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ORIGINAL ARTICLE

PATTERN OF CHEST X-RAYS FINDINGS AND CLINICAL CORRELATION WITH THE SEVERITY IN COVID-19(RT-PCR POSITIVE) INFECTED PATIENTS ADMITTED IN A COVID-19 DEDICATED HOSPITAL IN BANGLADESH

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Abstract:

Objective: *This study aims to analyze Chest X-ray findings in COVID 19(RT-PCR positive) patients, correlate between clinical and radiological findings and short-term outcomes of the patients with the view to enhance clinicians' understanding of CXR findings in COVID 19 patients.* ***Methods:*** *This descriptive type of observational study included 277 reverse transcriptase-polymerase chain reaction (RT-PCR) confirmed COVID-19 patients who were undergone CXRs, based on the clinician's decision. Data were collected from May to September 2020 of Maternal and Child Health Training Institute (MCHTI)- a COVID-19 dedicated hospital, Lalkuthi, Mirpur-1, Dhaka and analyzed statistically through SPSS,Version 25. Each chest X-Ray is then scored using the Brixia score, a semi-quantitative scoring system rating lung involvement from 0 to 18 by a radiologist. The scores are then analyzed and compared with the characteristics of the patients, clinical presentation, and short-term outcome (in-hospital & after discharge) to correlate the severity and post covid-19 complications of COVID-19 infected patients.* ***Results:*** *A total of 277 RT-PCR-positive patients were performed chest x-ray P/A view, among them 58.12%(161) were male and 41.88%(116) were female. Age variation was from 6 to 95 years and the mean age was 42.48±15.53(S.D).Most of the patients(94.94%)were symptomatic and the majority(97.9%) of symptomatic patients had comorbidities(p-value 0.02).Among the x-ray performed patients(n=277), 39.35% (109) patients had positive findings suggestive of covid-19 infection. Comorbidities and sex had significant relation on positive x-ray findings(p-value 0.0001 and 0.001);males (70.6%) had more positive findings than females(29.4%).Positive x-ray findings were more common among the age group 41 to 60 years (p-value 0.0001 and Cramer's V 0.59).Most of the patients (94.49%) had bilateral lungs involvement and consolidations were the commonest x-ray findings (43.1%).Clinical severity was assessed by symptoms and Spo2 level (<91%) and 20.2% were clinically severe (M-23.6%, F-15.5%). Age, co-morbidities, and higher Brixia score (>8) had a significant relation to clinical severity (p-value 0.0001,0.0001&0.0001) and sex also influences clinical severity though statistically not significant*

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(p-value 0.2).There was a significant relationship between positive X-Ray findings and decreased Spo2 level (p-value 0.0001, Cramer's V 0.47).Regarding in-hospital outcome; 94.9% were recovered and 2.75%were death (only male)and following discharge; 42.60% (119) had post covid-19 complications and 0.72% (02) were dead. Comorbidities and age had an effect on short-term outcomes after hospital discharge though not statistically significant (p-value 0.16 and 0.16). The most common respiratory complications were SOB on exertion (23) and the most common non-respiratory complication was post covid fatigue syndrome (42). Comparison between Brixia score and post covid complications; more the Brixia score, the more the chance of post covid complications though statistically not significant (p-value 0.44). ***Conclusion:*** *This study reveals bilateral lungs involvement and multifocal consolidations are the most common patterns of X-ray findings and clinical severity is associated with a higher Brixia score, male sex, increasing age, and presence of comorbidities.*

Keywords: *RT-PCR, COVID-19, Spo2 level, Brixia score, Post covid-19 complication.*

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Introduction:

COVID-19 is an infectious disease caused by a strain of coronavirus. Definitive diagnosis of COVID-19 requires a positive RT-PCR test. But this serologic examination (RT-PCR) has several limitations. To have a rapid evaluation of chest involvement, radiological evaluation of patients with suspect of COVID-19 is mandatory, especially in the emergency department (ED) while waiting for RT-PCR results. Also, chest X-ray facilities are available in our basic health care units. Although chest X-Ray is less sensitive than chest CT, chest radiography is typically the first-line imaging modality used for patients with suspected COVID-19.[6-8] Performing CT scans is not easy during this pandemic due to widespread unavailability, costly, excessive radiation exposure especially to younger patients, and difficult scanner disinfection procedures. Most Italian hospitals are employing CXR as the first-line method, with faster results compared with those of RT-PCR.[1,3] The European Society of Radiology (ESR) and the European Society of Thoracic Imaging (ESTI) recommend the use of X-ray imaging primarily for COVID-19 patients in intensive care.[4] The American College of Radiology (ACR) notes that CT decontamination required after scanning COVID-19 patients may disrupt radiological service availability.[5] However, imaging has limited sensitivity for COVID-19, as up to 18% demonstrate normal chest radiographs when mild or early in the disease course.[9-11,19-20] The most frequent findings are airspace opacities, whether described as consolidation or, less commonly GGO. The distribution is most often bilateral, peripheral, and lower zone predominant.[5,9,13-17] In the Fleischner Society's view, chest X-rays have no single feature of covid-19 pneumonia or a chest radiograph is specific or diagnostic, but a combination of multifocal peripheral lung changes of ground-glass opacity and/or consolidation, which are most commonly bilateral, may be present. The chest X-ray is a discriminating tool, a positive CXR may obviate the need for CT. But if the clinical suspicion is high and the PCR or/and chest X-ray is normal, then a chest CT is indicated.[18]

