บทความวิจัย
Research Article

ลักษณะภาพรังสีทรวงอกของผู้ป่วยโควิด 19 ในเขตเมือง

วิราพร กาญจนสุทธิรักษ์ พ.บ. ว.ว. รังสีวิทยาทั่วไป กรองกาญจน์ กาญจนรัตน์ พ.บ. ว.ว. รังสีวิทยาวินิจฉัย
ภาควิชารังสีวิทยา คณะแพทยศาสตร์วชิรพยาบาล มหาวิทยาลัยนวมินทราธิราช กรุงเทพมหานคร

วันรับบทความ : 22 เมษายน 2567
วันแก้ไขบทความ : 21 พฤษภาคม 2567
วันตอบรับบทความ : 24 พฤษภาคม 2567

บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาลักษณะภาพรังสีทรวงอกของผู้ป่วยโควิด 19 ในเขตเมือง

วิธีดำเนินการวิจัย: เป็นการศึกษาเชิงพรรณนาแบบย้อนหลังผู้ป่วยโควิด 19 ที่ได้รับการตรวจภาพรังสีทรวงอกที่โรงพยาบาลวชิรพยาบาล ระหว่างวันที่ 1 เมษายน พ.ศ. 2564 ถึง 30 มิถุนายน พ.ศ. 2564 ทำการทบทวนลักษณะที่พบจากภาพรังสีทรวงอก

ผลการวิจัย: ผู้ป่วยโควิด 19 ทั้งหมด 1,048 ราย ที่ได้รับการตรวจภาพรังสีทรวงอกที่โรงพยาบาลวชิรพยาบาล ในช่วงที่ทำการศึกษา เพศชาย 485 ราย เพศหญิง 563 ราย อายุเฉลี่ย 39.23±19.68 ปี ลักษณะภาพรังสีทรวงอกปกติ 811 ราย (ร้อยละ 77.4) ภาพรังสีทรวงอกพบความผิดปกติ 237 ราย (ร้อยละ 22.6) โดยผู้ป่วยผู้ใหญ่พบความผิดปกติแบบ ground glass opacity มากที่สุด (ร้อยละ 76.4) รอยโรคมักกระจายตัวอยู่ที่ขอบนอกของปอด (ร้อยละ 57.4) โดยมักพบรอยโรคที่ปอดทั้งสองข้าง (ร้อยละ 70.5) และเด่นที่ปอดส่วนล่าง (ร้อยละ 41.8)

สรุป: ลักษณะภาพรังสีทรวงอกของผู้ป่วยโควิด 19 ในเขตเมืองส่วนใหญ่ปกติ โดยลักษณะภาพรังสีทรวงอกผิดปกติที่พบบ่อยเป็นแบบ ground glass opacity ที่ปอดทั้งสองข้างเด่นที่บริเวณขอบนอกของปอดและปอดส่วนล่าง

คำสำคัญ: ภาพรังสีทรวงอก โรคโควิด 19 เวชศาสตร์เขตเมือง

บทความวิจัย
Research Article

Chest radiographic findings of patients confirmed to have COVID-19 in urban areas

Wiraporn Kanchanasuttirak M.D., Dip. Thai Board of General Radiology
Krongkan Kanchanarat M.D., Dip. Thai Board of Diagnostic Radiology
Division of diagnostic radiology, Department of radiology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok

Received : April 22, 2024
Revised : May 21, 2024
Accepted : May 24, 2024

Abstract

Objective: To determine the chest radiographic findings of patients confirmed to have COVID-19 in urban areas.

Materials and Methods: A retrospective descriptive study was conducted on consecutive patients confirmed having COVID-19 that underwent chest radiography at Vajira Hospital between April 1, 2021, and June 30, 2021. Chest radiographic findings were retrospectively reviewed.

