Research article

Utilization of chest imaging in COVID 19 pandemic

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ABSTRACT

Introduction and Aim: Coronavirus disease (COVID-19) is a viral infection that can lead to severe respiratory disease. Radiological examinations mainly computed tomography (CT) and Chest x-ray (CXR) play a role in diagnosis, follow-up, and management of COVID-19 infection. The purpose of this study was to look into the extent of using chest imaging in COVID-19 infection, as well to see if chest imaging in COVID-19 infections is justified and guided by clinical recommendation in Mosul, Iraq.

Materials and Methods: This cross-sectional study involved 245 people (93 males and 152 females), infected previously with COVID-19 infection in Mosul, Iraq. The participants were asked to self-complete an anonymous questionnaire. Data obtained was subjected to statistical analysis.

Results: The 245 participants had an average age of 25.7 ±8.44 years. The study sample included 57 (23.2%) with low education and 188 (76.7%) with moderate to high education. Among the radiological examinations undergone by these participants, chest X-ray (CXR) was the most common followed by chest computed tomography scan (CT scan). The CXR and the CT scan were done during the patient's illness either for diagnosis or follow-up of the disease. Non-clinically recommended examinations were reported by 64% and 20% of patients who undertook CXR and CT scan respectively, during COVID-19 illness. Higher education status was associated with a tendency to do non-recommended CXR examination during COVID-19 infection.

Conclusion: CXR and CT imaging are the most commonly used radiological examinations in the diagnosis and follow-up in COVID-19 infection. However, a non-clinically recommended utilization of these examinations was noted in Mosul, Iraq during the pandemic. Therefore, educating people of this region about the limitation of non-justified uses of imaging is essential for healthy maintenance of individuals, environment, and resources.

Keywords: COVID- 19 infection; computed tomography; chest x-ray; radiation; chest imaging.

INTRODUCTION

Coronavirus disease (COVID-19) is a viral disease that causes severe acute respiratory tract illness (1). COVID-19 infection was declared as a pandemic by the World Health Organization in March 2020 (2). The disease posed a significant threat to public health and a challenge to the scientific community, necessitating early and precise identification to slow the spread of the illness (3). The international community strives diligently to identify and embrace new techniques as quickly as possible for the diagnosis and treatment of COVID-19 patients. The proven reliable test for the diagnosis of COVID-19 infection has been the reverse transcription-polymerase chain reaction (RT-PCR) test (4, 5).

Radiological examinations are important in the diagnosis, management, and follow-up of COVID-19 infection. The most commonly used radiological exams are a chest x-ray (CXR) and a computed tomography (CT) scan, with the chest CT scan being more accurate and sensitive in detecting COVID-19 in its early stages (6).Other imaging modalities, such as chest X-ray (CXR), lung ultrasound, and positron emission tomography/computed tomography (PET/CT) have been found useful in assessing and monitoring disease progression in critically ill patients (3).

The COVID 19 pandemic had caused a rise in the frequency of radiological exams, raising the risk of radiation exposure to patients and medical personnel worldwide (7), as well as the risk of radiation-related health issues, particularly in young children (8). On the other hand, the risk of cross infection to radiology staff was also seen increased significantly during the pandemic (9). Radiological exams should therefore be performed in a well-justified manner. Hence, in this study we aim to highlight the extent to which chest imaging is used in COVID-19 infections in Iraq, the local justifications for its use, and whether or not it is as guided by clinical recommendations.

MATERIALS AND METHODS

A cross-sectional descriptive study was conducted in Mosul, Iraq, involving 245 people (93 males and 152 females) who had previously been infected with COVID-19, using anonymous self-completed questionnaires. The questionnaire was created in Google Forms and distributed to participants via Facebook social groups of city residents. The

participants who were not previously infected with COVID-19, as well as individuals who provided incomplete data were excluded from the study.

The study was conducted from August 2022 to October 2022. All participants were informed of the purpose, general contents, aims of the study, and written patient consents were obtained. The institutional ethical approval was obtained from the ethical committee of Nineveh University on 4-9-2022.

The infection during which the patient was asymptomatic or had mild symptoms, with no history of oxygen-supportive treatment or hospital admission was reported as a mild illness. Patients who reported the need for oxygen therapy or respiratory support or admission to the hospital were considered as having had moderate to severe infection.

Statistical analysis

The data obtained was saved in the Microsoft Excel 2020 program and analyzed using Statistical Package for the Social Sciences software (SPSS version25). Continuous data are described as mean and standard deviation, while the categorical data have been described as frequency and percentage. Testing the significant difference between groups was done using student t-test in continuous normally distributed variables, or by using Chi-square test for categorical variables. The statistical significance was set at a P $\geq$0.05.

RESULTS

The study included 245 participants (93 males, and 152 females), between the age range of 15-66 years, and an average of 25.7 ±8.44 years. Among the participants, 57 (23.2%) were those having a low education level, while 188 (76.7%) were either moderate to highly educated (have bachelor or higher degree). During the COVID 19 pandemic, the participants were diagnosed with COVID 19 infection for the first time in 182 instances, twice in 56 cases, and more than two times in 7 cases (from 2019 to the time of the current study).