Methods:

This is a single-center; descriptive type of observational study conducted at Maternal and Child Health Training Institute (MCHTI), Lalkuthi, Dhaka, Bangladesh- a COVID-19 dedicated hospital and data were collected from 16 April to 5 September 2020. Information of all admitted confirmed COVID-19 patients with performed chest X-rays in this facility were included in this study. The Authority/institutional review board has approved this study and informed consent was taken verbally from the patients due to the risk of cross-infection. 277 patients (figure 3) out of a total 422 confirmed COVID-19 admitted patients were performed chest X-ray P/A view according to advice by the attending physicians that were considered the analytical sample for our study. Due to scarcity of ICU beds, only 20 patients' got ICU care throughout the study period and among the 20 ICU care patients, 10 RT-PCR positive patients were performed chest X-ray. Each chest X-Ray is then scored using the Brixia score, a semi-quantitative scoring system rating lung involvement

from 0 to 18 and it was evaluated by a radiologist who had experience in radiology for more than ten years. The Brixia scoring system for COVID-19 pneumonia includes two steps of image analysis: in the first step, the lungs are divided into six zones (figure 1) on frontal chest projection (posteroanterior or anteroposterior projection according to the patient position):

- Upper zones (A and D): above the inferior wall of the aortic arch
- Middle zones (B and E): below the inferior wall of the aortic arch and above the inferior wall of the right inferior pulmonary vein (i.e., the hilar structures)
- Lower zones (C and F): below the inferior wall of the right inferior pulmonary vein (i.e., the lung bases)

In the second step, a score (from 0 to 3) is assigned to each zone based on the lung abnormalities (figure 2) detected on frontal chest projection as follows:

- Score 0: no lung abnormalities
- Score 1: interstitial infiltrates
- Score 2: interstitial and alveolar infiltrates (interstitial predominance)
- Score 3: interstitial and alveolar infiltrates (alveolar predominance)

