

# Chest Roentgenogram Features in Severe COVID-19 Pneumonia Patients Admitted in ICU in a Tertiary Health Care Centre in North East India

\*Donboklang Lynser<sup>1</sup>, Pranjal Phukan<sup>1</sup>, Chhunthang Daniala<sup>1</sup>, Iadarilang Tiewsoh<sup>2</sup>, Kaustuv Dutta<sup>3</sup>

<sup>1</sup>Department of Radiology and Imaging, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Mawdiangdiang, Shillong 793018, Meghalaya, India

<sup>2</sup>Department of Medicine, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Mawdiangdiang, Shillong 793018, Meghalaya, India

<sup>3</sup>Department of Anaesthesiology, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Mawdiangdiang, Shillong 793018, Meghalaya, India

**Corresponding author contact:** \*Donboklang Lynser, Department of Radiology, North Eastern Indira Gandhi Regional Institute of Health and Medical Sciences, Mawdiangdiang, Shillong 793018, Meghalaya, India. Email: bokdlynser[at]yahoo.co.in

**Abstract:** Introduction: At the end of 2019 a highly infectious disease called coronavirus disease (COVID-19) expanded globally. Some patients progress to require ICU care. RT-PCR is the diagnostic gold standard and CT chest is the radiological investigation of choice. However, it is not always feasible to follow up ICU patients by CT scan. Chest X-ray is the most practical radiological investigation in the ICU for follow up. We evaluate the chest X-ray findings in COVID ICU patients and correlate these findings with outcome from ICU. Materials and methods: All chest X-rays of COVID-19 ICU patients were reviewed. All RT-PCR confirmed severe COVID-19 ICU patients with an outcome (discharged/deceased) were included. X-rays were analyzed according to bilaterality, mediolateral, zonal distribution and density of lung lesions. The findings were correlated with outcome from ICU. Results: 20 males and 8 females (5:2) ranging from 21 to 98 years (mean 63 years) were included. Bilateral lung involvement was seen in 23/28 cases. Involvement of 4 or more zones is higher than 3 zones or less. Ground glass is the predominant feature (19/28 cases). The ratio of the number of patients discharged to the number of deceased decreases with increasing number of zones involved (3: 1 for 1 zone to 1:5 for 6 zones) and the number of zones involved (4 or more versus 3 or less) is statistically correlated with patient's age (p-value 0.005). Discussion: Although Chest CT is more sensitive, yet the value of chest x ray in the ICU settings cannot be overemphasized. In our study chest X-ray was able to detect lesions and prognosticate outcome from ICU. Number of zones involved correlate with the increasing age of the patient. Conclusion: Chest X-ray is an important radiological tool for follow up of severe COVID pneumonia patients under intensive critical care. Higher the possibility of poorer outcome from ICU with increasing number of zones involved.

**Keywords:** COVID pneumonia, Chest X-ray, CT scan, ICU, Outcome, SARS-CoV-2

## 1. Introduction

At the end of 2019 a novel virus, named SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2), expanded globally with the first Italian cases reported as early as February 2020.<sup>[1]</sup>

This new coronavirus causes a highly infectious disease, commonly called Coronavirus Disease 19 (COVID-19), Lung infection can result in severe pneumonia<sup>[2, 3]</sup>. Some patients may progress to respiratory distress, requiring intensive care treatment.

Genetic sequencing of SARS-CoV-2 has permitted the rapid development of real-time reverse transcription polymerase chain reaction (RT-PCR) of viral nucleic acid, and nowadays this is the diagnostic gold standard.<sup>[2]</sup>

Though Chest CT is an important diagnostic tool for COVID-19<sup>[4]</sup> and is more sensitive than the X-rays. Practically it is impossible or not reasonable to follow up with all patients once they are admitted to the ICU by chest CT. Chest X-ray therefore is the most important radiological tool in the intensive care environment for patient follow up and will still be an indispensable tool for management of

such patients<sup>[5]</sup>. Doing repeat CT for ICU COVID patients means the requirement for sanitation of the CT scan after every COVID patient which may not be feasible, therefore portable x ray stationed in the ICU environment for repeat x rays is a preferred radiological tool for follow up of patients in the ICU setting.

