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CLINICO-RADIOLOGICAL CORRELATION AND OUTCOME OF COVID-19 PATIENTS PRESENTING TO A L2 CENTRE IN WESTERN UTTAR PRADESH

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ABSTRACT

Objective of the current study was to evaluate the clinical features and severity of chest x-ray and its association with outcome in patients of Covid-19 in terms of hospital stay, discharge or death during hospital stay. A total of 100 patients above the age of 15 years diagnosed with Covid-19 by RT PCR of nasopharyngeal/oropharyngeal samples were included in the study. History of symptoms at onset was recorded, Chest-x-ray and hematological investigations were done. Chest x-ray findings were divided into three zones upper, middle and lower and each zone was given a score. Each zone involvement of either lung was given a score of 1. Maximum score was 6 with involvement of all zones of both lungs and minimum score was zero in patients with normal chest x-ray. These patients were followed up during their hospital stay in terms of oxygen requirement, Non invasive ventilation (NIV) requirement, Invasive mechanical ventilation, number of days of hospital stay and the outcome in terms of discharge or expired. Among the total of 100 patients, 58 were male and 42 were female patients. Maximum numbers of patients were in age group 45-60 years. Most common presenting complaint was fever followed by shortness of breath. Most common co morbidity was diabetes mellitus. We found that hypoxia at presentation, rate of intubation, and mortality was highest in patients with higher chest x-ray score and minimum in patients with chest x-ray score of zero. Discharge rate was highest in patient in lowest chest x-ray score. We conclude from the current study that chest x-ray score at the time of presentation has a predictive role in determining the risk of intubation and outcome in patients of covid-19.

Keywords: Covid-19, Chest X-ray scoring, Outcome, Co-morbidity.

1. INTRODUCTION

Covid-19 (Coronavirus disease 2019) is an extremely contagious disease which was first reported in Wuhan, China, in December 2019. Since then, it has involved the whole world in span of just 8 months with around 21 million cases with more than 7 lakhs deaths. The causative agent now known as Severe acute respiratory syndrome Corona virus-2 (SARS-CoV 2) which is an enveloped beta coronavirus-2, officially recognized by the World Health Organization (WHO) as a pandemic on 11 March 2020. First case of Covid-19 in India was reported on 30th January 2020. As of August 2020, the number of cases of confirmed Covid-19 globally is over 21 million with highest number of cases in US and exceeding two million cases in India [1]. Fist Covid-19 case was found in at our centre on 9 April 2020 and first death was reported on 21 Aril 2020.

Patients presenting with symptoms of flu-like illness, shortness of breath, fatigue, myalgia and/or a change in normal sense of smell (anosmia) or taste, lymphopenia on full blood count, Covid-19 will be an important differential diagnosis for the time being [2,3].

Studies have shown that many patients with Covid-19 infection do not develop pneumonia [4]; however, chest radiography of people who are seriously ill with respiratory symptoms when they present to hospital can help to identify those with covid-19 pneumonia.

The aim of this study was to study clinical and initial chest X-ray findings of the patients of Covid-19 diagnosed by RT-PCR of nasopharyngeal/oropharyngeal samples. These patients were followed during their hospital stay in terms of oxygen requirement, NIV requirement, Invasive mechanical ventilation, number of days of hospital stay and the outcome.

2. MATERIAL AND METHODS

This was a prospective observational study done at a tertiary care centre in western part of Uttar Pradesh state

of India from April 2020 to July 2020 in the department of TB and Respiratory Diseases. Ethical clearance for the same was obtained from the instituitional ethical committee.

2.1. Inclusion criteria

All the patients above 15 years of age diagnosed with Covid-19 infection by RT-PCR of nasopharyngeal/ oropharyngeal sample. Patients were classified into mild, moderate, severe category according to WHO classification [5].

2.2. Exclusion criteria

- Patients presenting with symptoms of flu and testing negative for Covid-19 by RT-PCR of nasopharyngeal/oropharyngeal sample.
- Patients with chest x-ray features of pneumonia but tested negative for Covid-19 by RT-PCR of nasopharyngeal/oropharyngeal sample.
- All patients tested positive for Covid-19 by RT-PCR of nasopharyngeal/oropharyngeal sample but less than 15 years of age.

