Recognition of COVID-19 Pneumonia in Patients Performing Different Interventional Radiological Procedures of The Chest

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ABSTRACT

Background: Coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organization on March 11, 2020. Many individuals remain completely asymptomatic and can transmit the infection to the general population. The high rate of false-negative results of reverse transcription-polymerase chain reaction (RT-PCR), particularly early in the course of the disease process, requires other tools to diagnose COVID-19 infection, with an important role of radiological imaging. Interventional radiology in many instances continues to provide frontline care during this pandemic and can overcome the unique challenges of safety while providing adequate and efficient high-quality patient care.

Objective: The aim of our study was to focus upon the detection of typical imaging features of COVID-19 infection for asymptomatic patients, performing the different interventional radiological procedures of the chest to avoid the spread of infection and thus influence better detection and further management.

Patients and methods: In this cross-sectional study, we have 382 patients, coming for different interventional radiological procedures of the chest from May 2020 till 30 October 2021.

Results: 35 (9.1%) patients had computed tomography (CT) features of COVID-19 pneumonia using CORADS classification. RT-PCR testing was performed in 28 cases while 7 patients showed negative results; four cases repeated the RT-PCR test and three of them became positive. The other 3 cases refused to repeat RT-PCR and were only isolated and carefully monitored.

Conclusion: The radiology staff including interventional radiologists should be aware of the accidental discovery of imaging features of COVD-19 infection, before proceeding with the interventional procedure. CT chest is an important tool for detection of COVID-19 detection, even in asymptomatic patients.

Keywords: COVID-19 pneumonia, CT chest, Radiological procedures.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is an infectious illness caused by the coronavirus 2 (Severe acute respiratory syndrome (SARS)-CoV-2) that causes severe acute respiratory syndrome [1, 2]. Most people develop symptoms four to five days after being exposed to COVID-19, but the virus can take up to two weeks to incubate [3].

The clinical signs range from moderate to severe, with the majority of infected people experiencing minor symptoms. Pneumonia is the most dangerous and prevalent symptom of infection, and it is characterised by fever, expectoration, dyspnea, and bilateral chest infiltrates on imaging. Upper respiratory problems, loss of smell or taste, and diarrhea are some of the less common symptoms [4, 5].

Many people, on the other hand, are entirely asymptomatic and can spread the virus to the wider public [6].

Because of the high probability of false-negative RT-PCR findings, especially early in the disease phase, alternative methods are needed to detect COVID-19 infection, with radiological imaging playing a key role [7]. On chest radiographs and CT exams, several typical imaging features of COVID-19 have been documented [8-11].

In many cases, interventional radiology is still providing frontline care throughout the pandemic, and it has proven to be capable of overcoming the specific problems of safety while delivering appropriate and efficient high-quality patient care [12].

The aim of our study was to focus upon the detection of typical imaging features of COVID-19 infection for asymptomatic patients, performing the different interventional radiological procedures of the chest to avoid the spread of infection and thus influence better detection and further management.

PATIENTS AND METHODS

This cross-sectional study adherent to STROBE guidelines was done from the first of May 2020 till 30 October 2021. We have included 382 asymptomatic patients referred for the different interventional radiological procedures of the chest.

223 patients were presented with suspicious pulmonary nodule, mass, or cavity lesion. 78 patients were presented with mediastinal mass including enlarged mediastinal lymph nodes. 25 patients were presented with a hilar or para-hilar lesion. 21 patients were requested for CT-guided taping of pleural effusion and sampling from pleural thickening. 13 patients were referred for ablation of a solitary pulmonary nodule in

known cases having primary malignant neoplasm. 22 patients were presented with miscellaneous disorders as osseous lesions from the rib with extra-thoracic soft tissue component, or para-vertebral loculated collection.

Non-contrast high-resolution chest CT examinations, using (8 MDCT, Siemens Healthineers, Erlangen, Germany) were done for all patients. All patients were placed in a supine position with both arms elevated. Scan direction was caudocranial in all patients. Scout was taken starting from 1 cm below the lowest costophrenic angle to 1 cm above the lung apices.