With this in mind we undertake this study on chest radiological findings of COVID-19 confirmed patients by RT-PCR admitted in the ICU, to study on the chest x ray findings and outcome from ICU.

## 2. Materials and Methods

This retrospective study was conducted after Institute's IEC approval during the first wave of COVID19 at our institute in 2020, when vaccination for COVID was not yet initiated. Review of all portable chest x rays of RT-PCR confirmed COVID-19 patients referred from COVID ICU were done. All X-rays were acquired using a portable x ray machine stationed in the ICU using digital cassettes and CR readers. An independent review of chest X-rays was done by experience radiologists and reported with consensus. The X-rays were analyzed according to laterality (right/left/bilateral), zonal distribution (3 zones in each lung

field), mediolateral (central half/lateral half) and density (consolidation/ground glass). All x rays at admission were reviewed and correlated with the outcome from ICU (discharged/deceased). Statistical analysis was done using IBM SPSS trial version.

### 3. Results

In our series, we have 20 males and 8 females with a ratio of 5:2, age ranges from 21 to 98 years with a mean of 63 years (Figure 1). Lesser females were admitted in the COVID ICU, yet they have a proportionally poorer outcome compared to male patients (Figure 2). Most patients present with bilateral involvement (23/28) (Figure 3). With respect to lesion

density, the ground glass in the predominant feature (19/28) (Figure 4). Mediolaterally, centrally or central with peripheral halves involvement is more predominant than peripheral halves only (Figure 5). With regard to zone of involvement, patients with 4 or more zone involvement have a poorer outcome compared to 3 zones or less (Figure 6) and it is seen that the ratio of number of patients discharged to number of those who died decrease with increasing number of zones involved 3: 1 (for 1 zone) to 1:5 (if 6 zones involved) (Figure7). There is also a significant difference between those involving 4 zones or more and 3 zones or lesser with respect to age (Table 1)