2.3. Methodology

A total of 100 patients diagnosed by RT-PCR of nasopharyngeal/oropharyngeal samples were included in the study. Chest x-ray and blood investigations like haemogram, renal function test, and liver function test were done for all patients. Spo2 at presentation in emergency department was recorded for all patients by pulse oximeter. D-dimer, Serum Ferritin, CRP were done for the patients who were having spo2- level below 94 % at the time of presentation.

Chest X-ray findings were divided into three zones; upper, middle and lower zone based on involvement of the area of lung. Upper zone was marked from apex of lung to upper hilar margin, middle zone between upper and lower hilar margin and lower zone extending between lower hilar margin to costophrenic sulcus respectively, however these zones do not correspond to any anatomic structures [6]. Each zone was assigned a number so the maximum score was six in patients involving all zones of both the lungs and minimum score was zero in patients with normal chest x-rays. Chest X-rays were reported by two radiologists. Patients were followed up during the entire hospital stay. There daily progress were recorded in terms of vitals as blood pressure, pulse rate, respiratory rate, temperature charting, saturation at room air, oxygen requirement and need for noninvasive or invasive ventilation. Outcome was seen in terms of number of days of conversion for mild, moderate and severe category, improvement on supplemental oxygen, NIV and mechanical ventilation, patients discharged after testing negative by RT-PCR or patient expired during course of treatment and its association with chest x-ray findings at presentation expressed in terms of percentage.

Hospital administration formulated various committees for the management of patients at this time of pandemic which were: Administrative committee, Management protocol Committee, Security Team, Health Care Welfare Team, Central Laboratory Services/ Diagnostic Workshop Team, IT &Telemedicine, Public Relation Committee, Duty Roaster and Day to Day Activities Team which have their roles defined.

Hospital has set up an exclusive COVID Ward with a central control room equipped with tele-medicine facility where patients who tested positive for Covid-19 were admitted and managed. Apart from PPE adorned physicians and para-medical staff giving duties inside the Isolation Ward, multi-specialty team of physicians keeps in touch with all Covid patients from control room through telemedicine. Patients were managed symptom-matically according to the present recommendations of WHO [5].

3. RESULTS

Total 100 patients were included out of which 58 were male and 42 were female (chart 1). Maximum number of patients were in the age group 46-60 years (16 male,13 female) followed by age groups 15-30 years (13 male; 14 female), 61-75 years (17 male; 5 female), 31-45 years (12 male; 9 female), and one 80 years old female (chart 2).

