Prediction of mortality and mechanical ventilation among critically ill patients of COVID-19 infection

Abstract

BACKGROUND

Large number of patients are in need of critical care as the coronavirus disease (COVID-19) pandemic has swept all over the world, posing great pressure on critical care resources. Particularly, among those receiving mechanical ventilation, mortality of critically ill patients with COVID-19 is high. High demand of hospitalization and an increased number of intensive care units (ICUs) admission has been required in COVID-19 pandemic [1]. Therefore, to evaluate critical COVID-19 patients, it has become mandatory to develop prognostic models.

OBJECTIVES

To predict mortality and mechanical ventilation among critically ill patients of COVID-19 infection.

MATERIALS AND METHODS

This is a retrospective study done for a sample of 100 patients to evaluate COVID-19 infection requiring mechanical ventilation among critically ill patients. The study included all the people who were infected with COVID-19 infection irrespective of them being cured, improved or admitted in intensive care units. The study population almost involved all the patients who came in emergency being suspected for COVID-19 infection using RT-PCR tests.

RESULTS

Among 100 patients included in the study, the mean age group seen to be 54.53 years (34 females, 66 males). Among males and females, mean age group of females affected with COVID include 53.08 and among males, 55.27. There were comorbidities present in some of the individuals infected with COVID-19, which presented as a risk factor for acquiring infection among them. The risk was high with diabetes mellitus (36%) followed by hypertension (31%) and heart diseases (1%). 28 patients died after ICU admission with infection and mean time of death of the patients from the time of Intensive Care Unit admission to death of the patient is 3.5 days. Some personal modalities also aided in easy acquiring of infection which included obesity, age, respiratory infections such as asthma, COPD, etc using qSOFA (quick Sequential Organ Failure Assessment) score for assessing sepsis associated with infection.

CONCLUSIONS

COVID-19 infection is easily acquired through droplets of infected person or contact with those infected with COVID and not all the patients do require mechanical ventilation and

intensive care unit admission. The need of ICU admissions increase in those people who have comorbidities and respiratory problems; mechanical ventilation in those patients is required in those who have oxygen saturation (SpO2 < 90% on room air). With additional medications and appropriate timely management, the patient gets recovered but in some who are unable to tolerate with the ongoing treatment and where the complications get started, they are failing to thrive and hence mortality occurs.

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is a primarily respiratory tract infection caused by a newly recognized betacoronavirus named SARS-CoV-2, firstly recognised in China (Wuhan), in December 2019 [1]. The outbreak of this infection has spread rapidly across the globe as pandemic from that time onwards. 87.994 critically ill patients and 2.668.036 deaths had been reported as of March 15, 2021 [2]. The clinical spectrum of COVID-19 ranges from asymptomatic infection to severe respiratory failure [3].