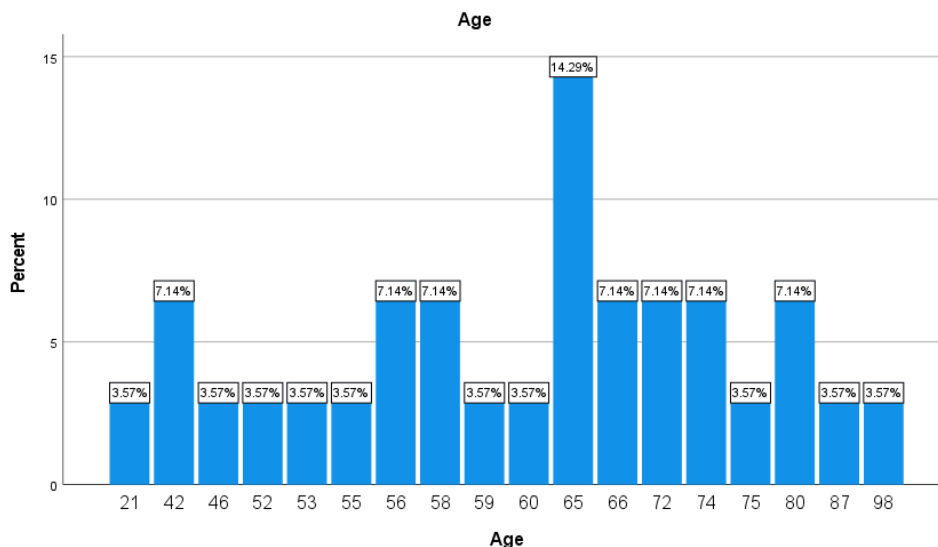


Figure 1: Showing the distribution of cases according to age groups

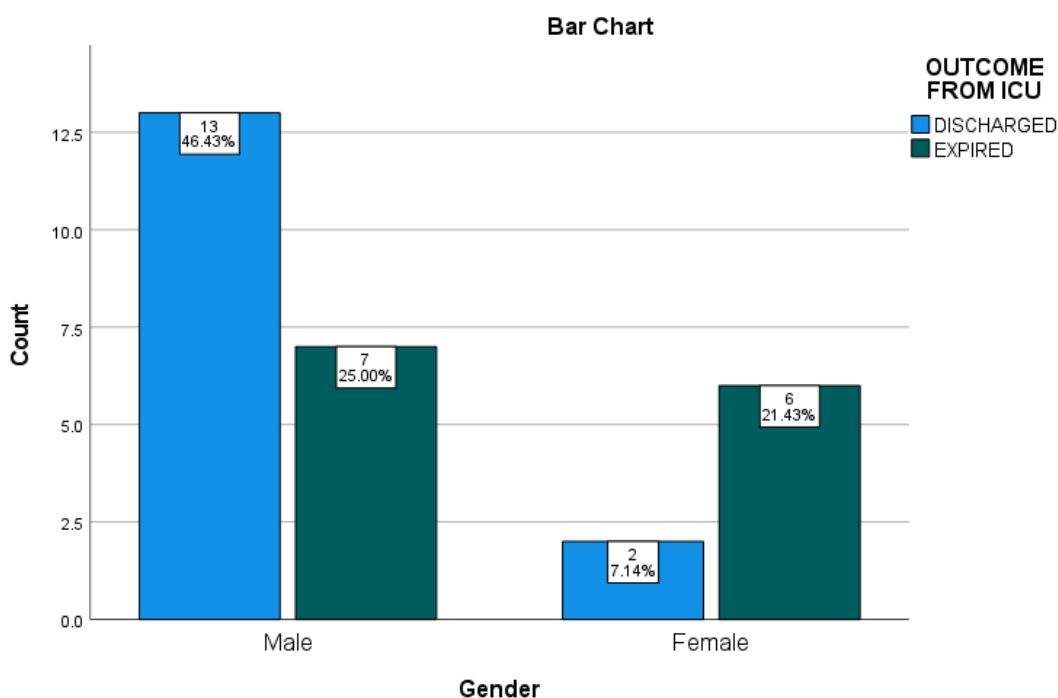


Figure 2: Showing distribution of cases according to gender

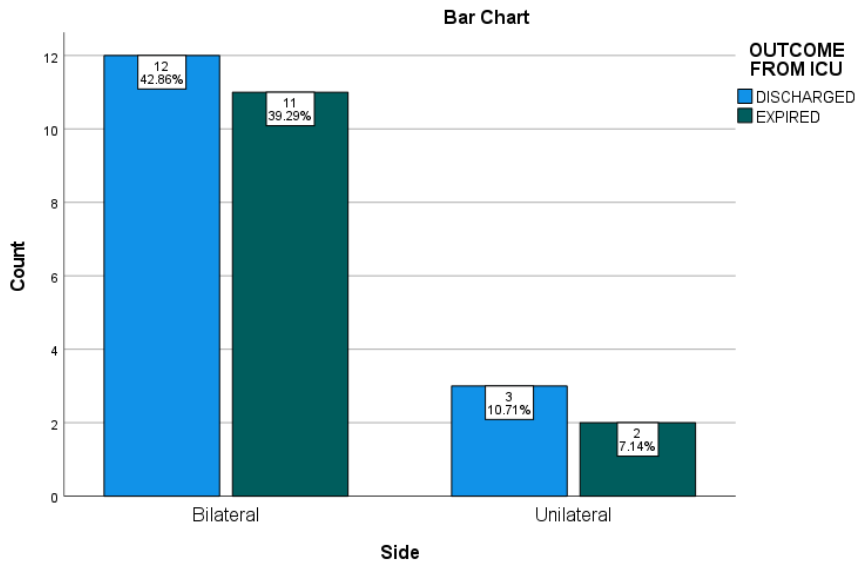


Figure 3: Showing the outcome of cases from ICU according to bilaterality.

