregnant women (3 out of 9 patients, *i.e.* 33.33%) and non-pregnant women (3 out of 22 patients, *i.e.* 13.64%), as well as liquid pleural effusion in one pregnant woman (11.11%) and in 3 non-pregnant women (13.64%) (**Table 2**).

Table 2. CT scan characteristics of patients.

Radiological findings	Pregnant women (n = 9%)		Non-pregnant women (n = 22%)	
Pericardial effusion	3/9	33.33	3/22	13.64
PA dilatation	1/9	11.11	3/22	13.64
Pleural effusion	1/9	11.11	3/22	13.64
Ground-glass opacities	2/9	22.22	5/22	22.73
GG opacities + cond.	7/9	77.78	6//22	27.27
Condensation	0/9	0.00	2/22	9.09
Reticulation	2/9	22.22	4/22	18.18
Crazy paving	1/9	11.11	0/22	0.00
Type of lesions				
Pseudo-nodular	7/9	77.78	6/22	27.27
Range	5/9	55.56	7/22	31.82
Linear band	5/9	55.56	2/22	9.09
Axial distribution				
None	1/9	11.11	10/22	45.45
Central	0/9	0.00	3/22	13.64
Mixed	6/9	66.67	3/22	13.64
Periphery	2/9	22.22	6/22	27.27
Longitudinal Topography				
Rightupper lobe	5/9	55.56	6/22	27.27
Middle lobe	7/9	77.78	7/22	31.82
Right lower lobe	7/9	77.78	9/22	40.91
Left upper lobe	6/9	66.67	6/22	27.27
Left lower lobe	6/9	66.67	8/22	36.36
Number of lobes affected				
0	0/9	0.00	10/22	45.45
1	0/9	0.00	4/22	18.18
2	2/8	25.00	2/22	9.09
3	2/8	25.00	1/22	4.55
4	4/8	50.00	5/22	22.73
Bilaterality of lesions				
None	1/9	11.11	10/22	45.45
Unilateral	2/9	22.22	8/22	36.36
Bilateral	6/9	66.67	9/22	18.18
Degree of lesion involvement				
None	1/9	11.11	10/22	45.45
Minimal	1/9	11.11	6/22	27.27
Moderate	1/9	11.11	2/22	9.09
Severe	2/9	22.22	2/22	9.09
Extensive	3/9	33.33	2/22	9.09
Critical	1/9	11.11	0/22	0.00

3.3. Comparison between the 2 Groups

Table 3 combines the data comparing pregnant and non-pregnant women. After univariate analysis, dyspnea was the main clinical feature (85.7% versus 25.5%, p = 0.024). On the CT scan, the predominant lesions were ground-glass images combined with pulmonary condensations (77.8% versus 27.3, p = 0.01), pseudo-nodular (77.8% versus 27.3, p = 0.01) and linear bands (55.6% versus 9.1%, p = 0.005), of left upper lobar topography (66.7% versus 27.3%, p = 0.041), and middle lobar (77.8% versus 31.8%, p = 0.02). After multivariate analysis, and introduction of the latter factors into a single logistic regression model, the predictive factors of COVID-19 in pregnant women were the appearance of pseudo-nodular lesions (aOR = 13.9 (1.25 - 134.2); 95% CI, p = 0.032), and the presence of linear bands (aOR = 17.8 (1.46 - 217.6); 95% CI, p = 0.024) (Figure 1 & Figure 2).

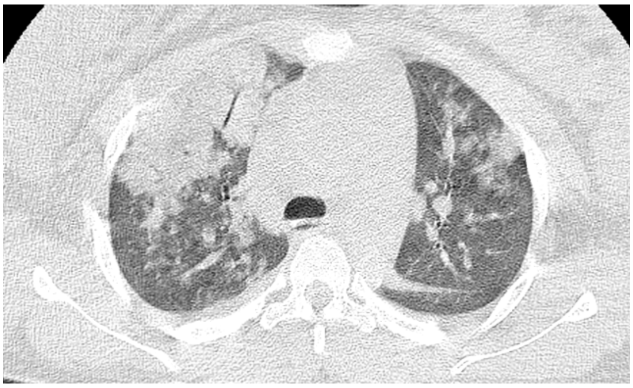
Table 3. Factors associated with COVID in pregnant women.