The CT parameter of the CT chest without contrast was as follows: The 1.25 mm thickness, 0.625 mm interval using 512 x 512 matrix with tube speed 35 mm/rotation and 0.5 sec rotation time. The KV was 120 and mA ranging from 150-400 according to the body weight.

A dedicated workstation was used to view all CT images, and they were reconstructed in multi-planar reformation and viewed in different planes.

Diagnosis of COVID-19 pneumonia was done using the CORADS classification, followed by RT-PCR for confirmation.

All CT images were reported by teamwork, including an interventional radiologist and a radiologist with 7 years specialized in chest imaging before starting the interventional procedure.

CO-RADS classifications:
The grading of suspicion of COVID-19 infection was done according to the CORADS score on CT chest as follows: CO-RADS 1: CT shows normal appearance or other findings matching with a non-infectious disease. The possibility of COVID-19 is unlikely. CO-RADS 2: CT shows imaging findings matching with other infections rather than COVID-19.

The possibility of COVID-19 is low. CO-RADS 3: CT shows imaging findings matching with the presence of infection but was uncertain whether COVID-19 is present or not. CORADS 4: CT shows imaging findings matching with a high level of suspicion for COVID-19, however not extremely typical as unilateral ground glass patches, or multifocal pulmonary consolidations. CO-RADS 5: CT shows imaging findings matching

with a very high level of suspicion for COVID-19 as there are typical CT findings. CO-RADS 6: Positive cases confirmed by RT-PCR test [13].

Ethical consent:
An approval of the study was obtained from Ain Shams University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.
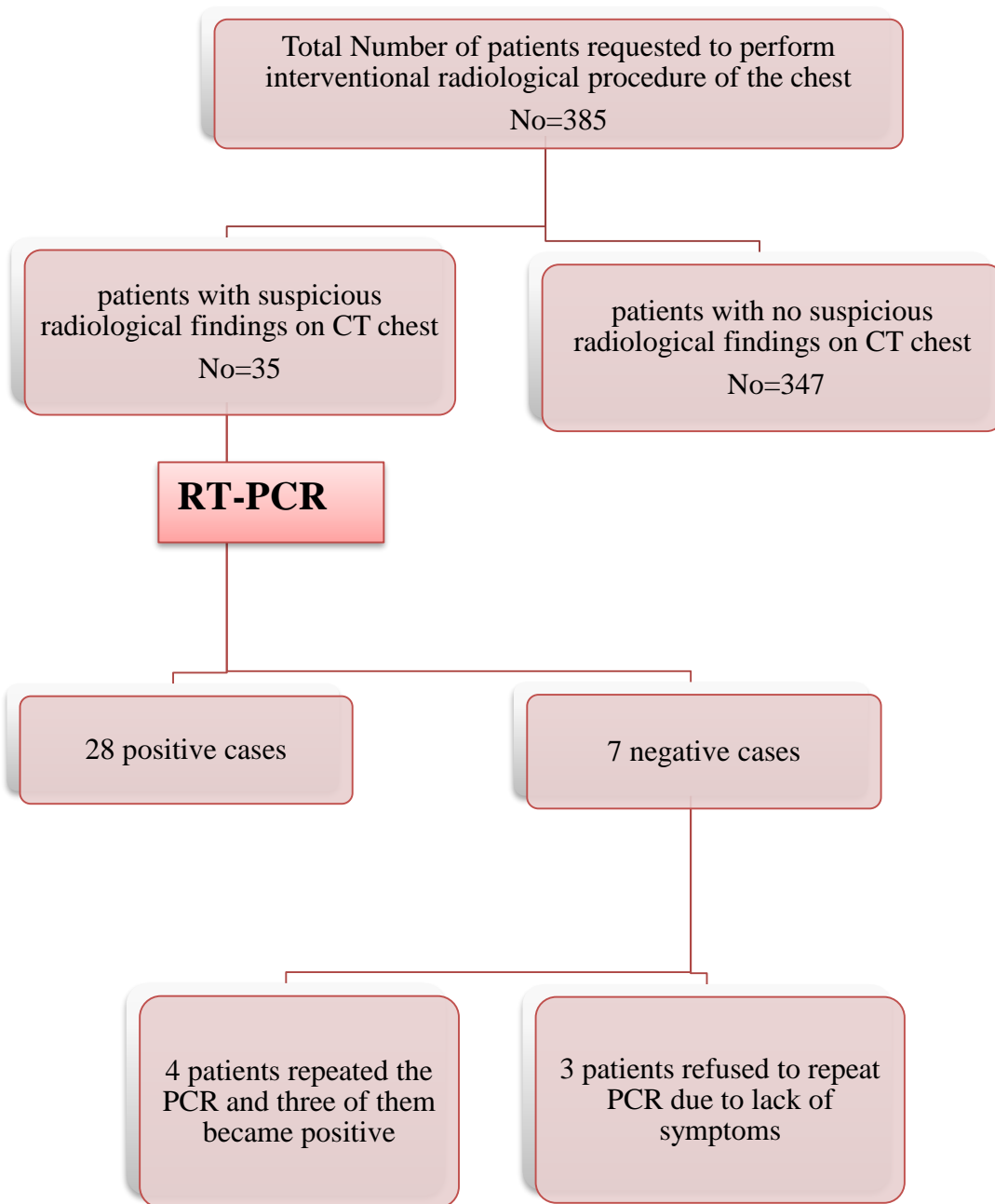
Statistical analysis
The collected data were coded, processed and analyzed using the SPSS (Statistical Package for the Social Sciences) version 22 for Windows® (IBM SPSS Inc, Chicago, IL, USA). Qualitative data were represented as frequencies and relative percentages. Quantitative data were expressed as mean ± SD (Standard deviation).