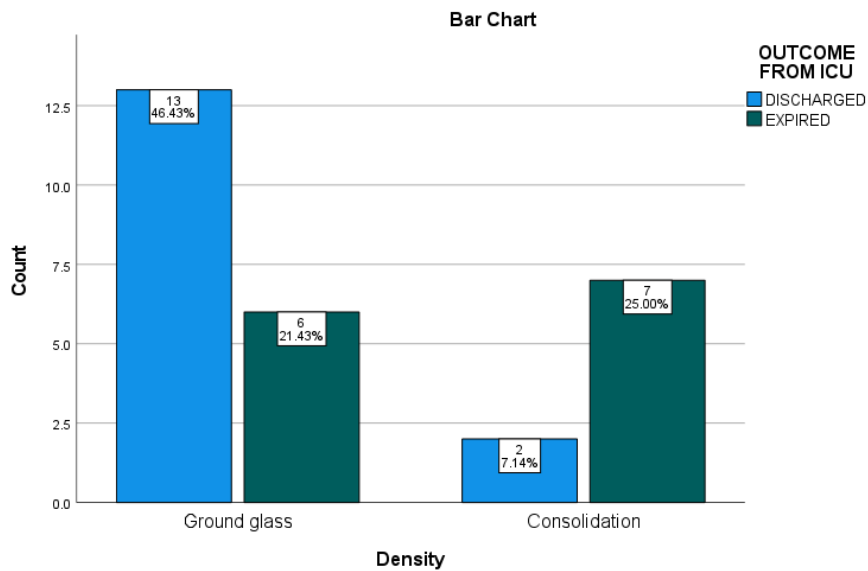


Figure 4: Showing the outcome of cases from ICU according to density.

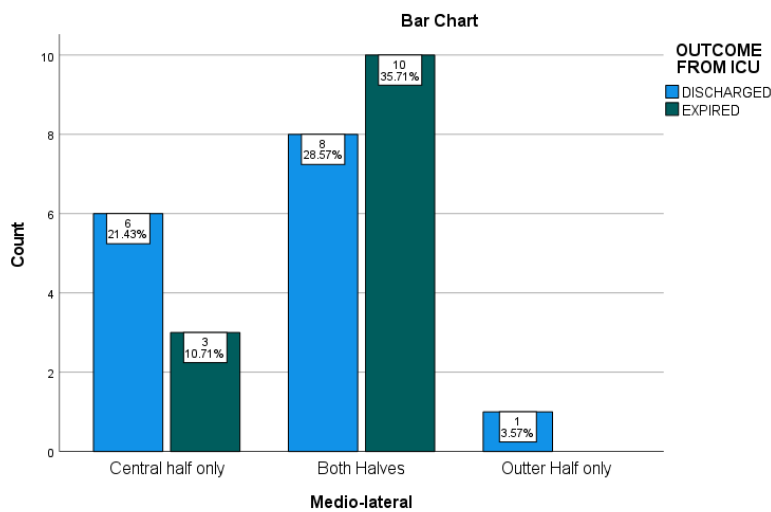


Figure 5: Showing the outcome of cases from ICU according to mediolateral distribution.