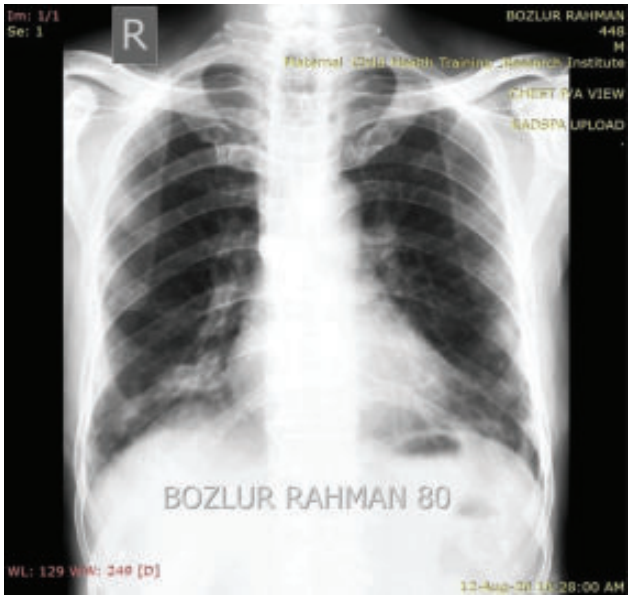

Fig.-1: *First step of Brixia score system*

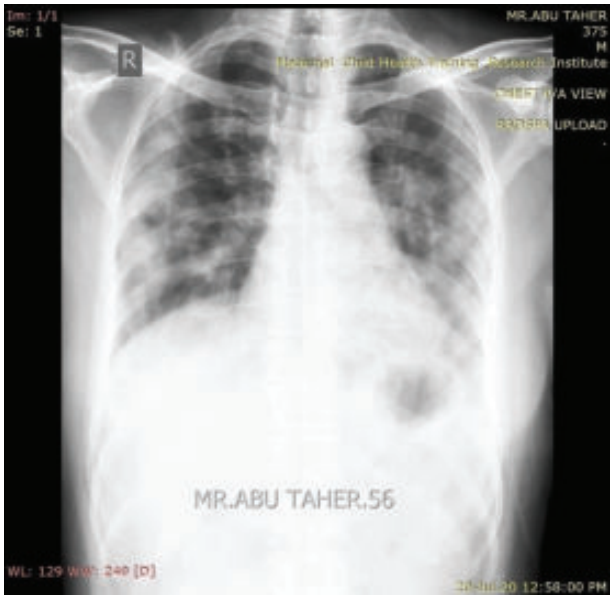

Fig.-2: *Second step of Brixia score system*

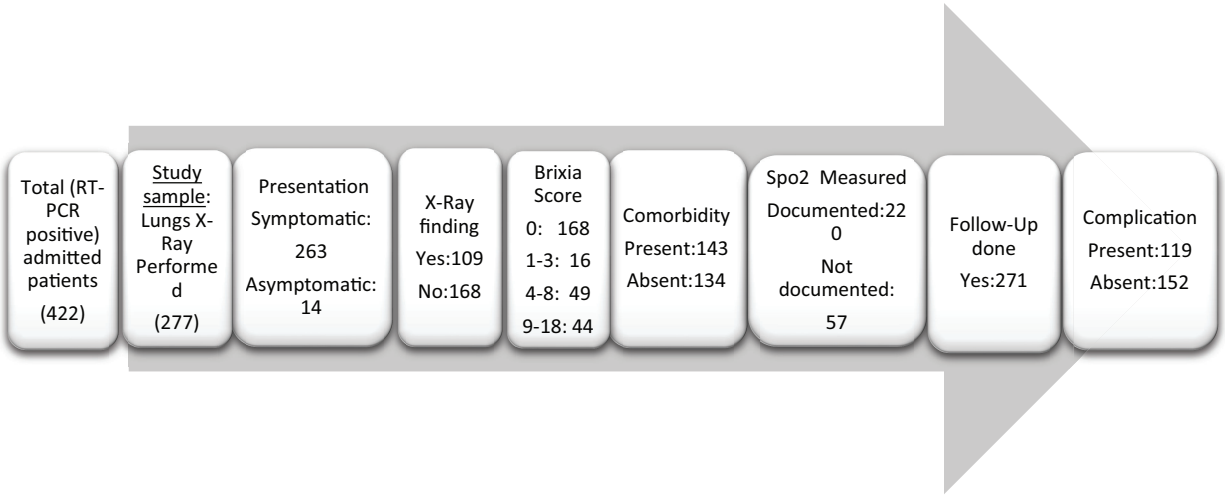

Fig.-3: *The sample size of the different components of the study*

The information collected from the patients and their medical record were entered in the Microsoft Excel workbook by the researchers followed by reviewing the data for any necessary corrections. The finalized data were imported into the statistical software (SPSS Version 25) for analysis.

Variables and Definitions: Patients were categorized into: age categories were less than 21 years, 21-40 years, 41-60 years, and more than 60 years. During the initial and subsequent consultation, the patients also gave information related to their smoking habits, comorbidities, history of contact with any confirmed COVID-19 patients, duration of symptoms, and the in-hospital outcome of the patients. Measured Spo2 (%) level were categorized as severe case:<91%, moderate case:91%-93% and mild case:>93%. We have also compiled the performed radiological tests (chest x-ray) and rating by Brixia score and then compare with clinical findings, measure Spo2 level and short-term outcome. During the follow-up consultation via telephone, the patients mentioned a wide range of post covid symptoms that were recorded as self-reported post-covid-19 complications.

Statistical Analysis: To describe the characteristics of the study sample, we have categorized their demographic information, health status, and clinical findings associated with COVID-19, which were summarized as counts and percentages, and to assess their association using at the significance level of P <0.05 (in case of small sample size, less than 5, in the bivariate cells Fisher's exact test was used).Next,considering the measured Oxygen Saturation level of the patient as a clinical severity marker and investigated a similar association between the result of the radiological test (Brixia score) and the oxygen saturation measured during the examination to find any significant association which may provide further insight of COVID-19. Lastly, we have focused to report the post-covid complications during follow-up that were recorded at different times on a single teleconsultation. We used SPSS, version 25, to perform the data management and statistical analysis.

Results:

A total of 277 RT-PCR-positive patients out of 422 (admitted) were performed chest x-ray P/A view according to Physician's advice; among them 58%(161) were male and 42%(116) were female. Age variation was ranged from 6 to 95 years and the mean age was 42.48±15.53SD. Age groups were divided into 0-20 years 6.14% (17), 21-40 years 41.88% (116),41-60 years37.90% (105), and more than 60 years 14.08% (39).More than 50% of the study population were service holders. Most (94.9%) of the patients were symptomatic (M-151, F-112) and only 15.1%(14) patients were asymptomatic. 93.8% (151) male and 96.6% (112) female were symptomatic.Symptoms were more frequent (100%)among the age group>60year; whereas age group<21 years, 94.1% were symptomatic (p-value 0.101).Comorbidities had a significant relationship with the presentation of symptoms. 97.9% of symptomatic patients had comorbidities but 91.8% of asymptomatic patients had no comorbidities(p-value 0.02).The most common symptoms were fever(29.4%),cough(22.4%), and shortness of breath (16.7%).

Among the x-ray performed patients (n=277), 39.35 %(109) patients (M=77, F=32) had positive findings suggestive of covid-19 infection and 60.64% (168) patients (M=84, F=84) were normal findings. Co-morbidities had a significant relation on positive x-ray findings. Of those who had comorbidities,55.9%% had positive x-ray findings, and those who had no co-morbidities, 21.6% had positive x-ray findings for covid-19(p-value 0.000).Sex also had significant relation (p-value 0.001) on positive x-ray findings, male patients (70.6%) had more positive findings than female patients (29.4%).Smoking may affect symptoms because no female had a smoking history, on the other hand, 21.73% of male patients had positive smoking history though it is not statistically significant (p-value 0.2). 41.1% of symptomatic patients had positive x-ray findings and on the other hand,only 7.1% of asymptomatic patients had positive x-ray findings for covid-19 (fisher's exact test 0.011). Positive x-ray findings were more common among the age group 41 to 60 years(strong relationship) p-value 0.000, Cramer's V 0.59.