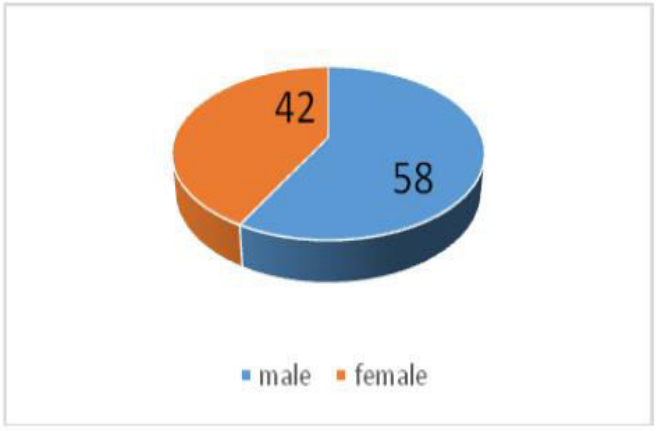

Chart 1: Demographic classification of study group

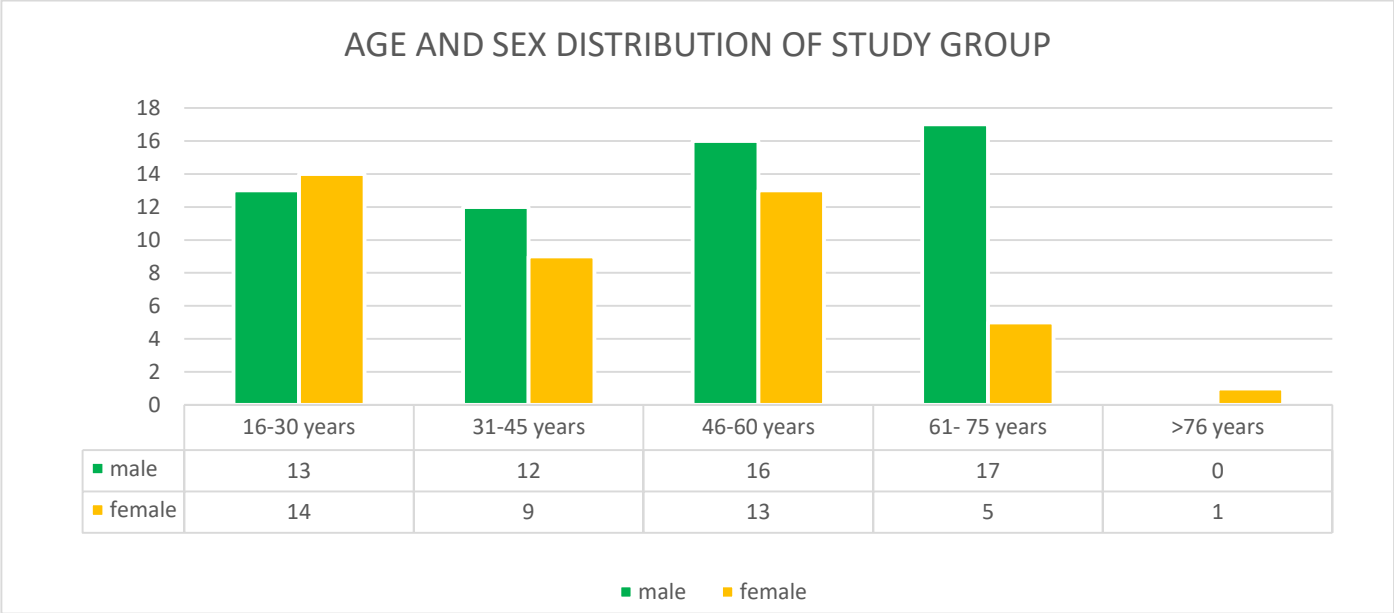

Chart 2: Distribution of patients in different age groups

The most common symptom was fever; total 57 patients presented with fever out of which 35 patients had fever of less than 5 days duration and 22 had fever for more than 5 days before presentation. 2nd most common presenting symptom was shortness of breath; total 42 out of 100 patients presented with breathlessness out of which 26 patients had less than 5 days duration and 16 had more than 5 days duration. 3rd most common symptom was dry cough in 30 patients; cough with expectoration in 15 patients, Followed by gastro-intestinal symptoms which were seen in 12 patients, sore throat was reported by 11 patients, fatigue, malaise and generalized weakness in 10 patients. Other less common symptoms were rhinitis/cold, loss of taste and smell and non specific symptoms like palpitation and headache. 2 patients presented with altered sensorium and were found positive for Covid-19 by RT-PCR (table 1).

Out of 100 patients included in the study, 07 patients were asymptomatic out of which two patients were on chemotherapy for malignancy and were immune-compromised and tested positive for Covid-19 by RT-PCR during workup before admission for chemotherapy. Remaining 5 patients had history of direct contact with a diagnosed case of Covid-19 and were tested in contact tracing and came out to be positive for Covid-19 by RT-PCR, however all of them were asymptomatic during hospital stay and did not complain of any Covid-19 symptoms.

Many co morbidities were seen in patients included in the study, out of which the most common was type 2 diabetes mellitus seen in 15 patients, both diabetes and systemic hypertension was seen in 9 patients and only systemic hypertension was seen in 7 patients. Other less common chronic diseases seen in the study group included coronary artery disease (3 patients), chronic kidney disease (2 patients), chronic liver disease (1 patient), hypothyroidism (3 patients), pulmonary Koch (3 patients), COPD (2 patients), bronchial asthma (3 patients), severe anemia (2 patients) and HIV/AIDS (1 patient).

Two (2) female patients were pregnant and 2 patients were on chemotherapy for malignancy making them high risk individual for contracting the disease. Among 100 patients included in the study single lung involvement was seen in 7 patients among which 4 patients had involvement of right lung (score=3) and 3 patients of left lungs respectively (score =3) (table 2).