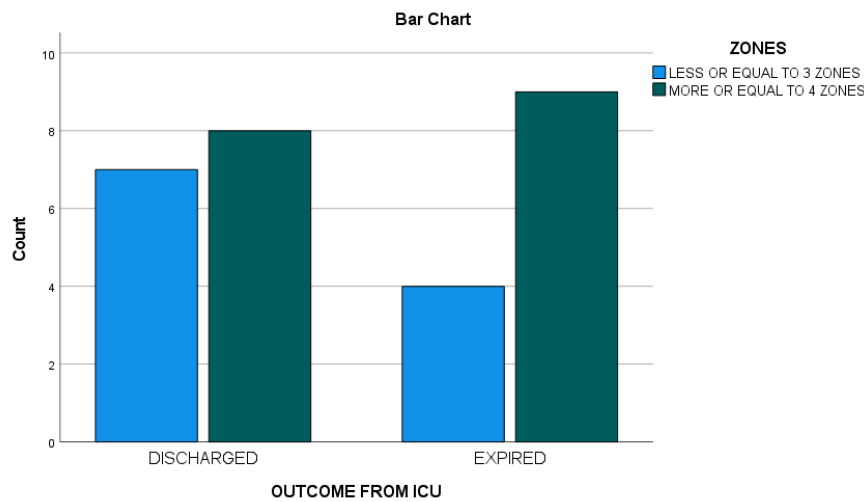


Figure 6: Showing distribution of cases according to zones and outcome from ICU

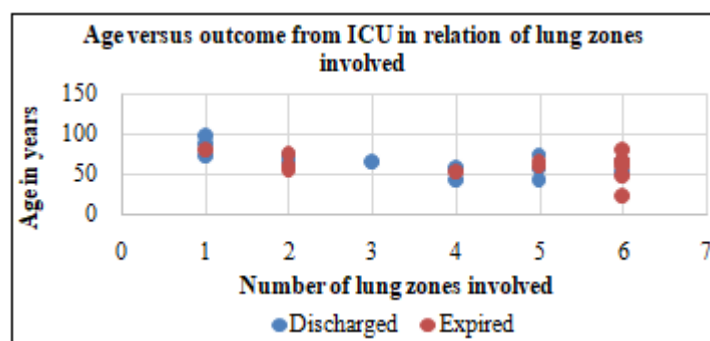


Figure 7: Showing outcome of cases form ICU according to age and number of zones involved.

Table 1: Showing the statistical test for age, gender, mediolateral, density and outcome from ICU, grouping variable is number or zones (less or equal to 3 zones and more or equal to 4 zones). Significance at 0.05

Test Statistics <sup>a</sup>					
	Age	Gender	Medio-lateral	Density	Outcome From ICU
Mann-Whitney U	35.000	77.500	52.500	86.000	78.000
Wilcoxon W	188.000	143.500	118.500	152.000	144.000
Z	-2.758	-.961	-2.302	-.436	-.844
Asymp. Sig. (2-tailed)	.006	.336	.021	.663	.399
Exact Sig. [2*(1-tailed Sig.)]	.005 <sup>b</sup>	.458 <sup>b</sup>	.053 <sup>b</sup>	.746 <sup>b</sup>	.487 <sup>b</sup>

a. Grouping Variable: ZONES  
b. Not corrected for ties.

#### 4. Discussion

In our study, we have analyzed the chest X-ray findings of COVID pneumonia patients admitted to the ICU in our centre. Male patients are more common in our series, this is in agreement with other studies.<sup>[6, 7]</sup> The mean age of our patients is 63 years which is also comparable to other studies.<sup>[6, 7]</sup> The most common mediolateral distribution is bilateral (Table 2) and is in agreement with other authors.<sup>[8]</sup> With regard to craniocaudal distribution, there is no agreement between the authors (Table 2).<sup>[8, 9, 10, 11]</sup> Over a third of RT-PCR positive cases for COVID-19 are known to show abnormalities in chest X-rays.<sup>[9]</sup> Though many cases are asymptomatic, yet cough and fever are the most frequent symptoms.

The mortality rate for our ICU COVID patient is 46.4 % (13/28) which is in agreement with the mortality rate found in a meta-analysis by Armstrong RA et al., who got 41.6 %.<sup>[12]</sup> It is known that mortality for patients admitted into ICU due to COVID-19 is higher than any other viral pneumonias<sup>[12]</sup>, therefore close follow up for lung lesions will help in prognosticating patients admitted in ICU. The silver lining however is that treatment for COVID related ICU patients has improved over successive waves,<sup>[13]</sup> and for such success a radiological follow up of COVID pneumonic lesions in the ICU environment using portable chest x rays is the most important radiological tool after the initial x ray at the time of admission to ICU (Figure 8, 9).