Among the positive x-ray findings (n=109), 99.08%(108)patients were symptomatic (M=77, F=31), and only one female patient had positive x-ray findings but was asymptomatic. On the other hand, among the normal x-ray findings (n=168); 92.26%(155)were symptomatic and 7.74% (13) were asymptomatic. Among the symptomatic positive x-ray findings patients (n=108), all(100%) had respiratory symptoms. On the other hand, among the symptomatic normal x-ray findings patients(n=168), 69.64%(117)had respiratory symptoms. The commonest respiratory symptoms were cough (100%=108), shortness of breath (50.92%=55), Sore-throat (18.51%=20) Runny nose (8.33%=09).

Out of total 277 patients, 51.6% (M-85&F-58) had comorbidities and most common co-morbidities among the patients were HTN-39.9%(M-59,F-30), DM-38.6%(M-54,F-32), Bronchial Asthma-11.2%(M-8, F-17).Majority 51% (73) patients (M-44,F-29) had multiple comorbidities.Comorbidities had a significant effect (p-value 0.000) on clinical severity. 28.7% of clinically severe patients had comorbidities and on the other hand, those had no comorbidities, 11.2% were clinically severe.

Male patients had more bilateral lungs involvement (table 1) than female patients (p-value 0.002).94.49%

(M-73, F-30) patients had both lungs involvement, 2.75% (03) male patients had only right lung involvement and 2.75% (03) patients had only left lungs involvement. Involvement of zones (table 2) showed that 11.9% (M-24, F-9) had both mid and lower zones, 6.1% (M-15,F-2) had all zones, 5.8% (M-9, F-7) had both lower zones involvement (P-value 0.05).Regarding the type of opacities (table 3), 43.12% (47) patients had consolidations; most had 70.21% (33)multifocal consolidations. Regarding other opacities;36.7% (40) had pneumonitis, 35.78% (39) had basal angels were minimally obscured, 20.18% (22) had acute pulmonary inflammatory lesion, 4.58% (05) had pleural effusion, 0.92% (01) had pneumothorax.

Table-I

*Sex * Lung(s) involvement Crosstabulation*

			Lung(s) involvement				Total	*p-value*
			Normal	Both lungs	Right lung only	Left lung only		
Sex	Male	Count	84	73	3	1	161	
		% within Sex	52.2%	45.3%	1.9%	0.6%	100.0%	
	Female	Count	84	30	0	2	116	*0.002*
		% within Sex	72.4%	25.9%	0.0%	1.7%	100.0%	
Total		Count	168	103	3	3	277	
		% within Sex	60.6%	37.2%	1.1%	1.1%	100.0%	

Table 1: Involvement of lungs among the X-ray performed patients

Table II

*Zone(s) involvement * Sex Crosstabulation*

			Sex		Total
			Male	Female	
Zone(s) involvement	Normal finding	Count	84	84	168
		% within Sex	52.2%	72.4%	60.6%
	Both lower zones	Count	9	7	16
		% within Sex	5.6%	6.0%	5.8%
	All Zones	Count	15	2	17
		% within Sex	9.3%	1.7%	6.1%
	Both mid & lower zones	Count	24	9	33
		% within Sex	14.9%	7.8%	11.9%
	Right all zones and left mid & lower zones	Count	10	7	17
		% within Sex	6.2%	6.0%	6.1%
	Right all zones & left lower zone	Count	2	0	2
		% within Sex	1.2%	0.0%	0.7%
	Right mid & lower zones and left lower zone	Count	4	2	6
		% within Sex	2.5%	1.7%	2.2%
	Right mid & lower zones and left all zones	Count	4	2	6
		% within Sex	2.5%	1.7%	2.2%
	Right lower zone and left mid & lower zones	Count	3	1	4
		% within Sex	1.9%	0.9%	1.4%
	Right lower zone only	Count	2	0	2
		% within Sex	1.2%	0.0%	0.7%
	Right all zones and left upper & lower zones	Count	1	0	1
		% within Sex	0.6%	0.0%	0.4%
	Right all zones and left upper & mid zones	Count	1	0	1
		% within Sex	0.6%	0.0%	0.4%
	Left lower zone only	Count	0	2	2
		% within Sex	0.0%	1.7%	0.7%
	Left mid & lower zones	Count	1	0	1
		% within Sex	0.6%	0.0%	0.4%
	Right mid & lower zones	Count	1	0	1
		% within Sex	0.6%	0.0%	0.4%
Total		Count	161	116	277
		% within Sex	100.0%	100.0%	100.0%

p-value 0.058

Table:III

$ Chest xray findings Frequencies

		Responses		Percent of Cases
		N	Percent	
Chest_xray_findings[a]	Basal angels are obscured	39	22.9%	35.8%
	Covid-19 pneumonia	3	1.8%	2.8%
	Covid-19 Pneumonitis	40	23.5%	36.7%
	ARDS	1	0.6%	0.9%
	Other finding(s)	10	5.9%	9.2%
	Consolidations	47	27.6%	43.1%
	Acute pulmonaryinflamat. involvement	22	12.9%	20.2%
	Hyperinflated both lungs fields	3	1.8%	2.8%
	Pleural effusion	5	2.9%	4.6%
Total		170	100.0%	156.0%

a. Dichotomy group tabulated at value 1.