RESULTS
Our study included 382 patients including 244 males (63.8%) and 138 females (36.2%). Only 35 (9.1%) patients (23 males and 12 females) ranged in age between 28 to 71 years (mean age of 51.5 ± 4.2 years) were presented by the accidental discovery of CT features of COVID-19-associated pneumonia in the form of ground glassing and consolidation patches mainly at a sub-pleural location with either unilateral or bilateral involvement of the lung parenchyma.

All 35 patients with imaging features worrisome of COVID-19 underwent RT-PCR testing for confirmation **(Figure 1).**

The RT-PCR was positive in 28 patients and negative in 7 patients. Only 4 negative PCR patients underwent a repeated PCR after 48 hours according to WHO recommendations and the test turned positive in 3 cases (one case was still negative yet was notified to the chest clinic for further management). The remaining 3 patients, refused to repeat RT-PCT in the absence of symptoms, yet they also underwent home isolation for 2 weeks.

Total Number of patients requested to perform interventional radiological procedure of the chest
No=385

patients with suspicious radiological findings on CT chest
No=35

patients with no suspicious radiological findings on CT chest
No=347

RT-PCR

28 positive cases

7 negative cases

4 patients repeated the PCR and three of them became positive

3 patients refused to repeat PCR due to lack of symptoms

Figure (1): Flow chart representation of the research methodology and results

We detected 7 patients during May and 7 during November **(Figure 2)**.
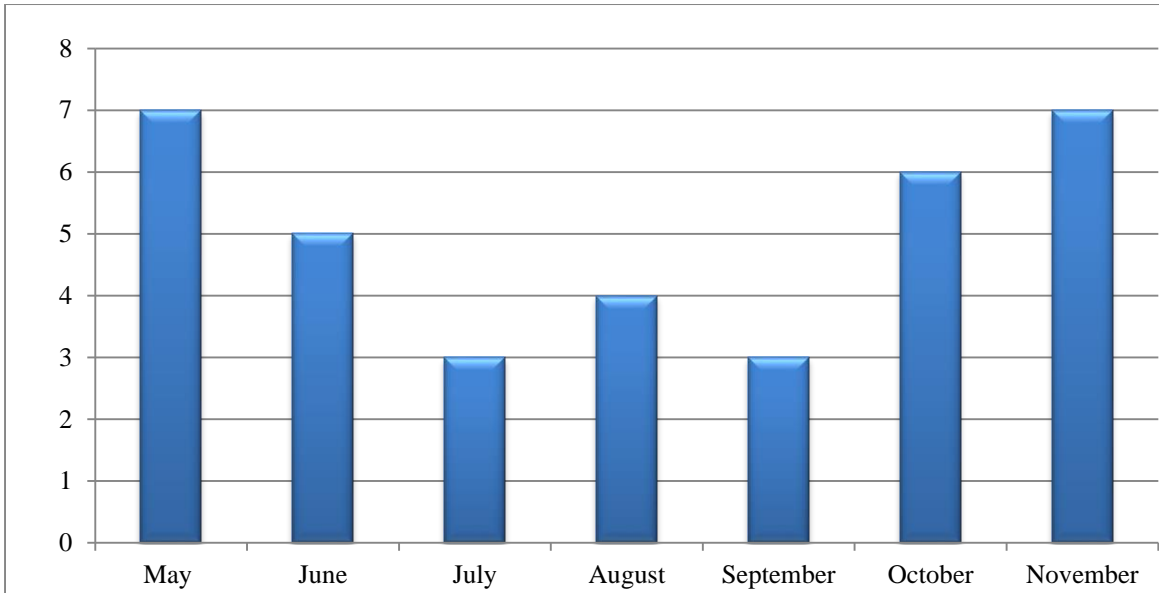
Figure (2): Bar chart representation of the number of patients with accidently discovered COVID-19-associated pneumonia referred for interventional radiological procedures of the chest.

The imaging features suggesting COVID-19-associated pneumonia in the involved patients were mainly multiple, predominantly peripheral ground-glass patches and pulmonary consolidations, affecting both lung parenchyma in 29 (82.9%) patients. 28 (80%) patients had a disease pattern in the form of ground glass patches, while 5 patients (14.2%) had both pulmonary consolidations and ground glassing (**Table 1**).

According to the CT severity score; there were mild pulmonary involvement in 30 patients (85.7%), moderate pulmonary involvement in 4 patients (11.4%), and severe pulmonary involvement in only one patient (2.8%).

Table (1): Demographic and imaging features of the study population with suspicious radiological findings on CT chest (No=35)

| Characteristics	Number
Age	56.5 ± 4.2 years (range 30 -68)
Gender	
Males	23 (65.7%)
Females	12 (34.3%)
Imaging features	
Unilateral	6 (17.1%)
Bilateral	29 (82.9%)
Pneumonic pattern	
GGOs	28 (80%)
GGOs with consolidation patches	5 (14.3%)
Interlobar septal thickening	2 (5.7%)
CORADS classification of the CT chest findings	
CORADS 3	14 (40%)
CORADS 4	12 (34.3%)
CORADS 5	9 (25.7%)

Among such 35 patients, fifteen patients were presented with suspicious pulmonary nodule, mass, or cavity lesion. Eight patients were presented with mediastinal mass including enlarged mediastinal lymph nodes **(Table 2 and figures 3-5)**.

