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WHAT'S NEW IN INTENSIVE CARE

Critical care crisis and some recommendations during the COVID-19 epidemic in China

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Since December 2019, a severe acute respiratory infection (SARI) caused by 2019 novel coronavirus (SARS-CoV-2), began to spread from Wuhan to all of China [1, 2], and indeed the world. As of Feb 10, 2020, there are more than 40,000 confirmed cases and > 1000 deaths in China.

Lack of critical care resource in face of COVID-19 epidemics

Based on data reported by the National Health Commission of China, there have been about 2000 new confirmed cases and > 4000 suspected cases daily over the past week in Wuhan [3]. About 15% of the patients have developed severe pneumonia, and about 6% need noninvasive or invasive ventilatory support. Currently, there are about 1000 patients who need ventilatory support and another 120 new patients daily who require noninvasive or invasive ventilation support in Wuhan city; however, there are only about 600 ICU beds [4]. To address this shortfall, 70 ICU beds were created from general beds and the government quickly transformed three general hospitals to critical care hospitals with a total of about 2500 beds that specialize in patients with severe SARS-CoV-2 pneumonia (equipped with monitors and high-flow nasal cannula, noninvasive ventilator or invasive ventilators).

An equally great (or potentially greater) problem is the shortage of trained personnel to treat these critically ill patients. Until the crisis, there were about 300 ICU physicians and 1000 ICU nurses in Wuhan city. By the end of January, more than 600 additional ICU doctors and 1500 ICU nurses were transferred to Wuhan from the rest of China. As well, an additional 3000 staff including infectious disease, respiratory, internal medicine physicians and nurses were transferred to Wuhan by the government.

There are logistical issues which make care of the patients difficult. These include donning of personal protective equipment (e.g., gloves, gowns, respiratory and eye protection), lack of instruments and disposables, and shortages of supplemental oxygen. Many severe hypoxemic patients only receive high-flow nasal oxygen (HFNO) or noninvasive mechanical ventilation rather than invasive mechanical ventilation because of intubation delay or lack of mechanical ventilators (especially at early phase). Our preliminary data show that only about 25% of patients who died were intubated and received mechanical ventilation.

Recommendations

It's not possible at this stage to create new equipment or personnel. However, it would be very helpful to have mathematical models developed which predict the expected number of patients, and the necessary resources (equipment and personnel) required to treat these patients. This would aid in determining what resources might be moved to Wuhan to help local health care personnel.

Challenge of early recognition and treatment of critical SARI patients

Several previous reports have described the characteristics of SARS-CoV-2 infected patients [2, 5, 6]. Most patients are > 50 years of age; the mean age is much older

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than patients infected with H1N1 or with Middle East respiratory syndrome (MERS) [7–9]. About 30 to 50% of COVID-19 patients have chronic comorbidities. The duration from the initial symptom to respiratory failure in most patients is > 7 days, which is longer than H1N1 [7, 8]. Additionally, many patients that go on to develop respiratory failure had hypoxemia but without signs of respiratory distress, especially in the elderly patients ("silent hypoxemia"). Moreover, only a very small proportion of patients have other organ dysfunction (e.g., shock, acute kidney injury) prior to developing respiratory failure. These characteristics suggest that traditional methods such as quick sequential organ failure assessment (qSOFA) score and the new early warning score (NEWS) may not help predict those patients who will go on to develop respiratory failure. Therefore, it is urgent to establish a prediction or early recognition model of patients likely to fail.

Although the novel coronavirus was quickly isolated and sequenced [10], there are no proven, effective drugs to treat COVID-19. Based on in vitro screening studies, several drugs were found to inhibit the virus [11]. One case report demonstrated a surprising effect of remdesivir for SARS-CoV-2 infection [12]; however, the clinical impact remains unclear. Encouragingly, several clinical trials are undergoing (ChiCTR2000029308, NCT04252664 and NCT04257656) to determine the effect of lopinavir/ritonavir or remdesivir. We have also tried Traditional Chinese Medicine such as Xuebijing, and several clinical trials are ongoing in this regard.

Recommendations

Identifying a biomarker(s) that predicts severity and outcome in COVID-19 patients early in the presentation would be extremely helpful. Our data (unpublished) demonstrate that severe lymphopenia and high levels of