Table III: Chest X-ray findings

Clinical severity was assessed(Table IV) by symptoms and documented measured Spo2 level(Spo2<91%, 91%-93%, and >93%) and leveled as severe, moderate, and mild cases respectively. Out of 277 patients; 79.42%(220) patients had documentation of measured Spo2 level(M-58.1%,F-41.9%) and 20.58%(57) patients were measured Spo2 level but there was no documentation. Among them 20.2% were clinically severe cases(M-23.6%,F-15.5%), 11.6% were moderate cases(M-13%,F-9.5%), 47.7%(M-43.5%,F-53.4%) were mild cases and 20.6% were not ranked as severity due to unavailability of documented measured Spo2 level. Age had a significant relation to clinical severity(p-value 0.000); 38.5% of clinically severe patients were age group>60years, 23.8% had age group 41-60 years, 11.2% had age group 21-40 years and 17.6% had age group <21years. Sex also influences clinical severity though statistically not significant(p-value 0.2). 23.6% of male patients were clinically severe and 15.5% of female patients were clinically severe.

Table IV

*Age_Group * Clinical severity Crosstabulation*

			Clinical severity				Total
			Not done (No documentation of Spo2)	Severe (Spo2: <91%)	Moderate (Spo2: 91-93%)	Mild (Spo2: >93%)	
Age_Group	1 to 20 years	Count	5	3	1	8	17
		% withinAge_Group	29.4%	17.6%	5.9%	47.1%	100.0%
	21 to 40 years	Count	33	13	6	64	116
		% withinAge_Group	28.4%	11.2%	5.2%	55.2%	100.0%
	41 to 60 years	Count	15	25	16	49	105
		% withinAge_Group	14.3%	23.8%	15.2%	46.7%	100.0%
	> 60 years	Count	4	15	9	11	39
		% withinAge_Group	10.3%	38.5%	23.1%	28.2%	100.0%
Total	Count	57	56	32	132	277	
	% within Age_Group		20.6%	20.2%	11.6%	47.7%	100.0%

Table IV: Clinical severity among the study patients (p-value 0.000)

Relationship between X-Ray findings and measured Spo2 level (Table V) showed that there was significant relationship between positive X-Ray findings and decreased Spo2 level (p value 0.000, Cramer's V 0.47).Among the positive x-ray and positive RT-PCR result(n=109), total 99 patients were documented measured Spo2(%);39(35.8%)patients had Spo2 <91%, 25(22.9%) patients had SpO2 91-93% and 35(32.1%) patients had > 93% & 10 (9.2%) patients had no documentation for measured Spo2. On the other hand, among the positive RT-PCR result but normal x-ray findings(n=168), 10.1% (17) patients had Spo2 <91%, 4.2% (07) patients had Spo2 91-93%, 57.7% (97) patients had Spo2 is >93% and 28% (47) patients had no documentation for measured spo2.Smoking had no significant relationship on clinical severity or decreased Spo2 level(p value 0.23).

Table:V

*Lungs X-Ray Findings * Documented lowest Spo2 level(%) Crosstabulation*

			Documented lowest Spo2 level(%)				Total
			No document available	Less than 91%	Between 91to 93%	More than 93%	
Lungs X-ray Findings	No	Count	47	17	7	97	168
		% within Lungs X-Ray Findings	28.0%	10.1%	4.2%	57.7%	100.0%
		% within Documented lowest Spo2 level(%)	82.5%	30.4%	21.9%	73.5%	60.6%
	Yes	Count	10	39	25	35	109
		% within Lungs X-Ray Findings	9.2%	35.8%	22.9%	32.1%	100.0%
		% within Documented lowest Spo2 level(%)	17.5%	69.6%	78.1%	26.5%	39.4%
Total		Count	57	56	32	132	277
		% within Lungs X-Ray Findings	20.6%	20.2%	11.6%	47.7%	100.0%
		% within Documented lowest Spo2 level(%)	100.0%	100.0%	100.0%	100.0%	100.0%

p-value 0.000

Table V: Relationship between chest X-ray findings and Spo2 level

Radiological severity was assessed by Brixia score and correlated with clinical findings and short-term outcomes. Brixia's score was ranged from 0 to 18. This study showed that there is a significant correlation between age and Brixia score (p-value 0.000 and R square 0.27). Total 5.8% (16)patients had Brixia score less than 4, 17.7% (47) patients had Brixia score 4-8, 15.9% (44) patients had Brixia score more than 8, and 60.6% (168) patients had normal X-Ray findings (Brixia score 0).Relationship between Brixia score and Spo2 level (**Table VI**), there was a significant relationship between higher Brixia score(>8) with clinical severity(Spo2<91%), p-value 0.000, Cramer's V 0.30.