Results: A total of 1,048 patients confirmed to have COVID-19 underwent chest radiography in the institution during the study period. The chest radiographic findings were normal in 811 patients (77.4%) and abnormal in 237 patients (22.6%). The most common abnormality in adult patients was ground glass opacity (76.4%) involved peripheral (57.4%), bilateral (70.5%), and lower lung zones predominant (41.8%).

Conclusion: The chest radiographic findings of the patients confirmed to have COVID-19 in urban areas mostly normal. The abnormality frequently showed bilateral, peripheral, ground glass opacity, and lower lung zone predominant.

Keywords: chest radiographic findings, COVID-19, urban areas

Introduction

Currently, there is an epidemic of coronavirus disease (COVID-19) around the world. Globally, there have been 204,133,257 confirmed cases and 4,316,105 deaths (data as of August 10, 2021). From the current situation in Thailand, where the spread of COVID-19 is widespread. As a result, the number of infected patients increased rapidly in a short period of time. The new wave of April 2021 reported a cumulative total of 767,088 cases and 6,494 cumulative deaths (data as of August 10, 2021). This outbreak has affected the public health system, including the economic and social system. Patients with COVID-19 can be asymptomatic or have respiratory symptoms. Fever and cough are the most common symptoms. Some COVID-19 patients have developed pneumonia, while others develop severe pneumonia, leading to respiratory failure or other organ failure together, leading to death.[1,2,3] The study of Huang C, et al which investigated 41 COVID-19 patients, found that all of the patients had pneumonia and abnormalities found in chest computed tomography (CT).[3] Among the intensive care unit (ICU) patients were those with bilateral lobular and subsegmental areas of consolidation. In non-ICU patients, abnormalities were bilateral ground glass opacity and subsegmental area of consolidation.[3] The study of Ng MY, et al confirms that ground glass opacity and consolidation in the lung periphery have been the imaging hallmarks in patients with COVID-19 infection.[4]

In chest radiographs (CXR), although the sensitivity may not be very high for the detection of ground glass opacity in the early stages of infection, normal results may be reported. However, in patients with severe pneumonia, the appearance of consolidation is also seen.[4] The diagnosis of patients with pneumonia can occur or not. According to a study in China, chest CT is more sensitive than CXR. This has led China to use chest CT as the main test to help diagnose COVID-19 pneumonia.[3,5,6] However, in Thailand, chest CT is not used to aid with diagnosis due to resource limitations. Therefore, CXR is still the main test used to help diagnose COVID-19 pneumonia in Thailand, and it is important to separate patients for hospitalization and drug decision making for COVID-19 patients. Information about the characteristics of chest radiographs of COVID-19 patients is limited.

Vajira Hospital, Faculty of Medicine Navamindradhiraj University, has provided diagnostic and treatment services for COVID-19 patients in the area around the hospital, especially in four districts, namely Dusit, Phranakhon, Bang Phlat, and Bang Sue, which were considered an urban area throughout the period of the epidemic. However, there has not been any research on the CXR characteristics of COVID-19 in our patient group. Therefore, this study aims to determine the CXR findings for patients confirmed to have COVID-19 in urban areas.

