International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 10; Issue 01 (B); January 2021; Page No.23606-23612
DOI: http://dx.doi.org/10.24327/ijcar.2021.23612.4680

Research Article

ROLE OF USG IN COVID PNEUMONIA: OUR EXPERIENCE IN A TERTIARY CARE COVID HOSPITAL

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A R T I C L E I N F O

Article History:
Received 06th October, 2020
Received in revised form 14th November, 2020
Accepted 23rd December, 2020
Published online 28th January, 2021

Key words:
COVID 19, SARS-CoV-2, lung ultrasound, interstitial pneumonia, RT-PCR

A B S T R A C T

COVID 19 is an infectious disease caused by Severe acute respiratory syndrome. Coronavirus 2(SARS-CoV-2) has spread across the world within a very short time and A pandemic situation was declared by WHO on March 11th, 2020. Most important clinical manifestation is interstitial pneumonia. COVID 19 is mainly diagnosed by Reverse transcription polymerase chain reaction (RT-PCR) which has low sensitivity, which demands further investigations.

Although chest CT is standard imaging modality for early diagnosis and management of COVID 19 patients, bedside lung ultrasound has tremendous potential to become an important tool for diagnosis and disease monitoring. Lung ultrasound was described earlier and international protocols are there for its application.

We retrospectively reviewed 100 COVID 19 patients diagnosed with RTPCR, who was monitored with bedside ultrasound at isolation ward in Medical College and Hospital, Kolkata. Interstitial lung involvement was detected with high accuracy in lung ultrasound. The objective of our study is to evaluate ultrasound findings in patients with COVID 19 and highlight typical manifestations and advantages of bedside ultrasound in COVID 19 pneumonia. Our study will help clinical researchers make new guidelines for early diagnosis and disease progression, that will help assessment of disease severity and proper management.

INTRODUCTION

Before the pandemic of COVID-19, bedside ultrasound was used for lung imaging of patients with Ebola hemorrhagic fever to gather information that may modify medical management[(1)]. First case of COVID-19 was detected in seafood market in Wuhan, China [(2)] in December, 2019. The disease rapidly spread across the world soon after the first case was detected. Incubation period of the COVID 19 is between 1 and 14 days and average 3-7 days[(3)]. Common and mild symptoms of this disease are fatigue, cough, fever, myalgia, pharingitis, joint pain, anosmia and dysgeusia[(4)]. Most important manifestation of COVID 19 is pneumonia, which can be complicated by acute respiratory distress syndrome(ARDS), which leads to respiratory failure and case fatality[(5)]. Nasopharyngeal swab is subjected to Reverse transcription polymerase chain reaction (RTPCR) for diagnosis of COVID 19. However further investigation like chest CT has been suggested for this disease because of high rate of false negative results in RTPCR[(6,7)].

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Fang *et al* [(8)] pointed that chest CT has a high sensitivity (98%) in detecting COVID 19. Another study by Bernheim *et al* revealed normal chest CT findings in 56 % of the patients in first 2 days after onset of symptoms[(9)]. Subsequently Chest CT was proved to be very useful for disease monitoring[(10)].

Lung ultrasound has been highlighted as an important tool for diagnosis and disease monitoring in a COVID 19 patient in recent studies[(11)]. Lung ultrasound can be used even in pregnant patients[(12)].

However, lung ultrasound cannot be considered the gold standard for diagnosis of COVID 19 pneumonia. Major limitation of lung ultrasound is, it cannot demonstrate deep lung abnormalities. But it is very sensitive in detecting peripheral lung lesions [(13)].

The typical LUS pattern of COVID-19 pneumonia is the patchy and bilateral distribution of the main lesions [(14)]. In a panel of worldwide international experts [(15)], in the current epidemiological scenario, the highlighted lung ultrasound findings in the context of fever and/or respiratory symptoms, reduced lymphocytes, and increased levels of protein C-

reactive, LDH, and ferritin, are suggestive of COVID-19 pneumonia.

REVIEW OF LITERATURE

Basic Principal of Ling Ultrasound

Although ultrasound has been used for clinical diagnosis for many years, it has not been used for evaluation of lung[16]. Lung ultrasound is a newer technique, now being increasingly used in intensive care unit for assessment of lung since the work of Lichtenstein and Axler published in 1993[17]. Nephrologists also found lung ultrasound to be very useful for evaluation of their patients[18].