The limitations of our study include the small sample size and retrospective nature of the study. There is plenty of scope for further studies on usefulness of x ray for COVID patients in the ICU environment.

**Table 2:** Showing X-ray findings of our study compared with other studies [8, 9, 10, 11]

Chest X-ray findings		Dutta et al (n=42)	Wong et al (n=64)	Yoon et al (n=10)	Lomoro et al (n=32)	Lynser et al (present study)
Laterality	Right lung	9.5 % (4/42)	20 % (10)	50 % (5)	6.2 % (2)	17.8% (5)
	Left lung	47.6 % (20/42)	18 % (9)	50 % (5)		
	Bilateral	42.8 % (18/42)	6.3 % (32)		78.1 % (25)	82% (23)
Craniocaudal	Upper lung zone	7 % (3/42)	0	20 % (2)	3.1% (1)	1 (3.5%)
	Middle lung zone	57.1 % (24/42)		30 % (3)		1 (3.5%)
	Lower lung zone	83.3 % (35/42)	6.3 % (32)	50 % (5)	46.9 % (15)	1 (3.5%)
	No Predominance	-	37 % (19)		50 % (16)	25 (89%)
Mediolateral distribution	Central half	0 % (0/42)		20 % (2)		17.8% (5)
	Outer half	78.5 % (33/42)		60 % (6)		7.1% (2)
	No Predominance	21.4 % (9/42)		20 % (2)		75% (21)

## 5. Conclusion

We have provided an overview of chest X ray findings of patients with outcomes from the COVID ICU. We found that bilateral lung involvement is the most common finding at admission into ICU. Involvement of more zones is seen with increasing age of patients, which is associated with poorer outcomes from the ICU. Chest X-rays still will remain an invaluable tool for follow up of COVID ICU admissions.

**Conflict Of Interest:** The authors declare no conflict of interest

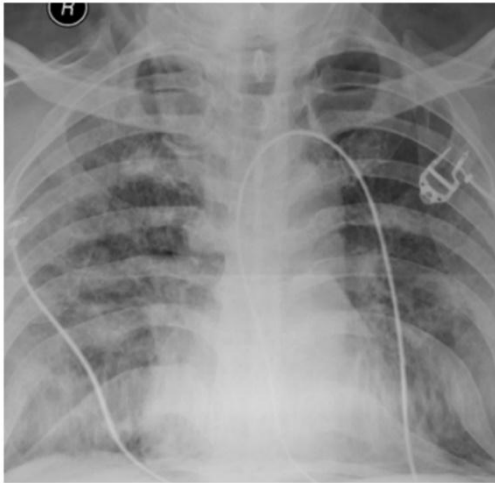
**Financial assistance:** Nil

**Ethical approval:** The study was conducted after clearance from our Institutional ethics committee and informed consent was waived as the study was retrospective in nature.

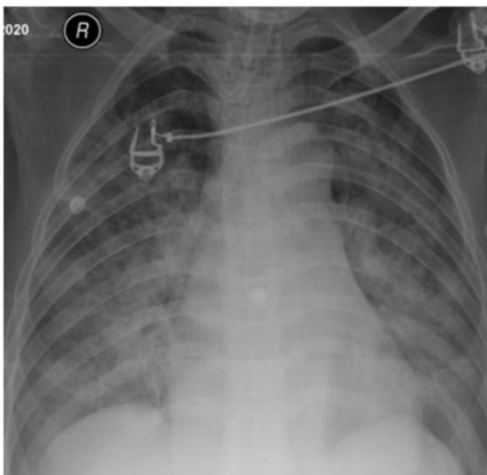
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**Figure 8:** A 65 years old patient discharged from ICU, Chest x rays showing multiple areas of ground glassing in the right lung field.



**Figure 9:** A 65 years old patient with poor outcome (expired) from ICU, chest x ray shows multiple focal areas of consolidation.