Two hundred thirty patients reported their infection/infections as being mild, while fifteen patients had at least one moderate to severe infection by COVID-19. Fig. 1 represents the distribution of the severity of infection.

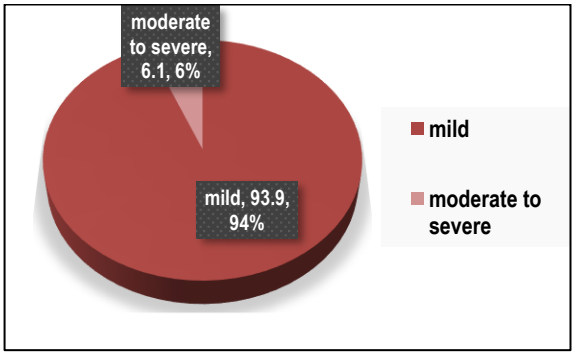

Fig. 1: Severity of COVID-19 infection among the participants (mild infection: no or mild symptoms. Moderate to severe infection: when the patient had severe symptoms, or reported any form of oxygen support or hospital admission during illness.

Diagnosis of COVID-19 in 108 (33.8%) patients was by the RT-PCR test. In 212 (66.3%) of the COVID-19 infections, the diagnosis was mainly by clinical symptoms, different combination of lab tests or radiological examinations. 95 out of 245 (38.78%) patients had a chest radiological test performed as part of their diagnosis or follow-up, and the radiological exams performed were either a chest X-ray or chest computed tomography. Out of 245 participants, 95 patients (30.8%) underwent a CXR at least once throughout their illness (es), either separately (80 cases) or in conjunction with the CT scan (15 cases). There were 114 CXRs performed. Similarly, 6.12% of the patients did a CT scan at least once during their illness (Table 1).

Regarding the additional chest imaging techniques, four instances out of 245 (1.63%) underwent a single magnetic resonance imaging (MRI) of the chest procedure while they were unwell. Two out of 245 (0.82%) participants had their chests ultrasound performed once.

Table 1: The frequency and percent of the chest imaging modalities used during COVID-19 infection

Chest imaging modalities	Patients n=245 (percentage)	No. of exams per total (n=320) infections (percentage)
CXR	95 (38.8%)	114 (35.6%)
CT scan and CXR	15 (6.1%)	19 (5.9%)
MRI	4 (1.6%)	4 (1.3%)
US	2 (0.8%)	2 (0.6%)

The CXR and CT scan were performed during the patient's illness, either for diagnosis or follow-up; some patients chose to have the exams performed in private centers against clinical advice. The number of patients who performed CXR exams on their own was 64% (61 out of 95), while CT scan examinations that were performed based on clinical recommendation was 20% (Fig.2).

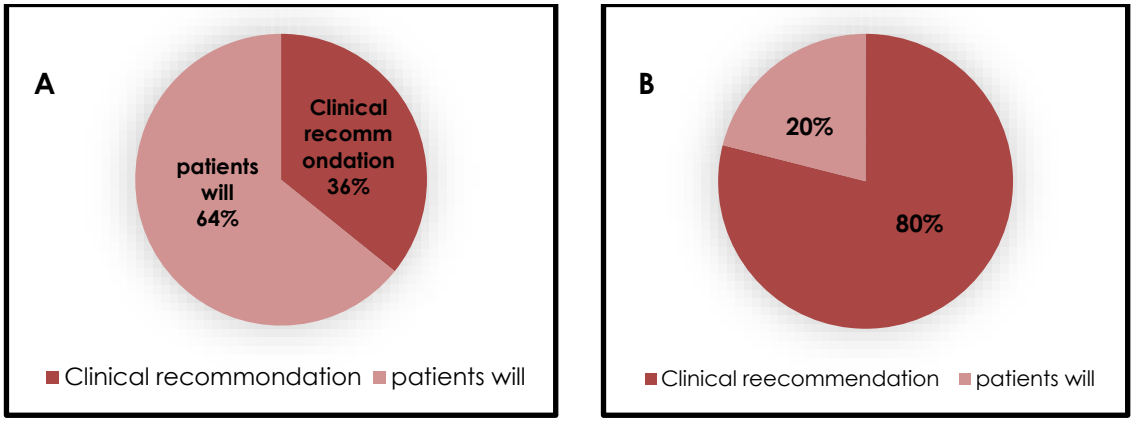

Fig. 2: The percentage of COVID19 patients who underwent CXR exam (A) and CT scan exam (B) with or without recommendation

Table 2: Sex, education, and severity in COVID-19 infection patients who underwent CXR

Parameter		Patients underwent CXR based on		Total number	P value
		Clinical recommendation	No clinical recommendation		
Sex	Male	14 (38.9%)	22 (61.1%)	36	0.623
	Female	20 (33.9%)	39 (66.1%)	59	
Education	Low	3 (12.5%)	21 (87.5%)	24	0.006
	High	31 (43.7%)	40 (56.3%)	71	
Severity	Mild	23 (28.8%)	57 (71.3%)	80	0.001
	Moderate to severe	11 (73.3%)	4 (26.7%)	15	

Table 3: Sex, education, and severity in COVID-19 infection patients who underwent CT scan

Parameter		Total number	Recommendation	
			Clinical No (%)	Non- clinical No (%)
Sex	Male	10	10 (100.0%)	0
	Female	5	2 (40.0%)	3 (60.0%)
Education	Low	2	1 (50.0%)	1(50.0%)
	High	13	11 (84.6%)	2 (15.4%)
Severity	Mild	9	6 (66.7%)	3 (33.3%)
	Moderate and severe	6	6 (100.0%)	0

No statistically significant difference was detected in the average age between the patients who did CXR during COVID 19 infection whether clinically recommended or not (26.9 y versus 25.4y respectively) CXR (p= 0.491).