A normally aerated lung strongly reflects ultrasound beam at lung-pleura interface. Lung images obtained in USG are not anatomical, instead they are different artifacts obtained from interaction of ultrasound beam with acoustic interface between chest wall and air in the alveoli along the pulmonary surface[19].

Normal ultrasound findings in a COVID 19 patient are smooth, regular, echogenic, continuous pleural line, presence of lung sliding and A lines. Lung sliding is seen due to movement of visceral pleura against parietal pleura with normal respiratory movement. A lines are horizontal artifacts seen below pleural line at multiple of distance between ultrasound transducer and pleural line[20].

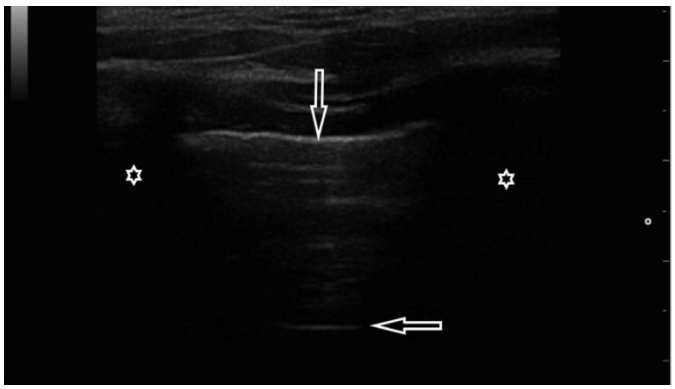


Figure 1 Normal ultrasound image with linear transducer: regular and echoic pleural line (↓) and A-line (←), shadow behind the ribs (*); linear transducer[21].

Although these findings indicates a normally aerated lung, however these finding does not exclude asthma, chronic obstructive pulmonary disease and pulmonary embolism or pulmonary embolism[22].

Role of Bedside Lung Ultrasound In COVID 19 Pandemic

Lesions obtained in a patient with COVID 19 are mainly peripheral and subpleural in location[13]. Lung ultrasound is an excellent tool for peripheral lung lesion in a Covid 19 patient. The same physician treating the patient can evaluate the lung using bedside ultrasound. This is very important in respect to the fact that a huge number of physicians were infected in Italy and Spain while treating Covid 19 patients[23].

Ultrasound Findings in a COVID 19 Pneumonia

Soldati *et al*[24] has proposed a standardized protocol for lung ultrasound which describes 14 areas of chest wall to be scanned in lung ultrasound.

Typical Lung ultrasound findings are found in all lung fields although bilateral posterior, lateral ones are more commonly seen[13]. Typical lung ultrasound findings are:

B-lines*:* Vertical Narrow based lines arising from pleural line are known as B lines .These lines represents interstitial and alveolar tissue edema. Typically, vertical artifacts in COVID-19 patients are long, touch the bottom of the ultrasound screen, and are bright and thick[25].

White lung*:* These are regions of white areas with the absence of A lines and vertical artifacts, which represents increased density of the lung parenchyma [25];

Subpleural consolidations*:* Irregular hypoechoic areas in the subpleural region which indicates a collapsed lung or atelectasis [25];

Interrupted pleural line*:* Thickening or interruptions of pleural line, caused by the replacement of air with blood, pus, and fibrin according to Huang [13];

Air bronchograms and pleural effusions: These are very rare and unusual findings in COVID 19 pneumonia. Their presence should raise suspicion of other diagnosis or super infections[26]

All the lung ultrasound findings are correlated with extent of lung injury[27]. In the early stages, the lesions are mainly B-lines with small regions of white lung. In the intermediate stages, these lesions extend over a larger lung surface. In case of respiratory failure, subpleural consolidations are noted predominantly in a lower lobes along with air bronchograms and large regions of white lung . The diagnostic efficacy of LUS is high in severe patients [27,28].

Soldati *et al*.[24] proposed a LUS Score of Severity of COVID-19 Related Findings:

Score 0: normal LUS pattern characterized by regular pleural line and A-lines;
Score 1: vertical artifacts are described. The pleural line appears indented with several B-lines;
Score 2: a broken pleural line with dark and white consolidation areas are described;
Score 3: large regions of white lung.