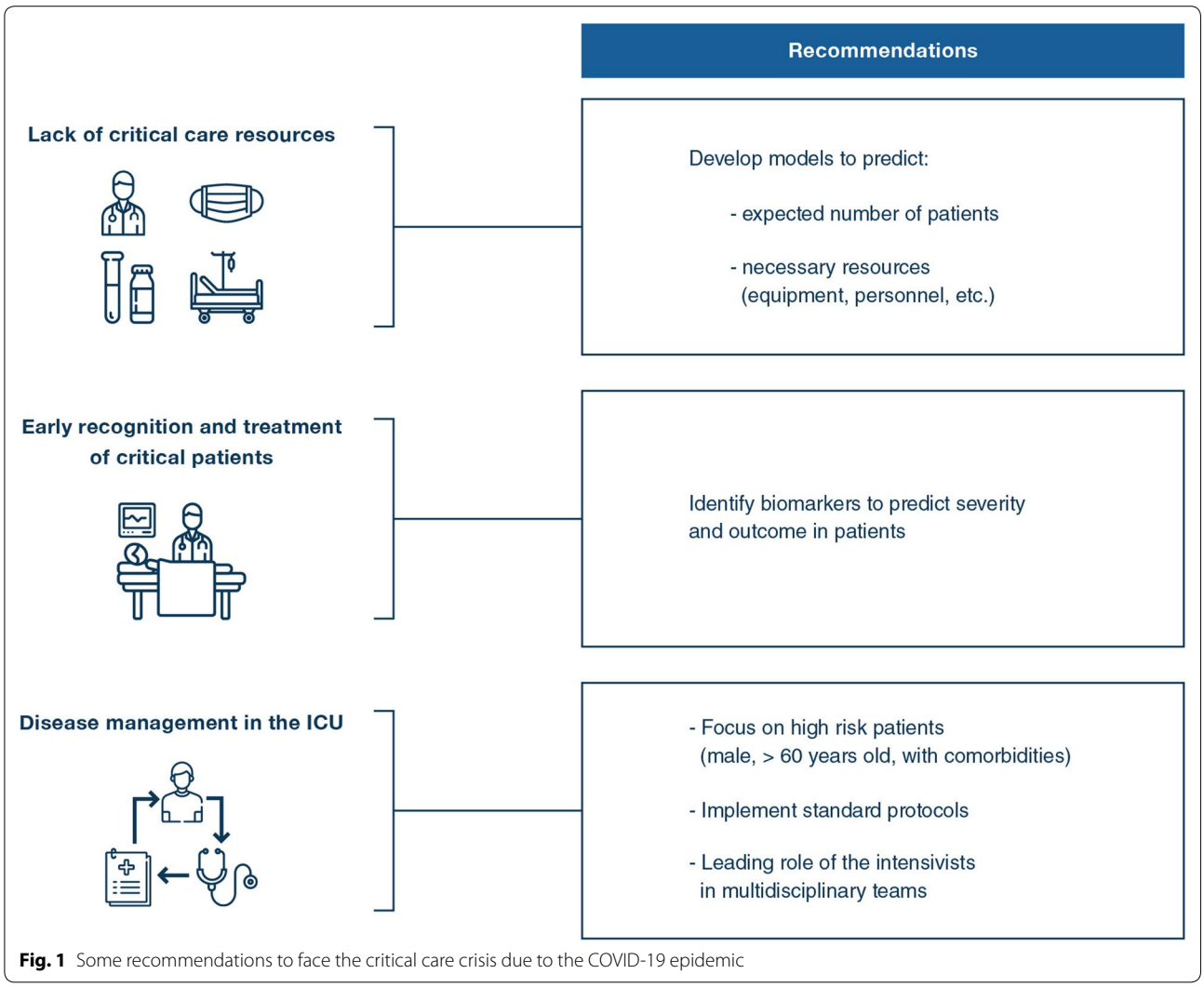

Fig. 1 Some recommendations to face the critical care crisis due to the COVID-19 epidemic

C-reactive protein correlated with the severity of hypoxemia and predicted hospital mortality. In addition, the change of lymphocyte counts during the first 4 days after hospital admission was highly associated with mortality.

Crisis in management of SARI in the ICU

The mortality rate of SARI is highest (4%) in Wuhan city, followed by other cities in Hubei province (1.4%) and other provinces (0.25%) [3]. The higher morality in Wuhan may due to the limited resources, but we are uncertain whether patients are sicker in Wuhan than in other cities. Understanding the characteristics of the dead patients would help in triaging patients and allocating resources. We analyzed data of 135 patients who died before Jan 30, 2019, in Wuhan city. Older age and male were common in non-surviving patients. More than 70% patients had one or more comorbidities. Hypertension (48.2%) was the most common comorbidity in non-surviving patients, followed by diabetes (26.7%) and ischemic heart disease (17.0%), similar to data reported by others [5, 6].

Importantly, as stated above, of the patients who died only ~ 25% received invasive mechanical ventilation or ECMO. The median duration of HFNO and/or NIV was 6(4–8) days before intubation or death. The mortality of patients who received ECMO is high: of 28 patients who received ECMO up to the present, 14 died, 5 weaned successfully, and 9 are still on ECMO. Lack of ventilators, fear of becoming infected during the intubation procedure, and unclear need for intubation were the main reasons for delaying invasive ventilation.

Compliance with lung protective ventilation strategy is also low in some centers, with some patients receiving tidal volumes > 8 ml/kg PBW and with high driving pressures. Sedation and paralysis strategies are also not standardized. Lack of intensivists may be a potential cause. Fortunately, we found a significant benefit of prone position in most severe ARDS patients.

Recommendations

There should be a focus on high-risk patients, e.g., male, > 60 years old, and patients with comorbidities. Additionally, a standard protocol for SARS-CoV-2 infection recommended by World Health Organization should be widely implemented [13]. It is crucial that our staff is trained to employ standard protocols for management, which may help implement evidence-based ventilatory and general ICU care in the face of an overwhelming workload. More importantly, in the context of a multidisciplinary team, intensivists should act as leaders, ensuring that severe patients receive standardized treatment (Fig. 1).

In summary, the COVID-19 epidemic has placed a huge burden on the Chinese health care system. This crisis has dramatically affected the delivery of critical care due to a lack of resources, lack of prediction models and of course the lack of effective pharmacotherapies. Front line critical care clinicians desperately require these tools.

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Compliance with ethical standards

Conflicts of interest

All authors report no conflicts of interest to declare.

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