Table VI

*Brixiascore Category * Clinical severity: Crosstabulation*

			Clinical severity			Total	*p-value*
			Not done (No documentation of Spo2)	Severe (Spo2: <91)	Moderate (Spo2: 91-93%)	Mild (Spo2: >93%)	
Brixia_ Categor	Brixia score:1-3	Count	3	2	2	9	16	*0.000*
		% within Clinicalseverity	5.3%	3.6%	6.3%	6.8%	5.8%	
	Brixia score:4-8	Count	4	12	12	21	49	
		% within Clinical severity	7.0%	21.4%	37.5%	15.9%	17.7%	
	Brixia score: >8	Count	3	25	9	7	44	
		% within Clinical severity	5.3%	44.6%	28.1%	5.3%	15.9%	
	Normal X-Ray finding	Count	47	17	9	95	168	
		% within Clinical severity	82.5%	30.4%	28.1%	72.0%	60.6%	
Total	Count	57	56	32	132	277		
		% within Clinical severity	100.0%	100.0%	100.0%	100.0%	100.0%	

Table VI: Relationship between Brixia scores and clinical severity

Regarding in-hospital outcome, 94.9% (263) were recovered, 3.6% (10) were referred, 1.1% (03) were death and 01(0.4%) were discharged on request.Comorbidities affected hospital outcomes though not statistically significant(p-value 0.19). 92.3% of recovery and 1.4% of death patients had comorbidities and on the other hand, 97.8% of recovery and 0.7% of death patients had no comorbidities. Among the positive x-ray and positive RT-PCR results (n=109), 1.1% (3) patients (male) were dead, one had a Brixia score of 7, two had Brixia score 10 & 11. Among the death patients, age variation-<21 years:01 and 41 -60 years:02. 02 patients had comorbidity and 01 patients had no comorbidity. Most had more than one comorbidity and the commonest comorbidity was HTN &DM.

Regarding short term outcome after hospital discharge; total 42.96% (119) patients(M-56.3%, F-43.7%) had post covid-19 complications (Table VII). Among the post-covid-19 complications; 52.9% were systemic manifestations, 42% were respiratory manifestations, 16% were musculoskeletal manifestations, 7.6% were GIT manifestations, 6.7% were cardiac, 4.8% were neurological, 2.5% were psychiatric manifestations, 1.7% (02) patients were death out of total 9(2.04%) death and 4.2% were other complications. Musculoskeletal, Psychiatric, Cardiac, Systemic, and Neurological manifestations were more common in females and Respiratory manifestations were more common in males.

Table VII

*Post covid complications *Sex Cross tabulation*

			Sex		Total
			Male	Female	
$Post_covid complication [a]	Respiratory Manifestation	Count	30	20	50
		% within Sex	44.8%	38.5%	
		% of Total	25.2%	16.8%	42.0%
	Gastrointestinal manifestation	Count	5	4	9
		% within Sex	7.5%	7.7%	
		% of Total	4.2%	3.4%	7.6%
	Neurological Manifestation	Count	14	12	26
		% within Sex	20.9%	23.1%	
		% of Total	11.8%	10.1%	21.8%
	Psychiatric Manifestation	Count	1	2	3
		% within Sex	1.5%	3.8%	
		% of Total	0.8%	1.7%	2.5%
	Musculoskeletal Manifestation	Count	5	14	19
		% within Sex	7.5%	26.9%	
		% of Total	4.2%	11.8%	16.0%
	Systemic Manifestation	Count	35	28	63
		% within Sex	52.2%	53.8%	
		% of Total	29.4%	23.5%	52.9%
	Cardiac Manifestation	Count	3	5	8
		% within Sex	4.5%	9.6%	
		% of Total	2.5%	4.2%	6.7%
	Death	Count	2	0	2
		% within Sex	3.0%	0.0%	
		% of Total	1.7%	0.0%	1.7%
	Other Manifestations	Count	3	2	5
		% within Sex	4.5%	3.8%	
		% of Total	2.5%	1.7%	4.2%
Total		Count	67	52	119
		% of Total	56.3%	43.7%	100.0%

Percentages and totals are based on respondents.
a. Dichotomy group tabulated at value 1.

Table VII : Post covid complication

Table VIII

*Brixia_Categor * Any Complication Crosstabulation*

			Any Complication				Total	*p-value*
			Yes	No	Unknown	Death after discharge		
Brixia_	Brixia score:1-3	Count	7	9	0	0	16	
Categor		% withinBrixia_Categor	43.8%	56.3%	0.0%	0.0%	100.0%	
	Brixia score:4-8	Count	19	28	1	1	49	
		% withinBrixia_Categor	38.8%	57.1%	2.0%	2.0%	100.0%	
	Brixia score: >8	Count	20	22	0	2	44	
		% withinBrixia_Categor	45.5%	50.0%	0.0%	4.5%	100.0%	*0.44*
	Normal X-Ray	Count	73	93	2	0	168	
	finding	% within Brixia_Categor	43.5%	55.4%	1.2%	0.0%	100.0%	
Total		Count	119	152	3	3	277	
		% withinBrixia_Categor	43.0%	54.9%	1.1%	1.1%	100.0%	