Fourteen areas (3 posterior, 2 lateral, and 2 anterior) should be scanned per patient using curved or linear probe according to body weight. A standardized sequence of lung ultrasound proposed by Soldati *et al*.[24] is shown in figure 2. These are as follows:

For a patient able to maintain the sitting position

1. Right basal on the paravertebral line above the curtain sign;
2. Right middle on the paravertebral line at the inferior angle of the shoulder blade;
3. Right upper on the paravertebral line at the spine of the shoulder blade;
4. Left basal on the paravertebral line above the curtain sign;
5. Left middle on the paravertebral line at the inferior angle of the shoulder blade;
6. Left upper on the paravertebral line at the spine of the shoulder blade;
7. Right basal on the midaxillary line below the internipple line;
8. Right upper on the midaxillary line above the internipple line;
9. Left basal on the midaxillary line below the internipple line;
10. Left upper on the midaxillary line above the internipple line;
11. Right basal on the midclavicular line below the internipple line;
12. Right upper on the midclavicular line above the internipple line;
13. Left basal on the midclavicular line below the internipple line; and
14. Left upper on the midclavicular line above the internipple line.

In critical care settings for patients who are unable to maintain the sitting position, partial view of the posterior basal areas, should be obtained.

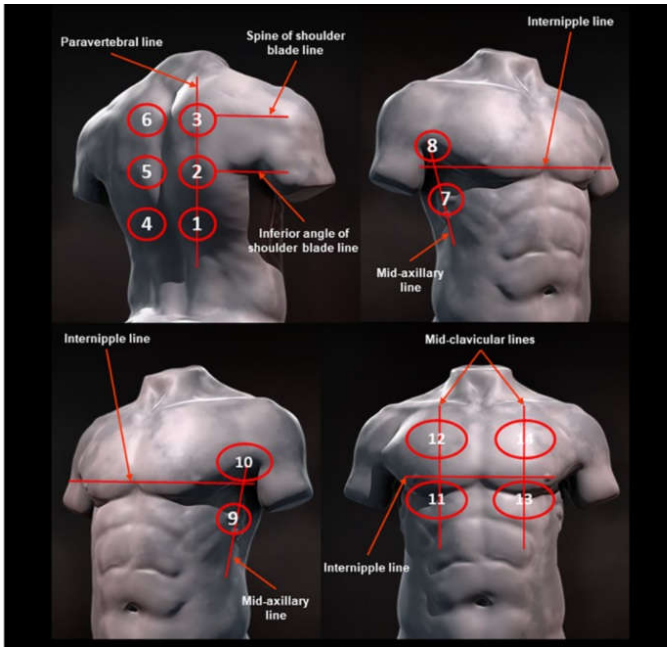


Figure 2 Proposed sequence of lung ultrasound by Soldati *et al*.[24]

MATERIAL AND METHOD

Patients

The study was conducted in Medical College , Kolkata on COVID patients admitted at Isolation ward (SSB Building, Green Building, Eden Building, CB Building, MC Hub) of Medical College, Kolkata which has been assigned as dedicated Tertiary care COVID hospital by Govt. of West Bengal. Bedside lung ultrasound was done using Logiq E9 Ultrasonography machine by GE using convex or linear transducer according to body weight.

All patients were classified on the basis of disease severity into one of the following four disease severity types according to the Diagnosis and Treatment Protocol of Novel Coronavirus (5th trial version) : mild, moderate, severe, or critical[29]. As we have performed our study with admitted patients in isolation ward, no patients has been categorized as mild disease. Severe and critical cases has been merged because of smaller number of patients in each group.

Duration of symptom was classified as early (<20 days), intermediate (20-30 days) and late (>30days)[30].

Inclusion Criteria

1. Patients who are admitted in COVID 19 Isolation ward of Medical College , Kolkata
2. Patients with moderate or severe disease with COVID RTPCR positive report
3. Those who gave informed consent to participate in the study
4. Patients with contraindication for CT Scan.
5. Pregnant mothers and neonates were included in our study.