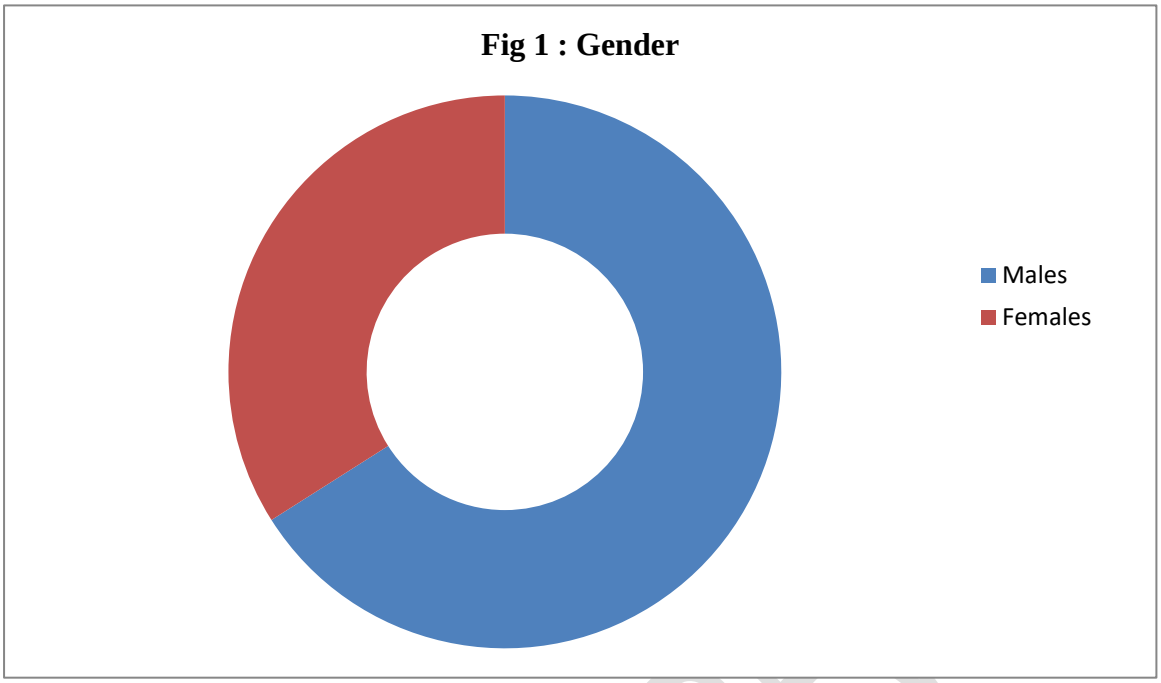
The first city where a COVID-19 patient identified in Italy was Placenza which is a small city of Northern Italy very close to Codogno. Consequently, to manage a sudden increase in COVID-19 patients requiring hospital admission, the local hospital was quickly changed into a “COVID-19 hospital” [4].

Intensive Care Unit (ICU) admissions and mortality is still limited with the knowledge of COVID-19 patient characteristics and risk factors associated with it. Older age, male sex, comorbidities, and higher qSOFA score are independently associated with worse outcome in those admitted to ICU [5-7].

However, clinical characteristics and predictors of mortality in COVID-19 patients admitted to ICU in Italy has been analyzed only by a few studies [8, 9]. To guide ICU capacity and resource allocation, the definition of risk factors for motality are mandatory. For the study, 66

males and 34 females were selected who were diagnosed positive in RT-PCR tests, (Fig 1).

Fig 1 : Gender



The aim of this study is to predict the mortality and mechanical ventilation among critically ill patients of COVID-19 infection.

MATERIALS AND METHODS

POPULATION

This study was approved by Institutional Review Board (IRB) and was conducted at Saveetha Medical College and Hospital of Chennai. This is a retrospective study of critically ill patients who were admitted in ICU in view of COVID-19.

Real-time reverse transcriptase-polymerase chain reaction (RT-PCR) assay of nasal and pharyngeal swabs has proved to be a diagnostic test for COVID-19 infection.

Those admitted to ICU who required mechanical ventilation or had oxygen saturation (Spo2) of at least 90% or more were defined as critically ill patients [10]. Due to rapidly worsening of their clinical conditions, informed consent for mechanical ventilation, intubation for underlying medical disorders were obtained in only a small amount of patients.

DATA COLLECTION

We reviewed Medical Records Department of SMCH for obtaining demographic details, complaints for which they were drawn to the hospital with duration, vitals, medical comorbidities, Glasgow coma scale (GCS) score, whether mechanical ventilation was required by the patient, number of days of ICU admission, (CORADS) The coronavirus disease 2019 (COVID-19) Reporting and Data System, whether survived or not, which category do they belong to with or without hypoxia. Patients were treated according to current guidelines and lung protective ventilator strategies were adopted [11].

