

Role of Thoracic Ultrasound in Detecting Pulmonary Complications in COVID-19

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Abstract

Introduction: COVID-19 is a serious rapidly spread viral infectious disease that appear in Wuhan city in China in December 2019 and soon became pandemic infection; the disease shows high mortality throughout the world that increased with complications, pulmonary complications of COVID-19 may be the corner stone of both morbidity and mortality as hypoxia secondary to lungs involvement may be the cause of other complication or may worse it, so early detection of pulmonary complication and early suitable intervention no doubt improve the outcome of COVID-19. The stander investigation to detect pulmonary complication is computed tomography (CT), but it is not available in many centers or there may be barriers to use it, so this study done to evaluate the role of thoracic ultrasound in detecting pulmonary complications in COVID-19, as it is bed side easy procedure that available in most centers.

Materials and Methods: This is a prospective interventional hospital base study, done in Port Sudan COVID isolation centre from July to September 2020, using portable ultrasound with 7 mm convex probe following BLUE protocol, and indicated therapeutic intervention done according the diagnosis.

Results: 24 patients were enrolled in this study, 70.8% male and 29.2% female. 12 patients (50%) showed features of pulmonary oedema, 4 patients (16.7%) showed features of pneumonia, other 4 (16.7%) patients showed sonological features of ILD, 2 patients (8.3%) showed features of ARDS, and 2 patients (8.3%) showed feature of pleural effusion regardless the cause of effusion.

Conclusion: Thoracic ultrasound is an effective diagnostic tool that detects the pulmonary complications in COVID-19 with reasonable sensitivity and specifies that in addition to clinical background give high diagnostic value and it should be the choice in area of constrained facilities or whenever computed tomography can't be used.

Keywords: Thoracic • Ultrasound • Pulmonary • Complications • COVID

Introduction

In December 2019 in Wuhan city in China novel corona virus disease start to appear with fever and respiratory manifestation so it detected as severe pneumonia, but soon it represent a serious rapid progressive medical problem and it showed different multisystem presentation and known as COVID-19, disease that rapidly spread and declared as global medical problem. First case in Sudan was registered in 13th march 2020 [1].

COVID-19 is a viral infectious disease that caused by corona virus, which is a new gene of corona virus that previously both SARS and MERS, syndromes that that showed serious fatal out breaks. The diagnosis of COVID-19 mainly based on detection of virus in nasopharyngeal sample through detecting its RNA using real time RT-PCR, but other haematological, chemical and/ or imaging investigation may help to reach the diagnosis and these are useful in following the course of the disease , detecting complication and shows the prognosis.

Many haematological, thrombotic and systemic complications may occur in COVID-19, these complications deteriorate the course of disease,

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worsening the morbidity and mortality of the disease. Pulmonary complication such as pneumonia, pulmonary oedema, pulmonary embolism, ARDS or even interstitial lung disease represent most common and most serious complications Early detection and management of pulmonary complication improve the outcome and may prevent other complication as hypoxia may be the corner stone in occurrence of other complication.

Chest Computed Tomography (CT) is the most useful imaging tool that used to detect pulmonary complications in COVID-19, but in many situations there may be difficulties to use CT or it may not be available as in our situation, so thoracic ultrasound may play significant role in detecting pulmonary complication, enabling early possible intervention. Thoracic ultrasound can study pleura, pleural space, lung, diaphragm, ribs and heart [2], with different specificity and sensitivity that varies between 95% to 100% and 81% to 100% respectively that depend on many factors being highly sensitive and specific to pleural effusion [3]. Although thoracic ultrasound is less sensitive and specific comparing to CT, it has advantages as a bed side investigation with less cost and easy access as procedure and availability.

Objectives

This study done to evaluate the role of thoracic ultrasound in detecting pulmonary complications in patients with COVID-19, enabling early intervention using the available facilities in area of constricted facilities.

Materials and Methods

This is a prospective interventional hospital base study done in Port Sudan COVID-19 isolation centre, from July to September 2020. In this study 24 COVID-19 PCR positive patients were enrolled. Thoracic ultrasound using portable ultrasound with 7 mm convex probe was done for all those patients,

then interpretation and diagnosis made following BLUE protocol (Bed side Lung Ultrasound Emergency Protocol) [4], accordingly suitable therapeutic intervention was done.

In This study according to BLUE protocol presence of regular symmetric A-lines and sliding sign consider as normal lung, loss of air with liver like appearance in absence or presence of one B-line diagnosed as pneumonic consolidation, sinusoid sign alone diagnosed as pleural effusion, three B-lines in one area consider pulmonary oedema, more than three B-lines diagnosed as ARDS, while presence diffuse B-lines in presence of consolidation which is a feature of ground glass appearance diagnosed as interstitial lung disease (ILD), and pleural effusion with localized rocket sign suggest pulmonary embolism but this is not included as definite diagnosis in study.