Materials and Methods

The present study is a retrospective descriptive study and was approved by the Institutional Review Board, Faculty of Medicine Vajira Hospital (COA157/2564). Between April 1, 2021, and June 30, 2021, patients confirmed to have COVID-19 and that were undergoing chest radiography at Vajira Hospital were enrolled in the present study. COVID-19 infection was confirmed by real-time reverse-transcriptase polymerase chain reaction (RT-PCR) testing on nasopharyngeal swabs and throat swabs. All of the patients underwent baseline CXR. All CXR were acquired as digital radiographs by following the institutional practice protocols. CXR was performed at the posteroanterior or anteroposterior projection by using portable radiography units. Two radiologists (with 14 and 12 years of experience) reviewed all of the chest radiographs on a picture archiving and communication system (PACS) workstation together with consensus. Each CXR was first characterized as either normal or abnormal based on lung parenchymal opacity (e.g. ground glass opacity (GGO), consolidation, reticulonodular opacity, and reticular opacity). Patients with follow-up CXR images were compared in order to determine whether there was progression or regression of the lung changes. Patterns of CXR findings, including ground glass opacity, consolidation, and pulmonary nodules, were diagnosed according to the Fleischner Society glossary of terms for thoracic imaging.[7] Ground glass opacities were defined as an increase in opacification of the lung that does not obscure the blood vessels or airways. Consolidation was defined as a homogenous opacification that obscured blood vessels and airway walls.[7] The location of lung involvement was categorized into the upper lung zone, the mid lung zone, the lower lung zone, and the mixed lung zones; right, left, or bilateral lung involvement. The distribution of lung involvement was categorized into peripheral, perihilar, and peripheral with perihilar predominance. Associated findings as pleural effusion, pneumothorax, and cardiomegaly were also recorded.

The patient characteristics and CXR findings were retrospectively reviewed. Descriptive statistics were reported as frequency and percentage or mean with standard deviation. CXR findings were reported as frequency and percentage. All of the statistical analyses were performed using IBM SPSS Statistics for Windows, Version 26.0 (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY, USA: IBM Corp.).

Results

During the study period, a total of 1,048 patients were confirmed to have COVID-19 infection by RT-PCR testing on nasopharyngeal swabs and throat swabs, as indicated. There were 485 males (46.3%) and 563 females (53.7%) with ages of 39.23±19.68 years (Mean±SD). The patients were grouped into two age groups: a pediatric group (age<15 years) and an adult group (age $\geq$15 years). All of the

patients had baseline CXR upon presentation, among the 1,048 patients, 811 patients (77.4%) had normal initial CXR, and 237 patients (22.6%) had abnormal initial CXR. Of the 811 patients that had normal initial CXR, 400 (49.3%) had follow-up CXR, and 47 patients (11.8%) showed abnormality on the subsequently follow-up CXR (figure 1).

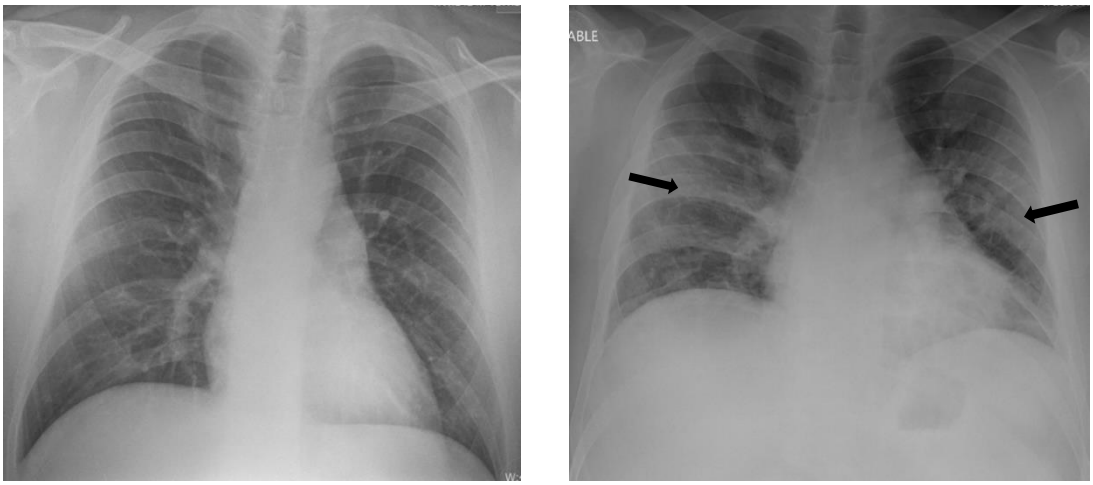

Figure 1 CXR in a 32-year-old male with confirmed COVID-19 infection. (A) The initial CXR appears normal. (B) The follow-up CXR (day seven from initial CXR) shows GGO at both mid and lower lung zones (arrows).