RESULTS

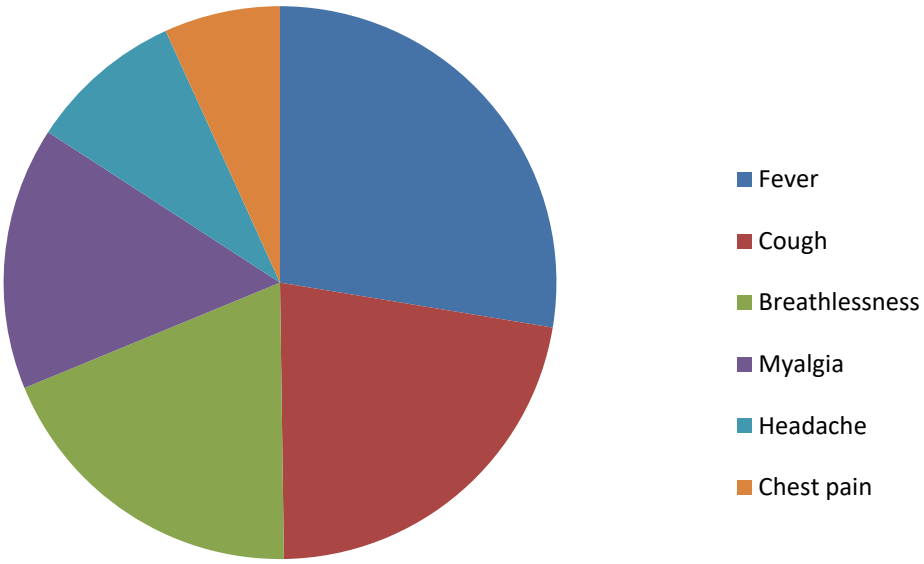
100 patients with a confirmed SARS-CoV-2 infection were admitted to our ICU during the study period and represent the studied population. The mean age of the patients was 54 years and 66% were males. Almost one or two comorbidities were present in atleast 77 patients in which hypertension was the most common (39%), followed by diabetes mellitus (36%) and angina (1%), (Table 1).

Table 1 : Demographic, clinical characteristic, comorbidities and outcomes of 100 patients with COVID-19 admitted to ICU

Demographic and clinical characteristics	**Total (n= 100)** **n (%)**	**Non survivors (n = 28)** **n (%)**	**Survivors (n = 72)** **n (%)**
Time from symptom onset to hospital admission	04	04	04
Time from hospital admission to ICU admission	03	03	03
Age	54	58	53
Gender			
Female	34	08	27
Male	66	20	45
Comorbidities			
Hypertension	31	09	22
Diabetes	36	14	22
Angina	01	01	
Initial symptoms			
Fever	61	24	37
Cough	49	19	30
Headache	20	03	17
Myalgia	34	18	16
Breathlessness	42	09	33
Chest pain	15	00	15
ICU length of stay	03	03	03

The most common findings at hospital admission were fever (61%), followed by cough (49%), breathlessness (42%), myalgia (34%), headache (20%) and chest pain (15%), (Fig 2).

Fig 2 : Presenting complaints



It took approximately 4 days for the patient to arrive to the hospital and get admitted after the onset of symptoms and 3 days for the patients to get shifted to ICU from emergency. Among patients who were admitted in ICU needed mechanical ventilation was 15 and 85 people managed to survive without external machine as their oxygen saturation reached the normal level when given sufficient amount of oxygen. The duration of mechanical ventilation for those people who required to maintain their oxygen saturation is given in (Table 2).

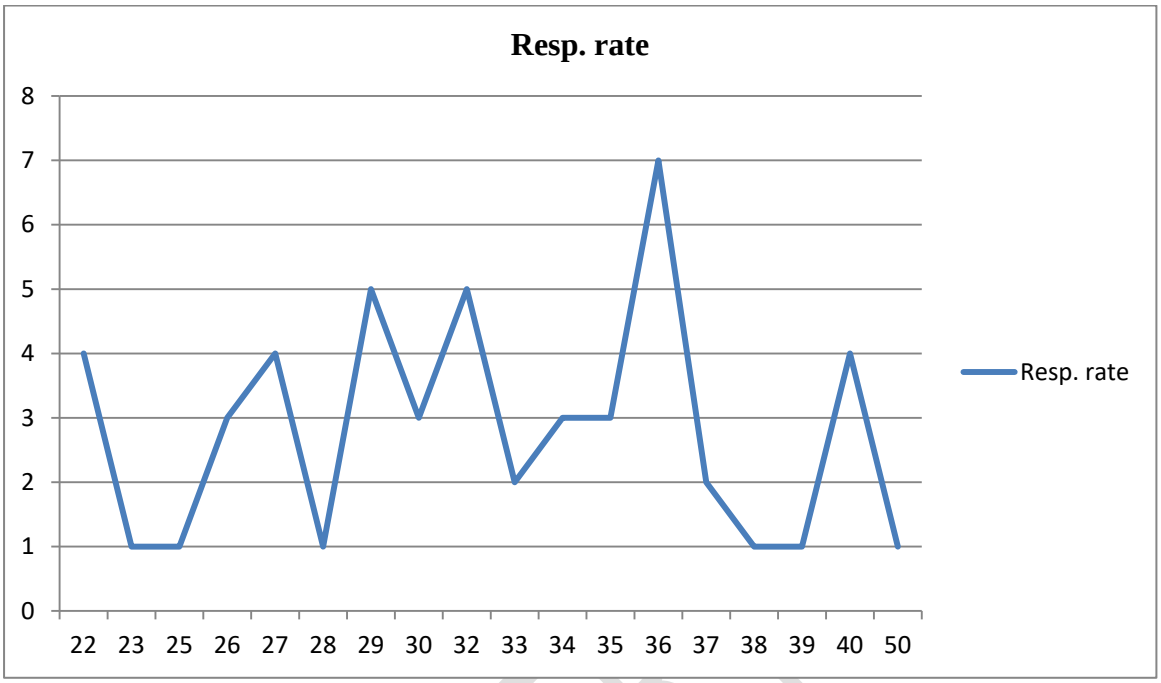
Table 2 : Cases requiring mechanical ventilation and its duration.