Exclusion Criteria

1. Patients with duration of symptom less than 4 days.
2. Patients with respiratory symptoms but without without having COVID RTPCR positive report

Ethical Consideration

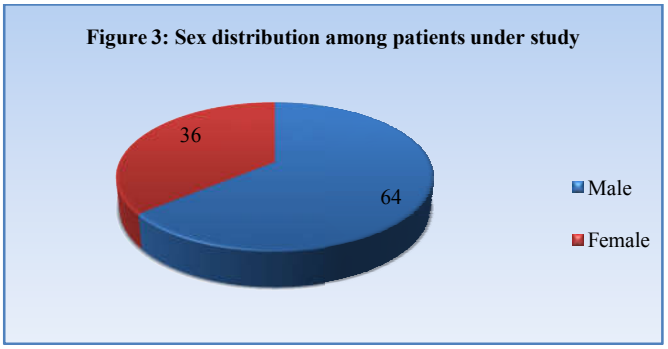
The study was conducted after getting approval from Institunal Ethics Committee and other authority. Informed consent was taken from all participants.

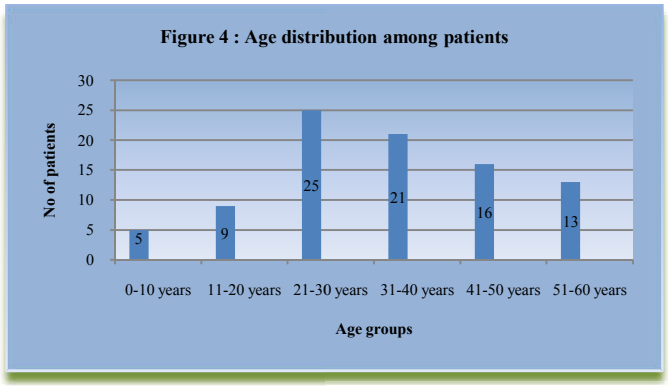
Analysis

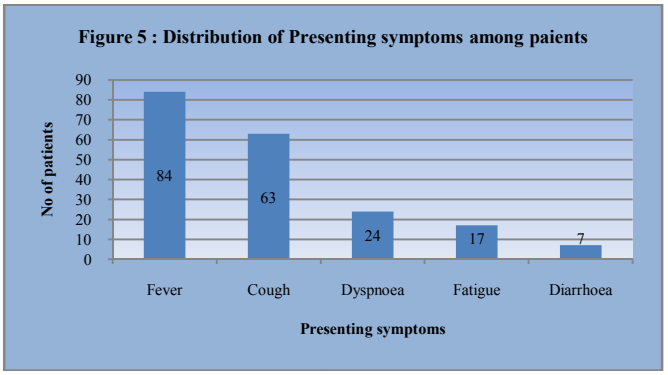
Data of individual case will be coded and entered MS Excel sheet and was analyzed using stastical package of social sciences (SPSS) 21.0. Statistical significance was set at $p \leq 0.05$. Descriptive static will be used.

RESULTS

Study population comprised randomly selected 100 patients with RT PCR positive COVID 19 reports. Out of them 64 male and 36 female patients were there. Mean age was 37.2 years with age range 3 day to 89 years. Fever was observed in 84 patients. Cough and dyspnoea were seen in 63 and 24 patients respectively. Fatigue was noted in 17 patents and diarrhea in 7 patients. Disease was classified as moderate in 42 patients and severe in 58 patients.







100% of the patients had positive lung ultrasound findings. B lines were present in 97 patients under study. White lung was seen in 71 patients and subpleural consolidation in 62%. Pleural line irregularity was seen in 56% of the patients. Air bronchogram was seen in 8 patients. Pleural effusion was seen in 6 patients, one of them had massive pleural effusion.