Of the 237 patients who that had abnormal initial CXR, 193 (81.4%) had a follow-up CXR and 99 patients (51.3%) showed progression in the subsequent follow-up CXR (figure 2).

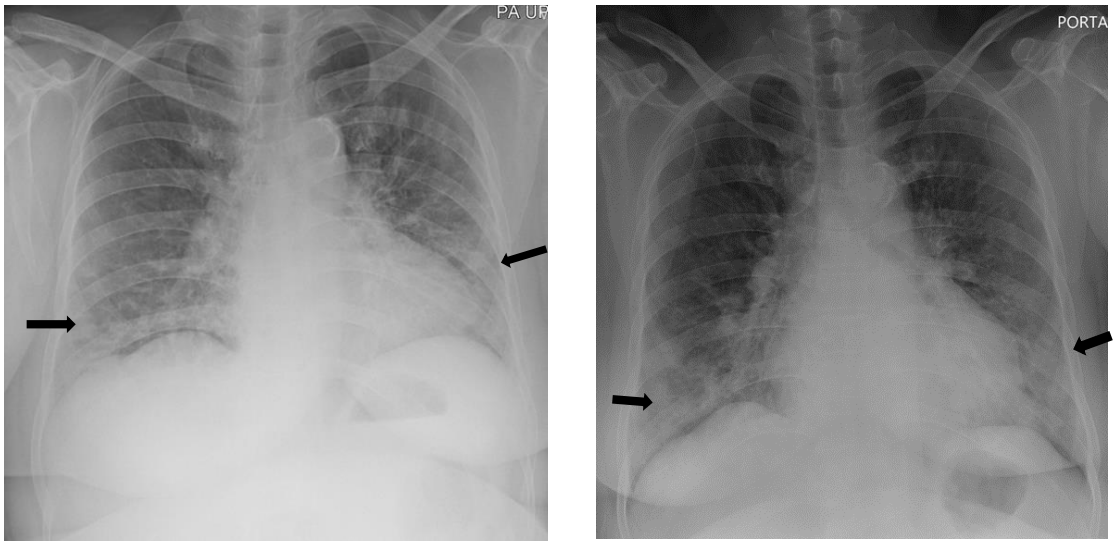

Figure 2 CXR in a 58-year-old female with confirmed COVID-19 infection. (A) The initial CXR shows GGO at both lower lung zones (arrows). (B) The follow up CXR (day four from initial CXR) shows progression of GGO at both lower lung zones (arrows).

The radiographic findings regarding the CXR of the patients confirmed to have COVID-19 are demonstrated in Table 1.

Table 1 The chest radiographic findings of patients confirmed to have COVID-19 (n = 1,048)

Characteristics	Total		Age <15 years		Age ≥15 years		P-value
	n	(%)	n	(%)	n	(%)	
Initial Chest x-ray (n = 1,048)							
Normal	811	(77.4)	112	(91.8)	699	(75.5)	<0.001
Abnormal	237	(22.6)	10	(8.2)	227	(24.5)	
(95%CI)	(20.1 - 25.3)		(4.0 - 14.6)		(21.8 - 27.4)		
Follow-up							
No	455	(43.4)	61	(50.0)	394	(42.5)	0.119
Yes	593	(56.6)	61	(50.0)	532	(57.5)	
Initial CXR normal (n = 811)							
Follow-up							
No	411	(50.7)	57	(50.9)	354	(50.6)	0.961
Yes	400	(49.3)	55	(49.1)	345	(49.4)	
Abnormality on follow-up CXR	47	(11.8)	0	(0.0)	47	(13.6)	0.004
Initial CXR abnormal (n = 237)							
Follow-up							
No	44	(18.6)	4	(40.0)	40	(17.6)	0.092
Yes	193	(81.4)	6	(60.0)	187	(82.4)	
Progression	99	(51.3)	0	(0.0)	99	(52.9)	0.012
Regression	47	(24.4)	1	(16.7)	46	(24.6)	1.000