Bilateral lung involvement was seen in 42 patients out of which 24 patients had involvement of all zones of both the lungs (score=6), 5 patients had involvement of only middle and lower zones of both the lungs (score= 4), 4 patients had involvement of only lower zones of both the lungs (score=2). In 6 patients, both lungs were involved but right lung was involved more than left (score=5) and in 3 patients who had involvement of both lungs left lung was involved more than right (score 5) (table 3). Normal chest X-ray at presentation was seen in 51 patients (score =0).

Table 1: Presenting complains of study group

Symptoms	</=5 Days duration	>5 days duration	Total
Fever	35	22	57
Shortness of breath	26	16	42
Dry cough	18	12	30
Cough with expectoration	11	4	15
GI symptoms	10	2	12
Sorethroat	6	5	11
Malaise/fatigue	4	6	10
Rhinitis/cold	2	2	4
Loss of taste/smell	2	0	2
Altered sensorium	2	0	2
Nonspecific symptoms like ghabrahat/chest pain/Headache	4	1	5

Table 2: Days of conversion and sp02 of patients with unilateral lung involvement

Unilateral lung involvement	Central	Peripheral	Diffuse	Spo2 at presentation	Time to conversion	Death
Right lung Left lung destroyed	-	-	All zones involved	58% on room air	-	Expired (Fuc of MDR TB)
Right lung			Yes All zones involved	80% on room air	14 days	-
Right lung involved	-	yes Lower zone involved	-	98% on room air	13 days	-
Left lung involved	-	-	Yes All zones involved	60% on room air	-	Expired (bronchial asthma)
Left lung involved	-	-	Yes All zones involved	90% n room air	13	-
Left lung involved	-	-	Yes Lower zone involved	80% on room air	12	-
Right lung involved	-	yes Lower zone involved		96% on room air	12	-

Table 3: Mean days of conversion, hypoxia at presentation and death of patients with bilateral lung involvement with different chest X-ray scores

Bilateral lung involvement	No. of patients	Hypoxia at presentation by pulse oximeter	Mean days of conversion	Deaths
All zones involved	24 (X-ray score =6)	19	11.6	14
Right lung more involved than left lung	6 (X-ray score = 5)	5	11.8	1
Left lung more involved than right lung	3 (X-ray score = 5)	2	10	-
Middle and lower zones involved both lung	5 (X-ray score=4)	3	12.25	1
Only lower zones involved both lung	4 (X-ray score= 2)	0	11	-

Among the patients with unilateral lung involvement 6 out of 7 patients (85.71%) presented with symptoms of less than 5 days duration out of which 4 were recovered and discharged after testing negative and two patients expired during course of treatment one of which had multidrug resistant tuberculosis and other was a known case of bronchial asthma. One patient (14.30%) presented with symptoms of more than 5 days duration who was discharged after testing negative by RT-PCR (table 4).

Among the 42 patients who had bilateral lung involvement, 25 patients (59.52%) presented with symptoms duration of less than 5 days and rest 17 patients (40.48%) presented with symptoms of more than 5 days duration. Ten (10) and 6 patients died in both the groups respectively (table 4), most of which had history of other chronic illness predisposing them on high risk for mortality as explained in Table 5.

Of 51 patients who had normal chest x-ray at presentation, 37 patients (72.54%) presented with history of less than 5 days and 14 patients (27.46%) presented with a history of more than 5 days and no mortality was seen in either group. All the 51 patients (100%) of this group were recovered completely and discharged after testing negative by RT-PCR of nasopharyngeal/oropharyngeal samples (table 4).

Total 42 patients presented with complain of shortness of breath; however hypoxia was recorded in only 36 patients by pulse oximeter. Out of 36 hypoxic patients 23 patients were given non invasive mechanical ventilation out of which 6 patients improved on non invasive ventilation, among the remaining 17 patients on NIV support 8 patients underwent endotracheal intubation but unfortunately none of them could survive and remaining 9 patients were continued on NIV support but could not survive. Rest 13 patients with hypoxia were managed by supplemental oxygen only by nasalcannula, Hudson mask or reservoir bag mask depending on oxygen requirement and 12 patients improved but one patient died who was a patient of MDR tuberculosis too (chart 3).