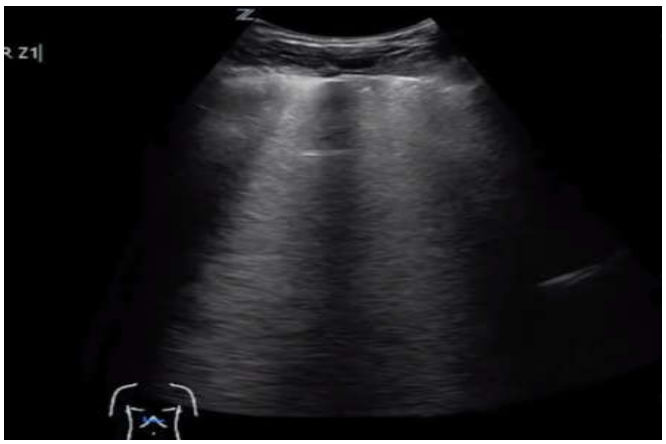


Figure 6 Vertical narrow based lines arising from pleural lines reaching upto bottom of the screen : B lines

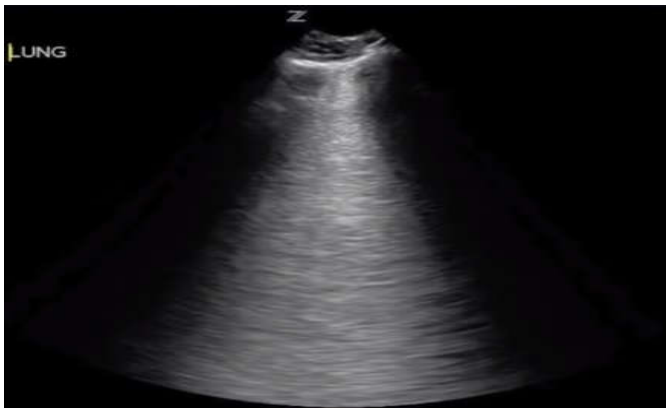


Figure 7 White artifact arising from lung pleura interface with absence of A line and B lines: White lung

Figure 8 Irregular hypoechoic area at subpleural region : Subpleural consolidation

Mean duration since onset of symptoms and lung ultrasound was 26.5 days with range of duration 5-56 days. Frequency of each lung ultrasound findings were classified with duration of symptoms, shown in table 1.

Figure 9 Thickening or interruption of pleural line

Figure 10 Hepatisation of lung with air shadows within tracheo-bronchial tree

Figure 11 Pleural effusion

Table 1 Lung Ultrasound (US) Findings in Patients Classified by Duration of Symptoms

Lung ultrasound findings	Early (<20days)	Intermediate (20-30days)	Late (>30days)	Total
B lines	30	37	30	97
White lungs	18	25	28	71
Subpleural consolidation	18	21	23	62
Pleural line irregularity	3	20	33	56
Air bronchogram	0	2	6	8
Pleural effusion	0	2	4	6

B lines were seen in 97 patients irrespective of duration of symptoms. Subpleural consolidation was seen in all three groups. Pleural line irregularity was rarely noted in early group, but was seen in 20 patients in intermediate group and 33 patients in late group.

There were 42 patients in moderate group and 58 patients in severe group. Frequency of lung ultrasound findings were classified according to disease severity and depicted in table 2.

Table 2 Lung Ultrasound (US) Findings in Patients Classified by Disease Severity

Lung ultrasound findings	Moderate	Severe	Total
B lines	39	58	97
White lungs	30	41	71
Subpleural consolidation	22	40	62
Pleural line irregularity	27	29	56
Air bronchogram	3	5	8
Pleural effusion	2	4	6

Pleural line irregularity was seen almost equally in both moderate and severe groups. Subpleural consolidation was seen more in severe disease group. Pleural effusion was seen only in 2 patients in moderate group and 4 in severe group.

Pericardial effusion was seen in 2 patients, both of them had pleural effusion also. Deep vein thrombosis was noted in a suspected patient with pulmonary thrombolism.

DISCUSSION

In our retrospective review of 100 COVID 19 pneumonia patient, we have evaluated the diagnostic value of lung ultrasound. Most common ultrasound finding was B lines, produced due to reverberation of ultrasound beam between decreased alveolar air and increased interstitial fluid. However differentiation between different causes of lung ultrasound cannot be done using B line[31].