Of the 237 patients that had abnormal baseline CXR, GGO was the most common finding (76.4%), followed by consolidation (46%). Peripheral (57.4%) and lower lung zone distribution (41.8%) were the more common locations, and most had bilateral involvement (70.5%). Pleural effusion was found in six cases (2.5%). Among the 122 pediatric patients (age less than 15 years), 112 (91.8%) had a normal baseline CXR and 10 patients (8.2%) had an abnormal baseline CXR. Of the 10 patients that had an abnormal baseline CXR, reticular opacity was the most common finding (80%), followed by GGO (20%). Perihilar distribution (70%) and peripheral with perihilar distribution (20%) were the more common distributions.

The radiographic findings of the abnormal initial CXR in patients confirmed to have COVID-19 are shown in Table 2.

Table 2 The radiographic findings of the abnormal initial CXR in patients confirmed to have COVID-19 (n = 237)

Radiographic findings	Total (n = 237)		Age <15 years (n = 10)		Age ≥15 years (n = 227)		P-value
	n	(%)	n	(%)	n	(%)	
Side							
Bilateral	167	(70.5)	10	(100)	157	(69.2)	0.154
Right	37	(15.6)	0	(0.0)	37	(16.3)	
Left	33	(13.9)	0	(0.0)	33	(14.5)	
Location							
Lower lung zone	99	(41.8)	0	(0.0)	99	(43.6)	0.006
Upper+Lower	74	(31.2)	10	(100)	64	(28.2)	0.009
Lower+mid	44	(18.6)	0	(0.0)	44	(19.4)	0.215
Upper lung zone	9	(3.8)	0	(0.0)	9	(4.0)	1.000
Mid lung zone	9	(3.8)	0	(0.0)	9	(4.0)	1.000
Upper+mid	2	(0.8)	0	(0.0)	2	(0.9)	1.000
Pattern							
Ground glass opacity	181	(76.4)	2	(20.0)	179	(78.9)	<0.001
Consolidation	109	(46.0)	0	(0.0)	109	(48.0)	0.002
Reticulonodular opacity	5	(2.1)	0	(0.0)	5	(2.2)	1.000
Reticular opacity	29	(12.2)	8	(80.0)	21	(9.3)	<0.001
Distribution							
Peripheral	136	(57.4)	0	(0.0)	136	(59.9)	<0.001
Perihilar	23	(9.7)	7	(70.0)	16	(7.0)	
Peripheral+ perihilar	62	(26.2)	2	(20.0)	60	(26.4)	
Central	16	(6.8)	1	(10.0)	15	(6.6)	
Associated findings	31	(13.1)	0	(0.0)	31	(13.7)	0.367
Cardiomegaly	25	(10.5)	0	(0.0)	25	(11.0)	0.605
Pleural effusion	6	(2.5)	0	(0.0)	6	(2.6)	1.000
Pneumothorax	1	(0.4)	0	(0.0)	1	(0.4)	1.000
Multiple pulmonary nodules	1	(0.4)	0	(0.0)	1	(0.4)	1.000