Table VIII: Relationship between Brixia scores and post covid complications

Comorbidities had an effect on short-term outcomes after hospital discharge though not statistically significant (p-value 0.16). Of those who had post covid complications (n=119) 49% had comorbidities, 1.4% were death and on the other hand, for those who had no comorbidities, 36.6% had post covid-19 complication and death 0.7%.Age also affects post-covid-19 complications though statistically not significant (p-value 0.16). Age group 1-20yrs; 29.4% had post covid complications but age group 41-60yrs, 51.45% had post covid-19 complications.Among the positive x-ray findings (n=109), 42.2% (46) had post covid-19 complications, 32 were male and 14 were female. On the other hand, those who had normal x-ray findings(n=158), 45.57% (72) had post covid-19 complications (M-38, F-34). The most common respiratory complications were SOB on exertion (23), non-productive cough (13).Among the non-respiratory complications, the most common was post covid fatigue syndrome (42). Other complications were feverish feeling, headache, body ache, chest pain, and others.

Comparison between Brixia score and post covid complications (table8); the more the Brixia score, the more the chance of post covid complications though statistically not significant (p-value 0.44).Of those who had Brixia score <4, 43.8% had post covid-19 complications, and those who had score >8, 45.5% had post covid-19 complications.

Discussion:

In this study, we evaluated the chest X-Ray findings in covid-19 infected patients who were RT-PCR positive. Chest radiographs may be normal in early/ mild disease due to long incubation of covid-19(12 days) and tend to peak 10-12 days after the onset of clinical symptoms.[22] In a study of COVID-19 cases requiring hospitalization, 69% had an abnormal chest radiograph at the initial time of admission and 80% had radiographic abnormalities sometime during hospitalization.[6] Another study shows that up to 18% demonstrate normal chest radiographs when mild or early in the disease course, but this decreases to 3% in severe disease.[9,10] Some study shows that chest X-Ray sensitivity for COVID-19 related lung shadowing of 25 to 69 percent.[23,24] The sensitivity of the chest X-ray positivity was 69 percent.[25] Our study shows 39.36% had positive findings for covid-19 on chest radiographs. A case series in China reported that a subset of two of five (40%) patients had normal chest radiographs.[26]Using the database of a large UC network in New York/New Jersey, researchers identified 718 patients with confirmed COVID-19 between March 9 and 24, 2020- the period during which greater NYC was the virus epicenter and their analysis found that 58.3% of the CXRs were normal, 89% either normal or only mildly abnormal despite symptoms at presentation severe enough to warrant CXR the UC setting.So, a normal chest X-ray does not exclude covid-19 pneumonia in symptomatic patients.

A study shows frequent involvement of bilateral lower zone consolidation, which peaked at 10–12 days from symptom onset.[17] A quantitative meta-analysis covering 2847 patients in China and Australia, and a multinational descriptive analysis of 39 case report articles summarizing 127 patients, found that covid-19 pneumonia changes are mostly bilateral on chest

radiographs (72.9%, 95% confidence interval 58.6 to 87.1).A small case series in Korea showed that bilateral lung involvement is most common(72%) and unilateral (25%).[27,28] Our study shows, 94.5% had bilateral involvement and 5.5% had unilateral involvement. Using the database of a large UC network in New York/ New Jersey, researchers identified 718 patients with confirmed COVID-19 between March 9 and 24, 2020- the period during which shows abnormalities were in the lower lobe in 215 (33.8%), bilateral in 133 (20.9%), and multifocal in 154 (24.2%).A small case series in Korea showed that 80% of radiographical changes were found peripherally.[28] ground glass (68.5%).[27]The appearance of nodules, pneumothorax, or pleural effusion (1-3%). A retrospective case series of 64 patients hospitalized with covid-19 infection in Hong Kong found that chest radiograph changes are often peripheral (41%) and lower zone (50%) in distribution.[30] Our study shows that 11.9% had both mid & lower zones, 6.1% had all zones involvement and 5.8% had both lower zones involvement.Another study shows the most common changes in the lung include consolidation, ground-glass opacity, and nodular shadowing.[29] Our study also found that the most common radiological opacity were consolidations (43.11%)(mostly multifocal consolidations) and covid-19 pneumonitis(36.69%), 4.59% had pleural effusion, 0.9% had a pneumothorax. Another study shows that the distribution is most often bilateral, peripheral, and lower zone predominant.[9,6] In contrast to parenchymal abnormalities, pleural effusion is rare (3%).[6]Some study shows that findings at chest radiography in patients with coronavirus disease 2019 frequently showed bilateral lower zone consolidation.[17]