Table 4: Mortality and discharge in patients in study group with unilateral, bilateral lung involvement and normal chest X-ray

Chest X-ray	Unilateral involvement		Bilateral involvement		Normal chest xray	
Duration of symptoms	</=5 days	>5 days	</=5 days	>5 days	</=5 days	>5 days
No. of patients	6	1	25	17	37	14
Mortality	2	0	10	6	0	0
Discharged	4	1	15	11	37	14

Table 5: Clinical features and chest X-ray findings of the patients who expired in the study group

Age/Sex	Spo2 at presentation	Chest X-ray score	Chest X-ray features	Comorbidity	Endotracheal intubtion	Non invasive ventilation
1.18y/f	58% on room air	3	Right lung all zones involved Left lung destroyed	MDR pulmonary tb	No	No
2.26y/f	67% on room air	6	Both lungs invoved with features of pulmonary edema	Severe anaemia	No	Yes
3.16y/m	54% on room air	6	Both lung involved with bilateral upper lobe cavities	Pulmonary tb	Yes	Yes
4.45y/m	76% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus	Yes	Yes
5.35y/m	70% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus	Yes	Yes
6.45y/f	60% on room air	3	Left lung involved all zones	Bronchial asthma	No	Yes
7.45y/f	60% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus ,systemic hypertension	No	Yes
8.60y/f	60% on room air	6	Both lungs involved with fetures of pulmonary edema	Type 2 diabetes mellitus	No	Yes
9.50y/m	80% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus	No	Yes
10.50y/m	58% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus	Yes	Yes

11.48y/m	60% on room air	6	Both lungs involved with features of pulmonry edema	Type 2 diabetes mellitus	No	Yes
12.50y/m	80% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus, systemic hypertension	No	Yes
13.68y/m	50% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus, systemic hypertension	Yes	Yes
14.65y/m	45% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus	Yes	Yes
15.65y/m	80% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus, chronic liver disease	Yes	Yes
16.62y/f	55% on room air	6	Both lungs involved with features of pulmonary edema	Coronary artery disease	Yes	Yes
17.62y/f	74% on room air	6	Both lungs involved with features of pulmonary edema	Type 2 diabetes mellitus, systemic hypertension	No	Yes
18.65y/m	68% on room air	6	Both lungs involved with features of pulmonary edema	Systemic hypertension	Yes	Yes