Discussion

COVID-19 is an ongoing global pandemic disease. The present study evaluated and analyzed the chest radiographic findings of patients confirmed to have COVID-19 in urban areas in Thailand. A total of 1,048 patients were confirmed to have COVID-19, 77.4% had normal baseline CXR, and 22.6% had abnormal baseline CXR. Previous studies have reported that a chest radiograph may be normal in patients with COVID-19 pneumonia, particularly in the early stage.[6,7] Of the 237 patients that had an abnormal baseline CXR, the most common finding was GGO (76.4%), which is similar to 74.4% in Ratnarathon's study[8], followed by consolidation (46%). Other studies of Wong HYF, et al and Ng MY, et al reported that consolidation was the most common finding identified in 47% and 60%, respectively.[9,4] A previous study of Ng MY, et al[4] confirms that ground glass opacity and consolidation in the lung periphery have been the imaging hallmarks in patients with COVID-19 infection, as indicated. Regarding the location and distribution of abnormality, peripheral (57.4%) and lower lung zone distribution (41.8%) were the more common locations, and most had bilateral involvement (70.5%). A previous study of Wong HYF, et al[9] reported abnormalities at CXR had a peripheral distribution (47%) and lower zone distribution (50%) with bilateral involvement (50%). The present study found a difference in the CXR abnormalities in the pediatric group (age less than 15 years), where reticular opacity was the most common finding (80%), followed by GGO (20%). Perihilar distribution (70%) and peripheral with perihilar distribution (20%) were the more common distributions.

In the present study, of the 811 patients that had normal baseline CXR, 11.8% had developed abnormality in the subsequently follow-up CXR. A previous study by Wong HYF, et al which was a retrospective case series of 64 patients hospitalized with COVID-19 infection in Hong Kong found that 31% (20 patients) had normal CXR on admission. Of these patients, 35%(n=7) developed radiological changes on follow-up CXR.[9]

The results of the present study suggest that CXR can play a role in the initial assessment and follow-up for patients confirmed to have COVID-19. A positive CXR may obviate the need for a CT study, thus reducing the burden on CT units during this pandemic.

Limitations of the present study included retrospective study, data from a single institution were collected and lack of clinical information such as underlying disease, immune status and day of illness of COVID-19 infection that might affect radiographic findings.

Conclusion

The chest radiographic findings of patients confirmed to have COVID-19 mostly normal. The abnormality of the adult patients in the present study frequently showed bilateral, peripheral, ground

glass opacity, and lower lung zones predominant, which is beneficial in differential diagnoses from other pneumonia. CXR also plays a role in follow-ups for patients confirmed to have COVID-19. In suggestions, correlating the findings with disease severity and progression, as with post-COVID-19 findings in further studies, will bring more benefits to patient care.

Acknowledgements

This study was supported by a grant from the Navamindradhiraj University Research Fund.

Conflicts of interest

The authors declare no conflict of interest.

References

1. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristic of coronavirus disease 2019 in China. N Eng J Med 2020;382(18):1708-20.
2. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395(10223): 507-13.
3. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395(10223):497-506.
4. Ng MY, lee EYP, Yang J, Yang F, Li X, Wang H, et al. Imaging profile of the COVID-19 infection: radiologic findings and literature review. Radiolo Cardiothorac Imaging 2020;2(1):e200034.
5. Zu ZY, Jiang MD, Xu PP, Chen W, Ni QQ, Lu GM, et al. Coronavirus disease 2019 (COVID-19): a perspective from China. Radiology 2020;296(2):E15-25.
6. Chung M, Bernheim A, Mei X, Zhange N, Huang M, Zeng X, et al. CT imaging features of 2019 novel coronavirus (2019-nCoV). Radiology 2020;295(1):202-7.
7. Hansell DM, Bankier AA, MacMahon H, McLoud TC, Miiller NL, Remy J. Fleischner Society: glossary of terms for thoracic imaging. Radiology 2008;246(3):697-722.
8. Ratnarathon A. Clinical characteristics and chest radiographic findings of coronavirus disease 2019 (COVID-19) pneumonia at Bamrasnaradura Infectious Disease Institute. Dis Control J 2020;46(4):540-50. (in Thai)
9. Wong HYF, Lam HYS, Fong AHT, Leung ST, Chin TWY, Lo CSY, et al. Frequency and distribution of chest radiographic findings in patients positive for COVID-19. Radiology 2020;296(2):E72-8.