Mechanical Ventilation Duration	Number of cases
NO	87
1 DAY	02
2 DAYS	06
3 DAYS	05
4 DAYS	02

According to the vitals, for assessing the sepsis associated with COVID-19 infection admitted in ICU, qSOFA method was used, Table 3. [qSOFA contains Glasgow coma scale score <15, respiratory rate >=22, systolic blood pressure <=100].

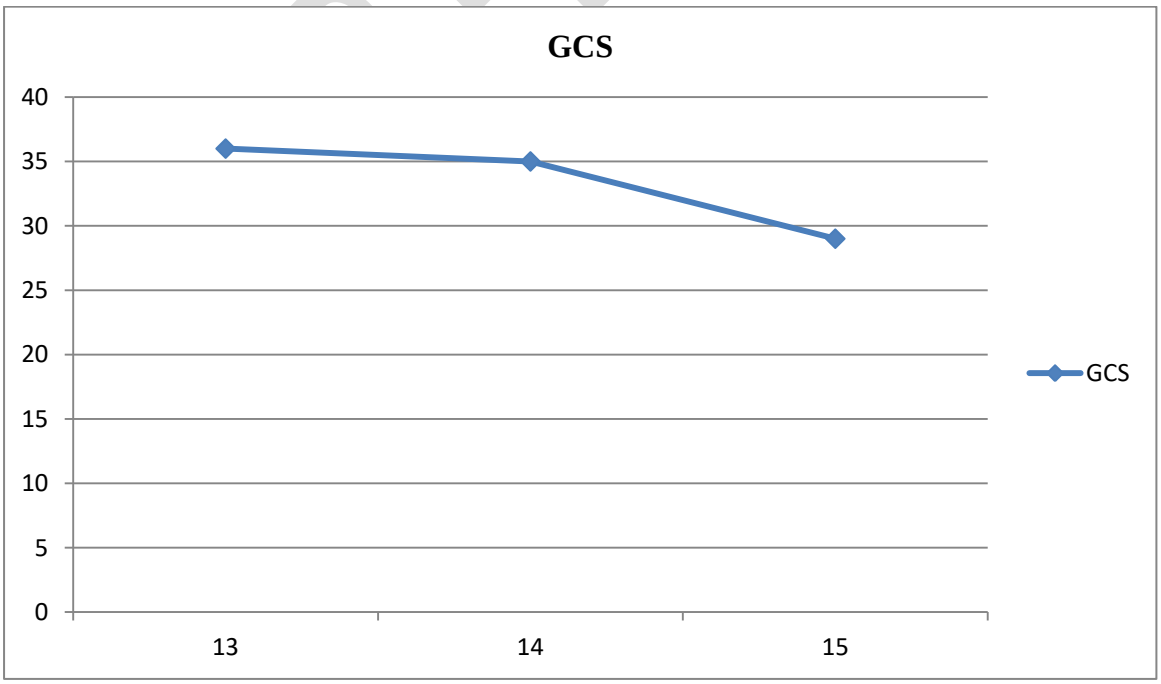
Table 3 : Quick Sepsis-Related Organ assessment (qSOFA)			
Points	**Respiratory Rate**	**Altered Mental Status**	**Low Blood Pressure**
	>= 22 breaths per min	Glasgow coma scale <15	SBP <=100 mmHg
Points	1	1	1