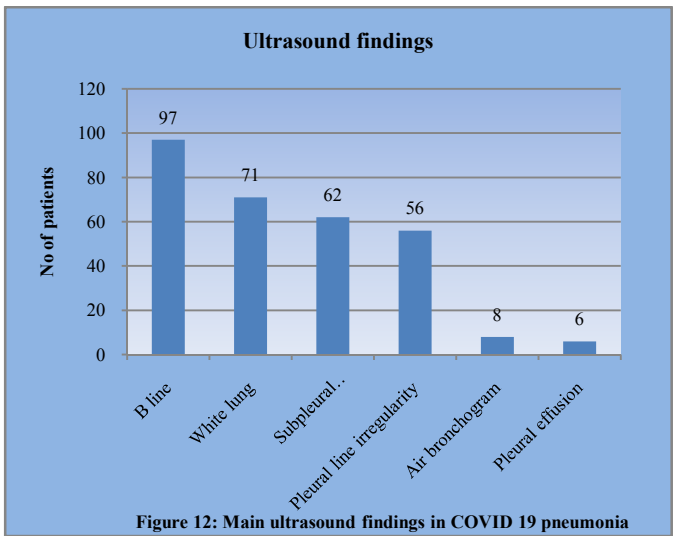


Figure 12: Main ultrasound findings in COVID 19 pneumonia

B-lines were present in most of the patients in our study. However, our results showed the frequencies of a irregular pleural line in relation to the time course of COVID-19.Thickened and irregular pleural line was seen in more number of patients as the duration of disease increased. A thickened pleural line on ultrasound represents pulmonary fibrosis and a longer duration of disease. Understanding pathologic changes on lung ultrasound helps us to detect as well as monitor disease progression in COVID 19 pneumonia [32].

Subpleural consolidation is visualized on lung ultrasound as a tissue like hypo echoic area in subpleural region, which reflects decreased aeration and increased inflammatory exudates. We found more consolidations in posterior and lateral views. Our study shows that pulmonary consolidation depicted on lung ultrasound may serve as an alert in patient management. Bedside lung ultrasound can be used in these critical patients repeatedly for monitoring of disease progression. Using bedside ultrasound in COVID 19 pneumonia is helpful in hospital with limited resource and manpower crisis during pandemic situation [33].

As reported earlier pleural effusion is rare in COVID-19. We only detected pleural effusion in 6 patients. The instances of pleural effusion that we saw were always subtle, ranging no more than a few millimeters in maximum distance between visceral and parietal pleural layers. Larger effusions was seen in 1 patient which might be indicative of bacterial super infection or cardiac pathologies [34]. USG guided pleural fluid aspiration has an important role in symptomatic management of such patients.

Bedside ultrasound is also useful in detecting concomitant deep vein thrombosis as surrogate indicator for pulmonary embolism in dysphonic patients with normal lung ultrasound findings. Usefulness of lung ultrasound for detection of pulmonary thromboembolism, need further evaluation and research [35].

Our study has few limitations. Firstly, no patient with COVID 19 RTPCR negative was included in our study. so, specificity of lung ultrasound could not be determined. Secondly, patients with duration of symptoms less than 4 days was not included in our study. Sensitivity of lung ultrasound in COVID 19 pneumonia may not be as high as shown in our study during early disease. Thirdly, it should be kept in mind that lung ultrasound can only detect peripheral lung lesions. Deep seated lesions in lung cannot be evaluated using lung ultrasound. Forthly, ultrasound is an operator dependant technique. So, results may not be good with inexperienced hand.

CONCLUSION

In conclusion it can be said that bedside lung ultrasound is a very sensitive technique for diagnosis of COVID 19 poneumonia. B-lines, white lungs, subpleural consolidation and irregular pleural line were the most commonly observed ultrasound findings. A thickened and irregular pleural line was more frequently observed findings in patients with longer duration of symptoms. Subpleural consolidation in lung ultrasound may be used as a sign of severe disease. Pleural effusion is least commonly detected finding in COVID 19 pneumonia.

Application of bedside lung ultrasound allows the examination without need to move the patient to Radiodiagnosis department, thereby decreasing the risk of cross infection. With advancement of technology it is possible to watch recorded lung ultrasound video clips at Radiodiagnosis department through PACS, which is away from isolation ward. Moreover, bedside lung ultrasound can be repeated numerous times without producing radiation to the patient. Its is a non invasive, rapid, and sensitive method for detection and monitoring of COVID 19. Further research is needed with larger number of patients for better understanding of different lung ultrasound findings and pathological correlation.