The sex, education and severity in patients who did CXR during their illness, according to whether clinically recommended were studied, it is found that there is no sex difference, while the higher education status is associated with less tendency to do non recommended exams such as having severe disease (Table 2).

There was no statistically significant difference in mean age between the patients who did CT scan during COVID- 19 infection whether clinically recommended or not (26.6 versus 41.33 years respectively, P= 0.48). The sex, education and severity in patients who did CT scan during their illness, according to whether or not clinically recommended are presented in Table 3.

DISCUSSION

A study by Winder *et al.*, (7) showed a progressive rapid increase in the uses of radiological exams such as CT scan and chest x-ray during 2019 and 2020 and reported that the number of examinations by CT scan and CXR increased by 25% and 39% respectively compared to 2018. The frequency of X-rays undergone by COVID-19 patients was also seen to increase markedly by nearly 5.3 times (from 3.1 in the year 2010 to 16.4 per 1000 patients in the year 2020) (7). The significant increase in the frequency of doing radiological examinations mainly chest CT in 2020 was attributed to the pandemic lung imaging recommendations (7). In the current study more than one-third (38.78%) of the participants had a type of chest radiological exam done to them at least one time

for the diagnosis or follow-up during their COVID-19 infections.

The chest x-ray and CT scan were the most often utilized imaging modalities for diagnosis and follow-up in COVID-19 infection observed in this study, which is in agreement with the same reported by earlier studies (9-13). Research also shows that CXR had lower sensitivity than CT for the early identification of pneumonia in COVID 19 patients (11-14). However, the chest x-ray due to its low cost and low radiation dose in comparison to a CT scan make it the first line, and the most frequent imaging exam, and acceptable for follow-up (9).

In the present study, chest x-ray examination was utilized in 35.6% of the documented infections, while CT scan was done in 5.9% of the total infections, the real utilization of chest imaging is expected to be higher than reported since that the studied sample is representing the patients who survive the infections and most of the cases (93.3%) are of mild infection. To our knowledge, there are no comparable studies in estimating the frequency of radiological exams during COVID-19 infections for diagnosis or follow up per individual or case. Mossa *et al*., in their study estimated the chest imaging exams to be done in 94% of the Covid-19 suspected or diagnosed patients, but the study was conducted in hospitalized patients for screening, diagnosis, follow up as well other conditions as trauma, pulmonary embolism or intensive care (9).

The fear of increasing radiation exposure from medical resources and its consequent impact on individual health is a global issue. A large multinational study based on the IAEA (International Atomic Energy Agency) meeting in 2019 involving 50 experts from 26 countries, discussed the cumulative effective dose (CED) from recurrent exposure to CT scan. The study addressed the issue of a worldwide increase in CED to the patients and suggested urgent actions to be undertaken by stakeholders, including the development of appropriate guidelines for the appropriate recommendations of imaging studies by health professional societies (8).

A multinational consensus statement put forth for the role of chest imaging in patient management during the COVID-19 pandemic, reports that imaging in patients is undertaken only when the patient was suspected to have the coronavirus disease or in cases when the COVID-19 patients who has had mild clinical symptoms and were at risk for disease progression (15). According to the American College of Radiology (ACR) recommendations, CXR and CT scans should be recommended only in patients diagnosed with COVID-19 disease and not as a screening tool for the disease (16). Most of the reports mention COVID-19 diagnosis to be confirmed using PCR (17, 18). However, as far as we know there is just a little evidence of improper use of radiological examinations during the recent pandemic of COVID-19 disease. In the present study part of the previously infected patients were having chest X rays and CT scans, without being clinically recommended mostly by patients with low education and mild disease. Further study is needed to understand the causes and impact of non-recommended chest examinations in COVID-19 infection patients. The limitations of our study include a small sample size, and a way of sampling which includes the patients who survived the pandemic only, in addition, to recall bias.

CONCLUSION

Imaging plays an important role in the diagnosis and follow-up in COVID-19 infection, CXR and CT scan are the most commonly used radiological examinations, and their use has certain indications in the COVID-19 infection. However, a non-clinically recommended utilization of these examinations was noted in Mosul, Iraq during the pandemic. Limitation of non-justified uses of imaging and education of the community about the hazards of medical radiation is essential for healthy individuals, a healthy environment, and conservation of resources.

CONFLICT OF INTEREST

The author declares no conflicts of interest.

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