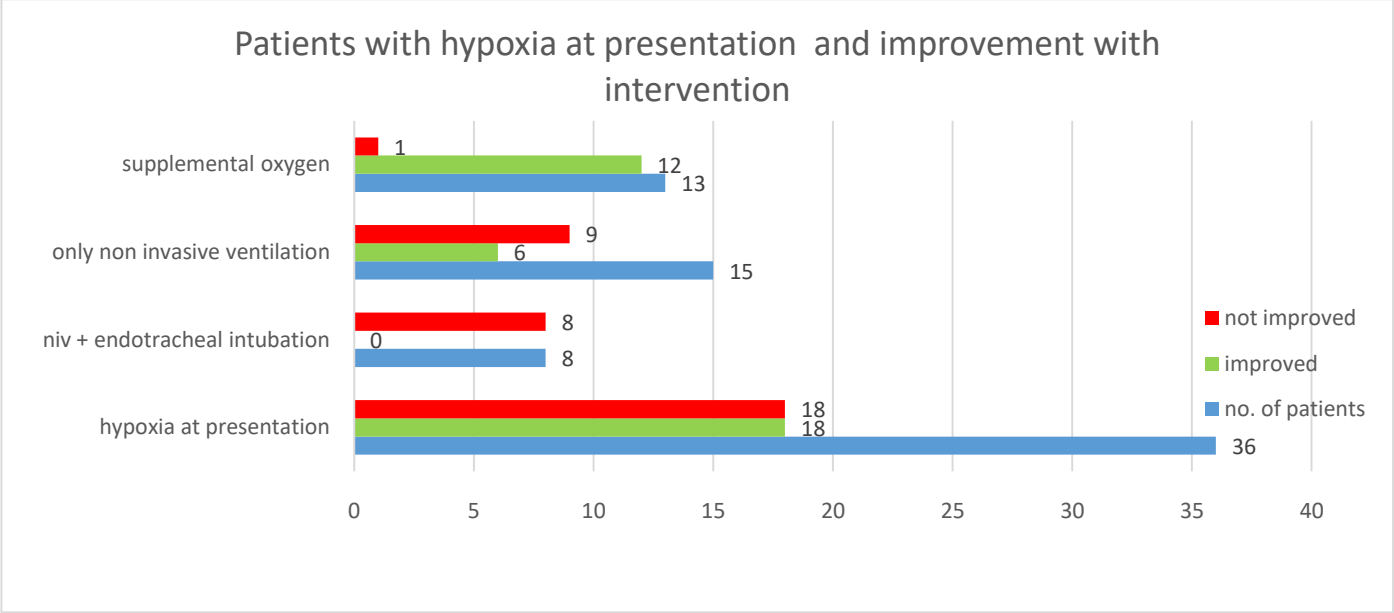

Chart 3: Patients presenting with hypoxia and result of interventions done

Among the 36 patients who were hypoxic on presentation, 30 patients (83.33%) had bilateral lung involvement in chest X-ray at presentation, 4 patients (11.11%) had unilateral lung involvement and only two patients (5.56%) with normal chest x-ray at presentation.

Among 100 patients, total leucocyte count was normal of 86 patients between 4000-12000 per microL. Among rest of 14 patients, 12 patients had leukocytosis among which 8 patients had bilateral lung involvement, 2 had unilateral lung involvement, one patient had normal chest x-ray and one patient was of malignancy with lung metastasis. Two patients had lymphopenia at presentation 2300/microL and 2800/microL respectively and had bilateral and unilateral lung involvement respectively. Platelet count was within normal range 1.5

lakhs to 5 lakhs in all the patients at presentation. Seven patients had hemoglobin <9g%, 10 patients had>14g% and 83 patients had hemoglobin between 9-14g%.

RFT was deranged in 6 patients and LFT was deranged in3 patients at presentation respectively. Repeat Covid-19 test by RT PCR of nasopharyngeal/oropharyngeal sample was done at day 7, day 12 and day 17 of first positive report. Mean days of conversion with standard deviation of patient from covid positive to covid negative by RT-PCR in patients with normal chest X-ray was seen as 11.3±3.2 days, in patients with unilateral lung involvement was 12.8±0.75 days and in patients with bilateral lung involvement was 11.53 ±3.07 days. So there was no significant difference in days of conversion from Covid-19 positive to negative however there was a difference in mortality among three groups.

Among patients with normal chest x-ray, 100% patients were recovered and discharged, where as among those with unilateral lung involvement, 71.42% of patients were discharged and those with bilateral lung involvement, only 61.90% of patients were discharged after testing negative by RT-PCR of nasopharyngeal/oropharyngeal sample. Highest mortality was seen in patients with chest x-ray score of 6 (58.33%) and lowest among those with chest X-ray score of zero, in between the rates of discharge and mortality can vary depending upon chest x-ray score and other co-morbidities (table 6).

Table 6: Mortality and discharge in study group according to chest X-ray score in terms of percentage

Chest X-ray score	Mortality percentage	Discharge percentage
6	58.33	47.61
5	11.11	88.89
4	20	80
3	40	60
2	0	100
1	0	100
0	0	100

4. DISCUSSION

Most common presenting symptoms of Covid-19 are systemic and/or respiratory manifestations [7, 8]. Other less common symptoms can be mild gastrointestinal or cardiovascular symptoms [9, 10]. It has been reported that a significant number of individuals infected with SARS-CoV-2 remain asymptomatic throughout the course of their illness acting as carriers [11-13].

For patients presenting with clinical features suggestive of Covid-19, radiological evaluation of patients is mandatory, especially in the emergency department while waiting for RT-PCR results. Chest x-ray is not equally diagnostic as CT scan of thorax as has been shown by many studies; however it helps in having a rapid evaluation of thoracic involvement and thus has a role in managing the pandemic [14-16].

Portable X-ray machine is very useful, inexpensive and radiographs can be taken to the patient's bedside, reducing radiology department's exposure to infection and minimizing the risk of cross-infection. CT scan was performed only for those patients with clinical suspicion of complication at our centre.

The ACR (American College of Radiology) believes that the following factors should be considered regarding the use of imaging for suspected or known Covid-19 infection:

1. CDC recommends viral testing as specific method of diagnosis for Covid-19 and does not recommend chest X-ray or CT scan for making a diagnosis.
2. Nasopharyngeal and or pharyngeal samples or lower respiratory tract samples whenever available are recommended by CDC for initial diagnostic testing of Covid-19 suspected individual.
3. Generally chest imaging findings in Covid-19 overlap those of other viral infections like influenza, SARS and MERS which further limits the specificity.