**Table (2):** Number of the patients referred for each interventional procedure of the chest

Indication for interventional radiological of the chest	Number of the patients
Suspicious pulmonary nodule, mass or cavity lesion.	15
Mediastinal mass including enlarged mediastinal lymph nodes.	8
Hilar or para-hilar lesion.	3
CT guided taping of pleural effusion and sampling from pleural thickening.	4
Ablation of solitary pulmonary nodule for known cases having primary malignant neoplasm.	1
Other miscellaneous disorder	4
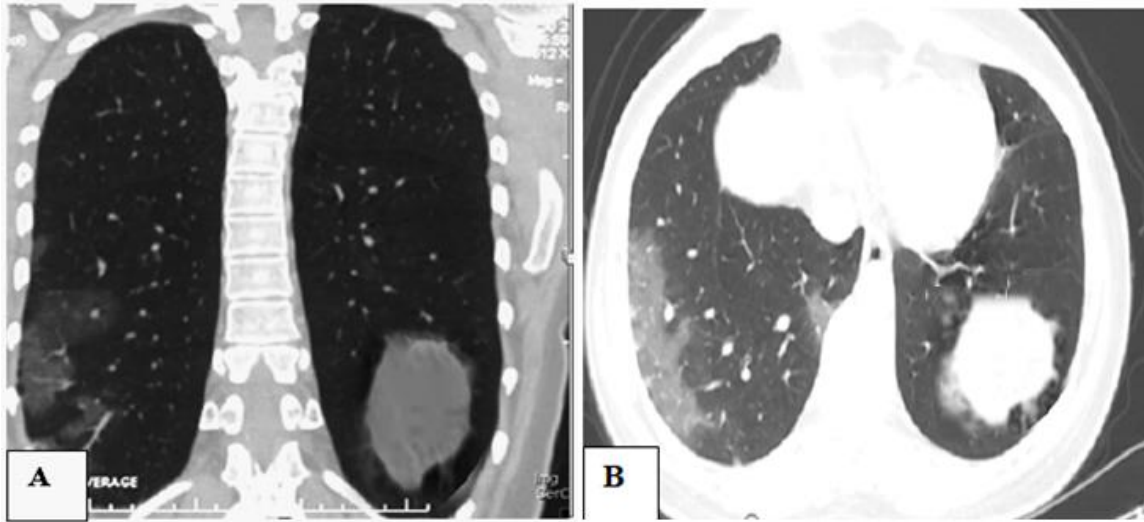
Figure (3): 57-years old male patient, with a history of cough and chest pain, referred for CT guided biopsy from the ill-defined pulmonary mass lesion at left lower lobe. (**A**) and (**B**) axial and coronal CT chest imaging respectively shows unilateral right sided sub-pleural pulmonary consolidations and ground-glass opacities (CORADS 4)