Characteristics	Univariate analysis			Multivariate analysis	
	Pregnant women (n = 9%)	Non-pregnant women (n = 22%)	p-value	OR (IC to 95%)	p-value
Headache	6 (75.0)	12 (71.0)	0.82		
Sudden anosmia	4 (57.1)	7 (41.9)	0.475		
Dyspnea	**6 (85.7)**	**7 (35.3)**	**0.024**		**0.551**
Asthenia	7 (100.0)	12 (70.6)	0.107		
Nasal discharge	2 (33.3)	2 (23.6)	0.638		
Sputum	2 (25.0)	1 (10.0)	0.396		
Cough	4 (50.0)	4 (40.0)	0.671		
Sore throat	3 (60.0)	5 (29.4)	0.211		
Pericardial effusion	3 (33.3)	3 (13.6)	0.208		
PA dilatation	1 (11.1)	3 (13.6)	0.849		
Pleural effusion	1 (44.4)	3 (18.2)	0.129		
Ground glass opacities	2 (22.2)	5 (22.7)	0.976		
GG +condensation	7 (77.8)	6 (27.3)	**0.01**		**0.833**
Condensation	0 (0.0)	2 (9.1)	0.35		
Reticulation	2 (22.2)	4 (18.2)	0.796		
Crazy paving	1 (11.1)	0 (0.0)	0.112		
Type of lesions					
Pseudonodular	**7 (77.8)**	**6 (27.3)**	**0.01**	**13.980 (1.255 - 134.268)**	**0.032**
Range	5 (55.6)	7 (31.9)	0.218		
Linearband	**5 (55.6)**	**2 (9.1)**	**0.005**	**17.848 (1.464 - 217.653)**	**0.024**
Axial distribution			**0.022**		**0.412**
Nonne	1 (11.1)	10 (45.5)	0.07		

Continued

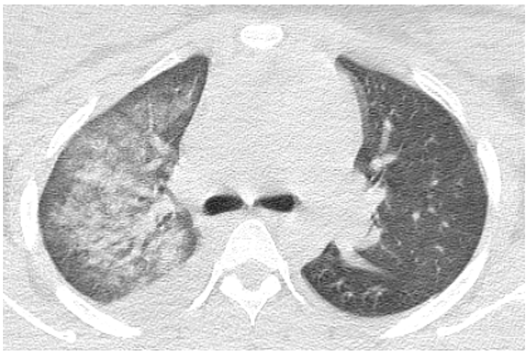
Central	0 (0.0)	3 (13.6)	0.24	
Mixed	6 (66.7)	3 (13.6)	0.003	
Periphery	2 (22.2)	6 (27.3)	Ref	
Longitudinal topography				
Right upper lobe	5 (55.6)	6 (27.3)	0.135	
Middle lobe	**7 (77.8)**	**7 (31.8)**	**0.02**	**0.73**
Right lower lobe	7 (77.8)	9 (41.0.)	**0.062**	
Left upper lob	**6 (66.7)**	**6 (27.3)**	**0.041**	**0.768**
Left upper lob	6 (66.7)	8 (36.4)	0.124	
Number of lobes affected			**0.103**	**0.355**
0	0 (0.0)	10 (45.5)	0.07	
1	0 (0.0)	4 (18.2)	0.17	
2	2 (25.0)	2 (9.1)	0.322	
3	2 (25.0)	1 (4.6)	0.131	
4	4 (50.0)	5 (22.73)	Ref	
Bilaterality			0.176	
None	1 (11.1)	10 (45.5)	0.07	
Bilateral	6 (66.7)	8 (36.4)	0.124	
Unilateral	2 (22.2)	9 (18.2)	Ref	
Degree of injury			0.13	
None	1 (11.1)	10 (45.5)	0.07	
Critical	1 (11.1)	0 (0.0)	0.112	
Severe	3 (33.3)	2 (9.1)	0.096	
Minimal	1 (11.1)	6 (27.3)	0.329	
Moderate	1 (11.1)	2 (9.1)	0.863	
Severe	2 (22.2)	2 (9.1)	Ref	

(A)



(B)

Figure 1. (A and B) Low-dose, non-contrast thoracic CT scan, 26-year-old pregnant woman. Bilateral pleural effusion, predominantly on the left (A). Multiple areas of ground-glass opacity, mostly peripheral, especially in the left upper lobes. Alveolar condensation with aerated bronchogram of the anterior segment of the right upper lobe (B). Bilateral pneumopathy, typical with a parenchymal involvement of about 50%.