A review from the Cochrane Database of Systematic Reviews on chest radiographs for acute lower respiratory tract infections which included two randomized trials comparing use of CXRs to no CXRs in acute lower respiratory tract infections for children and adults concluded that CXR did not improve clinical outcomes (duration of illness) for patients with lower respiratory tract infection.

The British Society of Thoracic Imaging (BSTI) has published a reporting Performa for the plain chest radiographic appearances of potential Covid-19 cases [17].

- **Classic/probable Covid-19:-**lower lobe and peripheral predominant multiple opacities that are bilateral (>> unilateral)
- **Indeterminate for COVID-19:-**does not fit classic or non-COVID-19 descriptors
- **Non-Covid-19:-**pneumothorax/lobar pneumonia /pleural effusion(s)/pulmonary edema/other
- **Normal:-**Covid-19 excluded.

Many patients with Covid-19 infection have a mild illness and do not develop pneumonia, as seen in this study 51% patients had normal chest X-ray and did not develop pneumonia and were treated as mild Covid disease as Wu Z et al found in their study that many patients with mild illness do not develop pneumonia. [4]. In the current study, chest X-ray was normal in 51% of patients at time of presentation to emergency department. In the studies done by Yoon et al [18], Wong et al [16], Chen et al [19] and Ng MY et al [20], it was observed that chest X-ray may be normal in upto 63% patients particularly in early stages. In these studies most common pattern seen in chest X-ray was consolidation with diffuse involvement of all zones of both the lungs (78.57%), followed by involvement of middle and lower zones in 11.90%, and only lower zone involvement in 9.5% patients. Ground glass appearance is common in earlier presentations and may precede the appearance of consolidation [16]. Bilateral lung involvement is more common (72.9%) than unilateral involvement [21], as is seen in this study too.

It was also observed in this study that patients who presented to the emergency department early *i.e.* </= 5 days of onset of symptom duration, has less involvement of lungs and less severe disease than those presenting late. Highest mortality was seen in patients with bilateral lung involvement (score =6) and having associated co morbidities especially diabetes mellitus and systemic hypertension and least mortality in patients with chest X-ray score of zero. The appearance of other features like nodules, pneumothorax, or pleural effusion might be incidental or caused by Covid-19.

5. CONCLUSION

The conclusion drawn from this study is that even though chest X-rays have a lower sensitivity in diagnosing Covid-19 particularly in early stage or mild disease, they do give an idea about the severity of the disease, helps in planning of management, may be useful in predicting hospital stay course and also helps in understanding the expected outcome of patients presenting to emergency department with symptoms of Covid-19. Patients having normal chest X-ray have a significantly lower mortality as compared to those who has initial abnormal chest X-rays at presentation. Bilateral lung involvement at presentation further ads to risk of mortality as compared to unilateral involvement or normal chest X-rays. Co morbidities, particularly diabetes mellitus, is a great predictor of outcome as the majority of patients in this study who expired were diabetic. Bilateral lung involvement causes hypoxia more as compared to unilateral lung involvement or normal chest X-ray at presentation thus leading to need for invasive or non invasive support measures and adding to risk of mortality. So we conclude that despite low sensitivity and specificity, chest X-ray must be done for patients presenting with features of Covid-19 to have a quick idea about involvement of lungs and it is cheap, easily available. Portable X-rays in Covid ward decrease risk of spread of infection which is the utmost important step to prevent the spread the disease. However, it should not be used solely for diagnosing Covid-19, as we saw in the present study, a large number of patients were found positive by RT-PCR of nasopharyngeal/oropharyngeal samples despite having a normal chest X-ray at presentation.

With no definitive drug or vaccine available till date for the treatment of Covid-19, it is the social distancing, wearing face mask and maintaining hand hygiene are the key steps to avoid getting infected and will help in preventing the spread of disease.

6. LIMITATION OF THE STUDY

CT scan of chest is more sensitivity modality to look for lung involvement but was not done in this study because a dedicated CT scan room for Covid-19 patients was not available at our centre.

Conflict of interest

Authors report no conflict of interest

Financial support

This study did not receive any financial support.

Patient consent

Authors verify that all the necessary informed consent was taken from the patients and it was made sure that their identity must not be revealed

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