A study in a corona filtration center, Benazir Bhutto Hospital Rawalpindi, based on CXR classification of British Society of Thoracic Imaging (BSTI) shows COVID-19 CXRs generally manifested a spectrum of pure ground-glass, mixed ground-glass opacities to consolidation in bilateral peripheral middle and lower lung zones. A quantitative meta-analysis covering 2847 patients in China and Australia, and a multinational descriptive analysis of 39 case report articles summarizing 127 patients, found that ground-glass opacity in 68.5% of cases (95% CI 51.8 to 85.2)[27]. In a study among 79 patients with classic/probable COVID-19 CXR findings, 71 (89.8%) had bilateral consolidation/ground glass haze, 72 (91.1%) had peripheral lung involvement while 66 (83.5%) had middle and lower zone involvement.[12]Using the database of a large UC network in New York/New Jersey, researchers identified 718 patients with confirmed COVID-19 between March 9 and 24, 2020- the period during which greater NYC was the virus epicenter show that of the 265 cases (41.7%) read as abnormal, 195 were classified as mild, 65 as moderate, and 5 as severe diseases. In our study, we assessed radiological severity by Spo2 &Brixia score and correlate with clinical findings and outcome. Brixia scores were ranged from 0 to 18. This study showed that there is a significant relationship between age and Brixia score (p-value 0.000 and R square 0.27). Total 5.8% (16)patients had Brixia score less than 4, 17.7% (47) patients had Brixia score 4-8, 15.9% (44) patients had Brixia score more than 8, and 60.6% (168) patients had normal X-Ray findings (Brixia score 0).

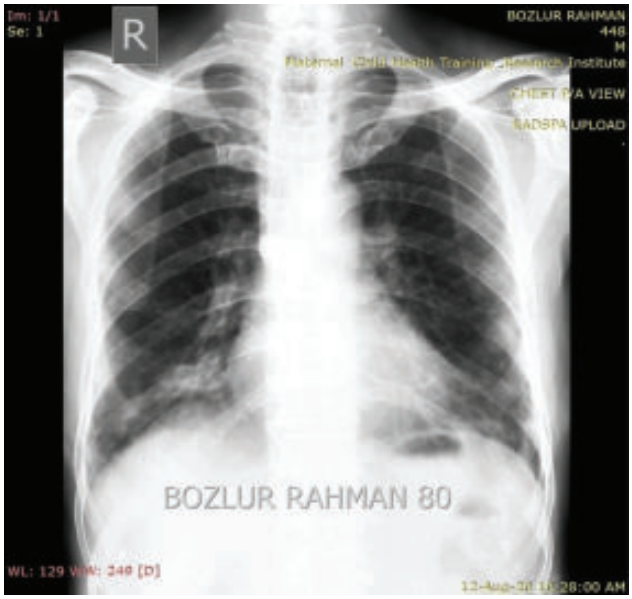

Fig-A: *Brixia score- 4*

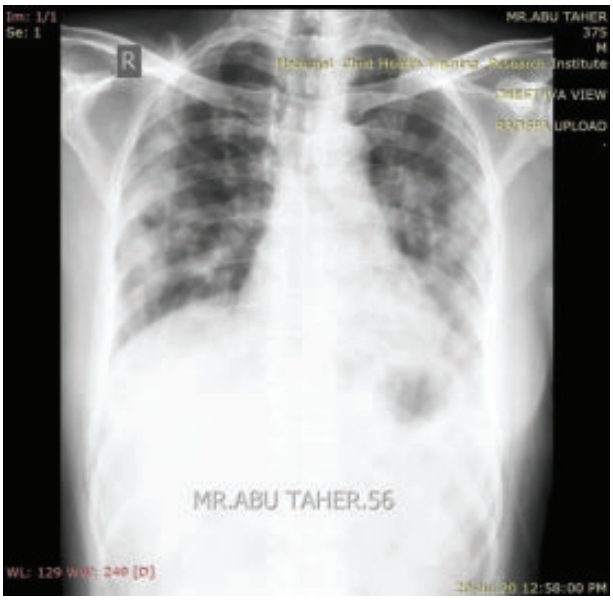

Fig-B: *Brixia score- 13*

Fig. (A& B): *Chest X-Ray findings in COVID-19 infected patients*

An Egyptian Journal of Radiology and Nuclear Medicine volume 51 shows that the outcome of COVID-19 disease was significantly related to the age, sex, and TSS of the patients. Male patients showed a significantly higher mortality rate as compared to female patients (*P* value 0.025). Also, the mortality rate was higher in patients older than 40 years, especially with higher TSS. Radiographic findings are very good predictors for assessing the course of COVID-19 disease and it could be used as long-term consequences monitoring.[31] Our study showed mortality was related to sex, age, and higher Brixia score. 1.1% of male patients were death but no female patient was dead among the study subjects.

Limitations:

Study limitations include its retrospective and observational nature. Additionally, only a single CXR was obtained for each patient at different times of clinical presentation, it is impossible to know whether patients with normal films at the time of imaging developed radiographic findings later in their illness. Although chest x-ray (CXR) is considered not sensitive for the detection of pulmonary involvement in early-stage disease.

Conclusion:

This study reveals bilateral lungs involvement and multifocal consolidations are the most common patterns of X-ray findings, and clinical severity is associated with a higher Brixia score, male sex, increasing age, and presence of comorbidities.This will enhance our clinician's understanding of CXR findings in suspected COVID 19 patients because of their availability and ease of decontamination, and delayed serological results.

Conflict of Interest:

The author stated that there is no conflict of interest in this study

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Ethical consideration:

The study was conducted after approval from the ethical review committee. The confidentiality and anonymity of the study participants were maintained

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