References

1. Moreno CC, Kraft CS, Vanairsdale S, *et al.* Performance of bedside diagnostic ultrasound in an

Ebola isolation unit: the Emory University Hospital experience. AJR 2015; 204:1157-1159.
2. BBC World News. https://www.youtube.com/watch?v=lq1kpx5LyQI&feature=youtu.be.&ab_channel=ICN-InternationalCouncilofNurses Accessed 8/9/2020.
3. Wang H, Wang Z, Dong Y, Chang R, Xu C, Yu X, *et al*. Cai Y Cell Discov. 2020; 6:10.
4. Xu XW, Wu XX, Jiang XG, Xu KJ, Ying LJ, Ma CL, *et al*. Clinical findings in a group of patients infected with the 2019 novel coronavirus (SARSCov-2) outside of Wuhan, China: retrospective case series. BMJ. (2020) 368.
5. Cossarizza A, De Biasi S, Guaraldi G, Girardis M, Mussini C. SARS-CoV-2, the Virus that Causes COVID-19: Cytometry and the New Challenge for Global Health. Cytometry A. (2020) 97:340-3.
6. Xie X, Zhong Z, Zhao W, Zheng C, Wang F, Liu J. Chest CT for typical 2019-nCoV pneumonia: relationship to negative RT-PCR testing. Radiology. 2020 Aug;296(2):E41-E45.
7. Huang P, Liu T, Huang L, Liu H, Lei M, Xu W, *et al*. . Use of chest CT in combination with negative RT-PCR assay for the 2019 novel coronavirus but high clinical suspicion. Radiology. 2020 Apr;295(1):22-23.
8. Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P, *et al*. . Sensitivity of chest CT for COVID-19: comparison to RT-PCR. Radiology. 2020 Aug;296(2):E115-E117.
9. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, *et al*. . Chest CT findings in coronavirus disease-19 (COVID-19): relationship to duration of infection. Radiology. (2020) 295:202-7.
10. National Health Commission of the People's Republic of China The diagnostic and treatment protocol of COVID-19 China. (2020). Available online at: http://www.gov.cn/zhengce/zhengceku/2020-02/19/content_5480948.htm (accessed January 8, 2021).
11. Mojoli F, Bouhemad B, Mongodi S, Lichtenstein D. Lung ultrasound for critically Ill patients. Am J Respir Crit Care Med. (2019) 199:701-14.
12. Inchingolo R, Smargiassi A, Mormile F, Marra R, De Carolis S, Lanzone A, *et al*. . Look at the lung: can chest ultrasonography be useful in pregnancy? Multidiscip Respir Med. (2014) 9:32.
13. Huang Y, Wang S, Liu Y, Zhang Y, Zheng C, Zheng Y, *et al*. A Preliminary Study on the Ultrasonic Manifestations of Peripulmonary Lesions of Non-critical Novel Coronavirus Pneumonia (COVID-19). (2020). Available online at: https://ssrn.com/abstract=3544750
14. Volpicelli G, Gargani L. Sonographic signs and patterns of COVID-19 pneumonia. Ultrasound J. (2020) 12:22.
15. Piscaglia F, Stefanini F, Cantisani V, Sidhu PS, Barr R, Berzigotti A, *et al*. . Benefits, Open questions and Challenges of the use of Ultrasound in the COVID-19 pandemic era. The views of a panel of worldwide international experts. Ultraschall Med. (2020) 41:228-36.
16. Mayo P.H., Copetti R., Feller-Kopman D., Mathis G., Maury E., Mongodi S. Thoracic ultrasonography: a narrative review. Intensive Care Med. 2019 Sep;45(9):1200-1211.
17. Lichtenstein D, Axler O. Intensive use of general ultrasound in the intensive care unit. Intensive care medicine. 1993 Jun 1;19(6):353-5.
18. Mullangi S, Sozio SM, Segal P, Menez S, Martire C, Shafi T. Point of care ultrasound education to improve care of dialysis patients. InSeminars in dialysis 2018 Mar (Vol. 31, No. 2, pp. 154-162).
19. Lichtenstein D, Axler O. Intensive use of general ultrasound in the intensive care unit. Intensive care medicine. 1993 Jun 1;19(6):353-5.