Fig 3 : Line diagram for respiratory rate of COVID-19 patients for evaluation of qSOFA score



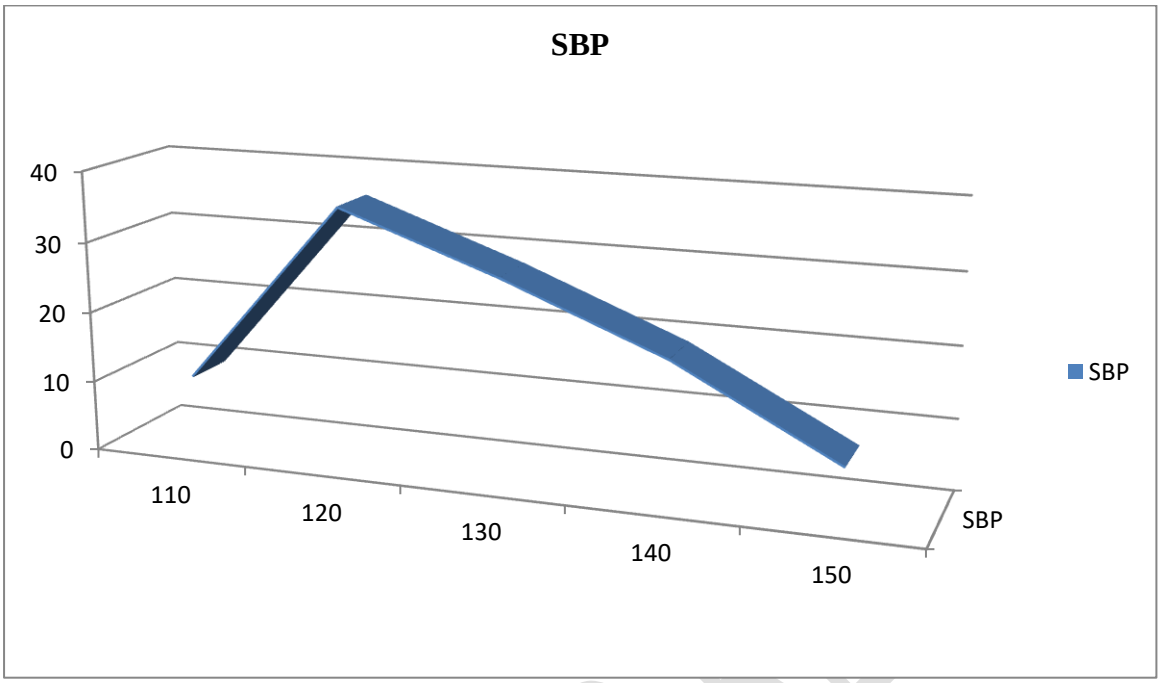
51% patients have 1 point for respiratory rate >=22 breaths per min.

Fig 4 : Line diagram of Glasgow Coma Scale of COVID-19 patients for evaluation qSOFA score



36% patients have GCS 13 followed by 35% patients having GCS 14 and 29% patients have GCS 15. Hence, all the patients involved in the study gets 1 point for GCS <15.

Fig 5 : Line diagram of Systolic Blood Pressure of COVID-19 infected patients for assessment of qSOFA score



The patients who were admitted in ICU did not show Systolic BP of <=100 mmHg and hence qSOFA score was 0 for SBP.