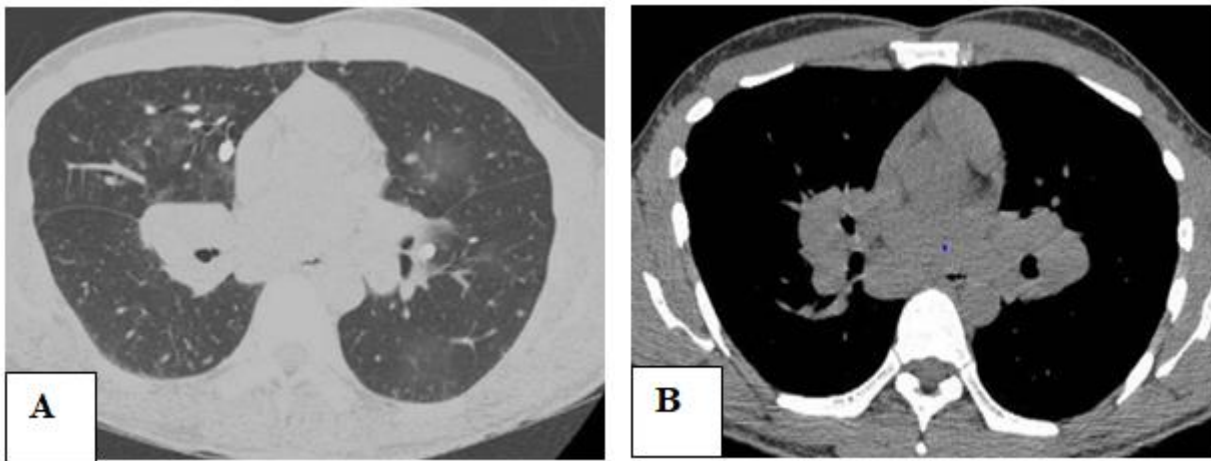
Figure (4): 29-years old female patient, with a history of dyspnea and cough referred for CT guided biopsy from enlarged bilateral hilar and mediastinal lymph nodes with imaging features suggesting pulmonary sarcoidosis. (**A**) and (**B**) axial CT chest imaging with lung and mediastinal window respectively showed bilateral pulmonary ground-glass opacities worrisome of interstitial pneumonitis versus viral pneumonia (CORADS 3). RT-PCR was positive for COVID-19 infection
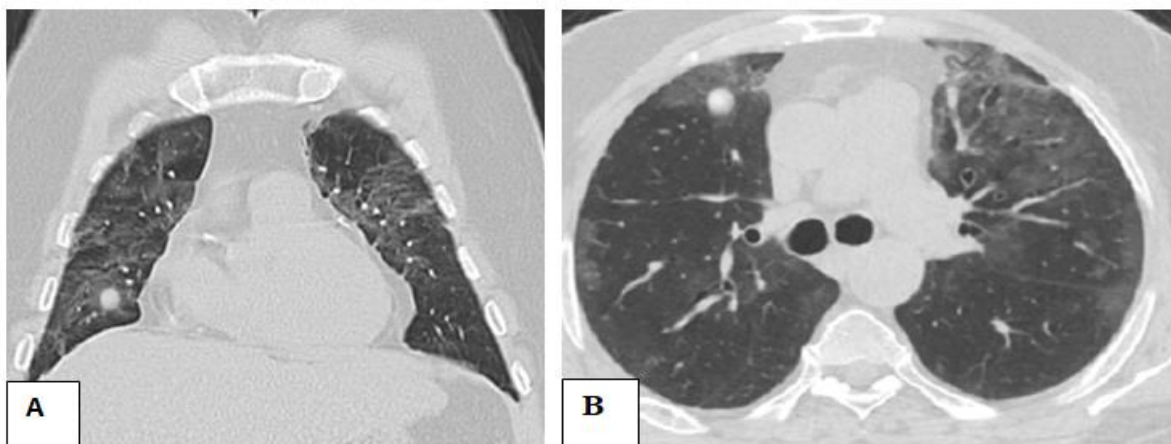
Figure (5): 58-years old male patient, having history of cancer colon referred for RF ablation of solitary metastatic right middle lobar pulmonary nodule coming for RF ablation. (**A**) and (**B**) axial and coronal CT chest imaging respectively shows bilateral sub-pleural pulmonary consolidations and ground-glass opacities (CORADS 5)