(A)

(B)

Figure 2. (A and B) Low-dose, non-contrast thoracic CT scan, 33-year-old non-pregnant woman. Minimal areas of ground-glass opacity mostly mixed (A), predominantly right upper lobar (B), related to about 35% parenchymal involvement.

4. Discussion

In our environment, where several studies have been carried out on COVID-19, very few have highlighted an association with pregnant women, who constitute a fragile segment of the population. During the first wave of the epidemic, some pregnant women who tested positive for Covid-19, by RT-PCR test, were able to benefit from a thoracic scanner, which was requested, more often for an evaluation of the pulmonary involvement, than for diagnostic purposes. However, it is useful to specify that if radiating examinations are not recommended in pregnant women [12], their use is not formally forbidden and depends on the indications [6]. In our study, the scans were carried out in low dose, which remains without risk for the fetus, as stated by Liu *et al.* [13] [14]. Likewise, these examinations did not require any injection of iodinated contrast medium, which, if necessary, depending on the indications, does not constitute any teratogenic risk, as demonstrated by studies in animals [6] [15]. Therefore, in order to contribute to the improvement of patient management in general, and pregnant women in particular, we conducted the present study, which is one of the first in our context, and which allowed us to compare the CT characteristics of 9 pregnant women and 22 non-pregnant women of childbearing age, confirmed positive for COVID-19, by RT-PCR, at the Douala Gynaecological-Obstetric and Paediatric Hospital.

Our series established a median age of 26 years in pregnant women, relatively young, compared to 40 years in non-pregnant women, which diverges from the results of Liu *et al.*, in China, where the median age of pregnant women was 30 years [16], while this is close to the data of Diouf *et al.*, in Senegal, where the median age in 9 pregnant women testing positive for COVID was 28 years [17]. This discrete age difference between African and Asian populations may be due to our small sample sizes, but also to the relatively young age of pregnant women in sub-Saharan Africa [18].

Clinically, asthenia was the most frequent symptom in our two groups, sometimes associated with fever in pregnant women, and more often with headache in non-pregnant women, although this was not statistically significant. Ngalame *et al.* also found fever to be the predominant symptom in 18 pregnant women [19], as did Chawki Mrazguia in 11 other cases [20]. As a severity factor, usually encountered in the general population of our context [21], dyspnea was frequently encountered in our 2 groups (p: 0.024). Thus, this similarity of clinical data between pregnant and non-pregnant patients corroborates the results of the metanalysis of Yang *et al.*, which also described no significant difference [22].

Regarding CT features, the combination of ground-glass opacity images and parenchymal condensation, was frequently encountered in the 2 groups (p: 0.024), going in the direction of Huanhuan findings [16]. This was in slight contrast to the results of Xiaoping, where they were also associated with fibrous bands [23]. This discrepancy in the results is probably related to the delay in performing the CT scan, which varies between individuals, depending on the onset of the symptomatology. It is worth noting that the natural history of COVID-19 pneumonia is usually characterized by regression of the initial ground glass images, followed later by the progressive development of alveolar condensation [24]. In our pregnant women, the involvement was mainly of a mixed axial distribution, mostly bilateral, which without being significantly specific, was however similar to the results of the meta-analysis in 427 pregnant women by Oshay *et al.* [12]. In our 2 groups, the middle and lower right lobes were the most frequently affected, which was also consistent with the analyses of Shi *et al.* in a general population of 81 patients [25]. These authors assumed that the anatomical characteristics of the right bronchus, in particular its shortness, might be a factor favoring this unilateral right predominance. The other abnormalities commonly found in COVID-19 and present in both groups, such as pleural effusion, were rather a sign of severity [3] [22], although it is common to find it in early post-partum [14]. Specifically, and after multivariate analysis, only the pseudo-nodular and linear band lesion types were significantly found in both groups, although the pseudo-nodular form is described in only about 10% of cases, according to the literature [3].

Limitations of this study include the poor maintenance of many medical records, which hindered the collection of laboratory data, as well as the small size of our sample, and the retrospective nature.

5. Conclusion

CT lung lesions are more common in pregnant women compared with non-pregnant women of childbearing age who test positive for COVID-19 at DGOPH. Pseudonodular and linear banded images are the most significantly encountered lesions in our setting. Early CT diagnosis of key lung lesions would improve the outcome of pregnant women during this pandemic.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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