20. Bekgoz B., Kilicaslan I., Bildik F., Keles A., Demircan A., Hakoglu O. BLUE protocol ultrasonography in Emergency Department patients presenting with acute dyspnea. *Am J Emerg Med*. 2019 Nov;37(11):2020-2027.
21. Buda N, Segura-Grau E, Cylwik J,Wełnickid M. Lung ultrasound in the diagnosis of COVID-19 infection - A case series and review of the literature. Adv Med Sci. 2020 Sep; 65(2): 378-385.
22. Lichtenstein D., Mézière G., Biderman P., Gepner A., Barré O. The comet-tail artifact. An ultrasound sign of alveolar-interstitial syndrome. *Am J Respir Crit Care* Med. 1997 Nov;156(5):1640-1646.
23. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, *et al*. China Novel Coronavirus Investigating and Research Team. *N Engl J Med*. 2020 Feb 20; 382(8):727-33.
24. Soldati G, Smargiassi A, Inchingolo R, Buonsenso D, Perrone T, Briganti DF *et al*. Proposal for International Standardization of the Use of Lung Ultrasound for Patients With COVID-19: A Simple, Quantitative, Reproducible Method. *J Ultrasound Med*. 2020 Jul;39(7):1413-19.
25. Soldati G, Demi M, Smargiassi A, Inchingolo R, Demi L. The role of ultrasound lung artifacts in the diagnosis of respiratory diseases. Expert Rev Respir Med. (2019) 13:163-72.
26. (26) Brogi E, Gargani L, Bignami E, Barbariol F, Marra A, Forfori F, *et al*. . Thoracic ultrasound for pleural effusion in the intensive care unit: a narrative review from diagnosis to treatment. Crit Care. (2017). 21:325.
27. Peng QY, Wang XT, Zhang LN. Findings of lung ultrasonography of novel corona virus pneumonia during the 2019-2020 epidemic. Intensive Care Med. (2020) 46:849-50.
28. Poggiali E, Dacrema A, Bastoni D, Tinelli V, Demichele E, Mateo Ramos P, *et al*. . Can Lung US Help Critical Care Clinicians in the Early Diagnosis of Novel Coronavirus (COVID-19) Pneumonia? Radiology. (2020) 295:E6.
29. Diagnosis and treatment protocol of novel coronavirus, 5th trial version. China Government Network Central website. www.gov.cn/zhengce/zhengceku/2020-02/05/5474791/files/de44557832ad4be1929091dcbcfca891.pdf [in Chinese]. Published 2020. Accessed February 4, 2020
30. Zhang Y, Xue H, Wang M, He N, Lv Z, Cui L. Lung Ultrasound Findings in Patients With Coronavirus Disease (COVID-19). *American Journal of Roentgenology*. 2021;216: 80-84.
31. Cibinel GA, Casoli G, Elia F, *et al*. Diagnostic accuracy and reproducibility of pleural and lung ultrasound in discriminating cardiogenic causes of acute dyspnea in

the emergency department. Intern Emerg Med 2012; 7:65-70.
32. Volpicelli G, Mussa A, Garofalo G, *et al*. Bedside lung ultrasound in the assessment of alveolar-interstitial syndrome. Am J Emerg Med 2006; 24:689-696.
33. Wu S, Li K, Ye R, *et al*. Robot-assisted teleultrasound assessment of cardio-pulmonary function on a patient with confirmed COVID-19 in a Cabin Hospital. Adv Ultrasound Diag Ther 2020; 4:128-130
34. Peng Q-Y, Wang X-T, Zhang L-N. Findings of lung ultrasonography of novel corona virus pneumonia during the 2019-2020 epidemic. Intensive Care Med. 46:849-50. 10.1007/s00134-020-05996-6.
35. Lichtenstein D. Whole Body Ultrasonography in the Critically Ill. Berlin: Springer; 2010.

How to cite this article:

Nupur Basu *et al* (2021) 'Role of USG In COVID Pneumonia: Our Experience In A Tertiary Care Covid Hospital', *International Journal of Current Advanced Research,* 10(01), pp. 23606-23612.
DOI: http://dx.doi.org/10.24327/ijcar.2021.23612.4680

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