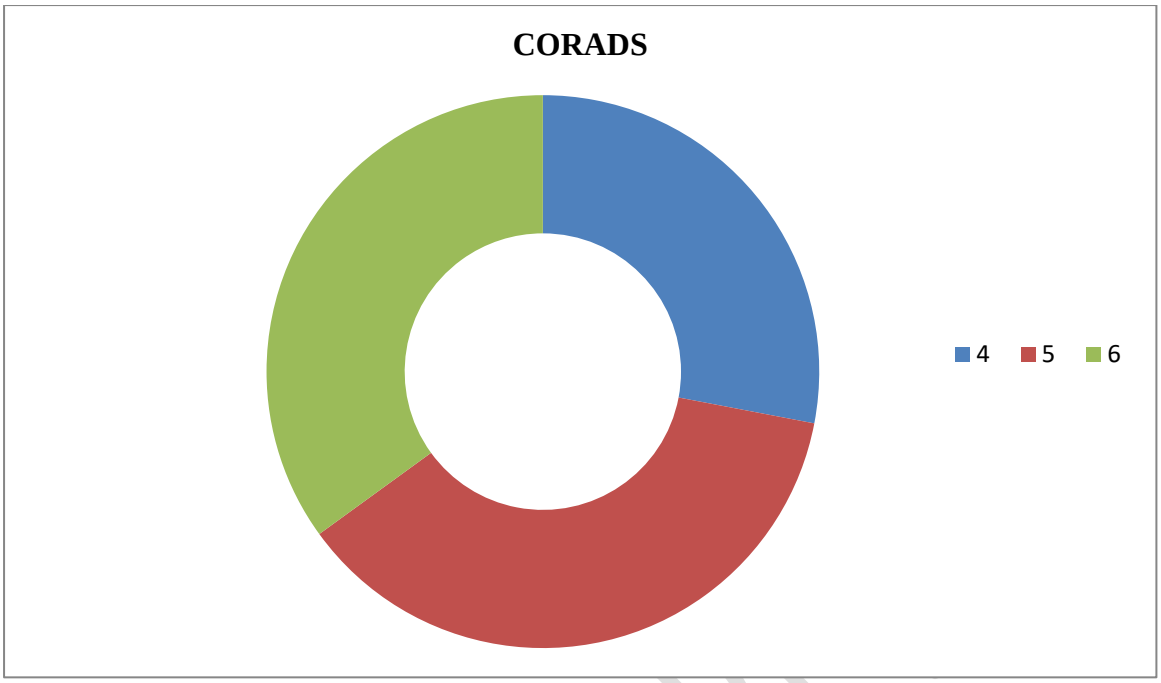
qSOFA >=2 suggests a poorer outcome and should alert clinicians of possible infection when previously not known [12].

COVID-19 Reporting and Data System (CORADS) is used to assess the suspicion of pulmonary involvement in COVID-19 [13]. An overview of CORADS is given in, (Table 4).

Table 4 : Overview of CORADS category and the Corresponding level of suspicion for Pulmonary involvement in COVID-19.

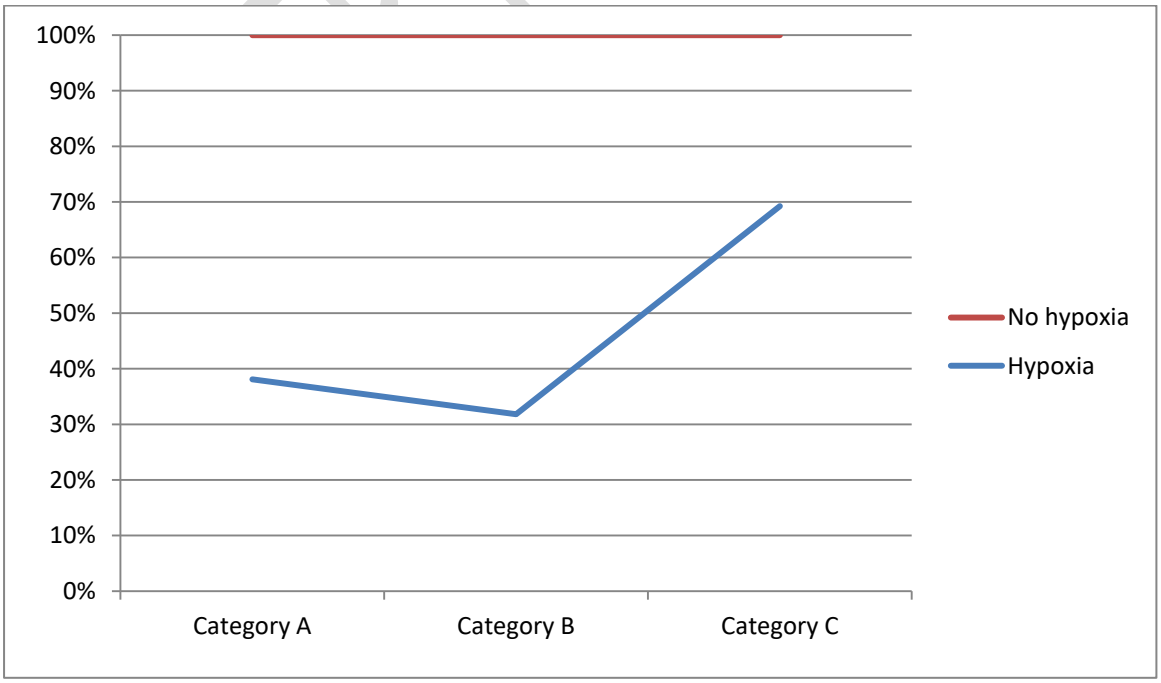
CORADS Category	Level of suspicion for pulmonary involvement in COVID-19	Summary
0	Not interpretable	Scan technically insufficient for assigning a score.
1	Very low	Normal or non-infectious.
2	Low	Typical for other infection but not COVID-19.
3	Equivocal/unsure	Features compatible with COVID-19 but also other diseases.
4	High	Suspicious for COVID-19.
5	Very high	Typical for COVID-19.
6	Proven	RT-PCR positive for SARA-CoV-2.