DISCUSSION

During the COVID-19 epidemic, interventional radiology should be on the lookout for any imaging indications that might indicate SARS-CoV-2 infection. Such results can be observed not only on chest CT, but also on any imaging for other clinical scenarios, such as CT of the neck and abdomen, where the lungs are partially seen [15].

The reported false-negative results of (RT-PCR) to diagnose COVID-19 infection results in missing a large number of infected but asymptomatic patients, which act as a source of spreading infection [16, 17].

Interestingly, chest CT may show imaging features suggestive of COVID-19 infection even in asymptomatic cases, which would be of value for the detection of a hidden source of infection. This situation is of clinical significance since radiologically visible COVID-19 pneumonia is associated with potential virus transmission [18-20].

In this study, there were 35 patients out of 382 patients (about 9.1%) showed accidental imaging features of COVID-19-associated pneumonia. Several consequences flow from this unusual scenario. First, interventional radiology staff might be unexpectedly exposed and should be provided with adequate protective equipment. Second, we recommend reviewing all available chest images before starting the interventional procedure [21, 22]. Third, in case of suggestive findings, the CT suite needs to be appropriately cleaned before the next examination, while patients should be quickly directed to the COVID-19 pathway. Taken together, these actions are likely to slow down the clinical workflow, and prolonged waiting times for outpatients should be avoided [23].

Maintaining limited but adequate precautionary measures would be warranted to safeguard the health of the community, including healthcare actors and vulnerable persons [24]. In particular, we suggest continuing to review chest images immediately after the acquisition to promptly detect suggestive features of COVID-19 pneumonia, and reporting cases to the refereeing physician even when the examination is performed for other clinical indications [25, 26].

CONCLUSION

The interventional radiologists have to be aware of the accidental discovery of findings suggestive of COVID-19 infection, before proceeding in the interventional procedure. During the COVID-19 pandemic, CT chest is an important tool for detection of COVID-19 detection, even in asymptomatic patients. Thus, will minimize the spread of hidden infection and improve the diagnosis and further management. It also emphasizes the importance of using the proper personal protective equipment, to decrease COVID-19 transmission between the patients and health caregivers.

Conflict of interest: Nil.

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