Results and Discussion

A total of 24 patients were enrolled in this study, 17 (70.8%) male and 7 (29.2%) female. 12 patients (50%) showed features of pulmonary oedema, 4 patients (16.7%) showed features of pneumonia, other 4 (16.7%) patients showed sonological features of ILD, 2 patients (8.3%) showed features of ARDS, and 2 patients (8.3%) showed feature of pleural effusion regardless the cause of effusion (Figures 1 and 2). Those with pulmonary oedema received diuretics and for some of them GTN was added, 66.6% of them recovered, for patients with pneumonia antibiotics was added and 90% of them responded, both ARDS and ILD received steroid and CPAP but showed low and slow response.

Thoracic ultrasound despite the priority of CT, still it represents a helpful



Figure 1. Pleural effusion shows consolidation.

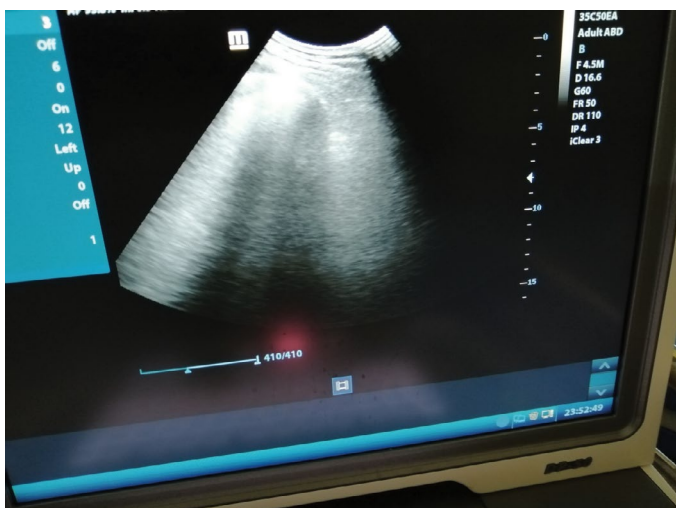


Figure 2. Pleural effusion shows B-line.

diagnostic imaging with high specificity and reasonable sensitivity that detect pulmonary complication in COVID-19; it has advantage over CT in that ultrasound is bed side, less radiation and side effect, more cost effect and easy technical procedure.

In this study pulmonary oedema represent the commonest complication that deteriorate the condition and it may progress to cause reversible or irreversible interstitial lung disease at some stage, so early detection and early suitable intervention surely improve the outcome in those patients, pulmonary oedema may be due to lung injury that affecting the endothelium and increase pulmonary capillary permeability or due to hypoalbuminaemia that decrease the intravascular oncotic pressure [5], both factors increase the interstitial fluid that progress to alveoli and causing congestion that appear as B-lines in ultrasound, those patients when detected in early stage usually respond to diuretics. Pneumonia represent significant percentage but still it is underestimation as thoracic ultrasound detect peripheral consolidation, pneumonia can presented as viral pneumonia that shows same presentation of COVID-19 such as cough, dyspnea, tachycardia and hypotension [6] so can't detected without imaging investigation and ultrasound is suitable technique specially for those in ICU, in addition to viral pneumonia nosocomial pneumonia may occur as many risk factors are there such as using of antibiotics, leukocytosis and leucopenia [6], at same time the virus may alter the epithelium surface in a matter that increase bacterial attachment and then occurrence of bacterial pneumonia [6], thoracic ultrasound can detect pneumonia but can't differentiate between types of pneumonia so haematological investigation and culture are needed for suitable therapeutic intervention.

Ground glass appearance represent 16.7% in this study and diagnosed as interstitial lung disease (ILD) which is showed the worst outcome. ILD in COVID-19 most probably bronchiolitis obliterans organising pneumonia (BOOP) that may occur as complication of viral pulmonary infection [6], but UIP, DIP and LIP should be taken in consideration as despite their chronic nature, rapid onset may occur in some patient accompanied by respiratory infection [6].

ARDS may occur secondary to the effect of virus on the endothelium of the pulmonary capillary which became excessively leaky [7], ARDS is a serious complication but if it detected in early stage it showed good response to ARDS management guidelines and ultrasound is of great value in early detection.

Pleural effusion with localized rocket sign may indicate pulmonary embolism but this picture is not highly specific therefore pulmonary embolism didn't put as diagnosis in this study and other causes of pleural effusion should be taken in consideration. 10% of pulmonary embolism arises from right heart and this may be the case of COVID-19 [8] as despite sonological features of pulmonary embolism usually there is no feature of peripheral source.

Conclusion

Thoracic ultrasound is an effective bed side imaging investigation tool that detect pulmonary complication early and so help in suitable intervention that improve the outcome in COVID-19 patients. Although its specificity varies but with clinical background it is highly valuable, non-invasive, easy accessible and economically effective investigation that can be the choice in constrained facilities areas.

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