Fig 6 : CORADS score in ICU admitted COVID-19 patients



The patients belonged to Category A/B/C with or without hypoxia. Category A included fever with sore throat and advised for home care. Category B included high grade fever with severe sore throat plus comorbidities or extreme ages advised for home care with oseltamivir. Category C included any danger sign including breathlessness, cyanosis, hypotension, drowsiness which can be managed in hospital with oseltamivir. The three types of categories with or without hypoxia is illustrated in (Fig 7)

Fig 7 : COVID-19 patients belonging to Category A/B/C with or without hypoxia.



DISCUSSION

Since COVID-19 has strongly proved ICU capacities, pandemic has become worldwide novel challenge for critical care systems. The majority of our patients (89%) were admitted to the ICU because of decreased oxygen saturation in room air and acute hypoxemic respiratory failure which required mechanical ventilation. The need for mechanical ventilation among COVID-19 patients admitted to ICUs ranges from 29.1% in one Chinese study [14] to 89.9% in a U.S. study [15] and 88% in an Italian study [8].

The ICU worldwide mortality for COVID-19 respiratory failure is 25.7% [16]. In the current study, mortality rate of COVID-19 critically ill patients was 28%. This data is close to the average of the two previously mentioned mortality rates and it is similar to what was reported for ARDS [17].

In our study, the most common initial symptoms were fever and respiratory symptoms such as cough and breathlessness and the patients were mainly middle-aged people with hypertension. These findings are in concordance with previously published studies [7, 8, 17, 18]. There has been many case series reporting that people with diabetes are at higher risk of COVID-19 related mortality [19] and ICU admission with poor outcome than people without diabetes [20]. Type of diabetes, length of the disease and related complications, type of treatment and glycaemic controls during the infection are rarely considered some of the factors which could have affected the outcome.

The qSOFA score used to assess whether the sepsis is associated with COVID-19, and the score seems to be 2 which proves to be favourable. Any difference in mortality rate could not be demonstrated between male and female patients once admitted to the ICU even if males are at higher risk for mortality in the overall population. The principle reason for ICU admission was related to the severity of respiratory failure and a high percentage of patients required mechanical ventilation since ICU admission.

CONCLUSIONS

In this we predicted the mortality and need of mechanical ventilation in critically ill patients affected with COVID-19 infection. Age, presenting complaints, comorbidities, qSOFA score, length of ICU stay, need of mechanical ventilation, survivors or non survivors along with discharge against medical advice, category to which they belong to with or without hypoxia for mortality and should be carefully evaluated in these patients. To overcome all the difficulties and to prevent mortality in patients, there must be a better organization of ICUs for the treatment of COVID-19 patients.

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