COVID-19: An initial view from the Scottish critical care frontline

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Following the initial cases of severe respiratory illness in Hubei province, China in December 2019, there was rapid global spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the current outbreak was officially recognised as a global pandemic by the WHO on 11 March 2020.[1]

With the rapid proliferation of the virus across the globe, there was need for a swift and efficient critical care organisational response to ensure preparedness of our system to cope with a large influx of critically ill patients. Of note, the reported mortality for those requiring invasive ventilation was in excess of 80%.[2] This organisational response to the pandemic encompassed four main areas: capacity and expansion planning, adequate staffing, personal protective equipment (PPE) provision, and protocols, training and learning.

In Edinburgh, UK the first patient with confirmed COVID-19 (SARS-CoV-2) disease was admitted as a precaution to our regional infectious diseases unit on 3 March 2020, with the first patient requiring invasive ventilation seven days later. Following this, there was a relatively rapid increase in patients requiring invasive ventilation, and during this timeframe intensive care capacity within our hospitals was initially doubled, then quadrupled. This was achieved through expansion into other clinical areas such as the cardiothoracic intensive care unit, and theatre recovery areas. To support the provision of intensive care bed spaces for potential COVID-19 patients, all elective surgery with the exception of transplant and cancer work, ceased in mid-March 2020.

To ensure adequate staffing of our expanded critical care footprint, a number of staff moved from their roles in other parts of the hospital to a critical care environment. Many of these staff had previously worked in a critical care environment, or had an already developed skill set with crossover. In addition, recently retired and academic colleagues made the return to full-time clinical work to support the workforce. These staff were supported through the transition period with intensive peer-shadowing, practical, skill-based update sessions and theoretical online teaching webinars which supported their return to a critical care environment.

The provision of personal protective equipment (PPE) was understandably a key area of concern for healthcare staff. According to current evidence, SARS-CoV-2 is primarily transmitted between people through respiratory droplets and contact routes.[3,4] From mid-March 2020, PPE guidance was produced jointly by the Department of Health and Social Care, Public Health Wales, Public Health Agency (Northern Ireland), Health Protection Scotland and Public Health England. This allowed clear and consistent practice and messaging regarding PPE for staff. Staff working in critical care environments were prioritised for face-fit testing, and there was close monitoring of stock levels and direct communication with the Scottish Government to ensure adequate provision of PPE for staff caring for COVID-positive patients.

The final part of the organisational response incorporated protocols, training and learning. Prior to our first critically ill patient with COVID-19, we had protocols covering intubation, hospital transfers and proning, utilising the experience of other centres. Simulation scenarios complementing these protocols were written and distributed for local units to use as educational resources. As a result of drilling these protocols through simulation, a number of important learning points were identified, and video guidance was produced for staff to refer to.

As seen with the initial Hubei province outbreak,[1] and latterly in the Lombardy outbreak in Italy,[5] our clinical experience

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within Scotland has reflected that the clinical spectrum of COVID-19 infection is wide: from asymptomatic infection to severe viral pneumonitis and multiple organ failure leading to death. Whilst our initial patients gave a history of recent travel to affected areas, as community transmission became established in the UK, patients began presenting without recent travel or contact with an infected individual. Laboratory findings supporting a diagnosis of COVID-19 disease included a lymphopenia, with elevations in lactate dehydrogenase, C-reactive protein and D-dimer.[6] Chest X-ray findings were consistent with a picture of atypical pneumonia, with patchy bilateral airspace opacification. Diagnosis was confirmed with the use of SARS-CoV-2 PCR, although the sensitivity of nasal swabs was, in keeping with published rates, low at around 60–70%.[7] In patients with a suggestive clinical history and a negative nasopharyngeal swab, it was our experience that deep sampling (though endotracheal aspirates) was often subsequently positive.

There was a strong emphasis on anticipatory care planning for all patients admitted with COVID-19 disease, so that patients who were likely to benefit overall from invasive organ support could be identified early, and that patients with multiple comorbidities and a high clinical frailty score (CFS) could be appropriately cared for in a ward environment, avoiding distressing interventions that would be unlikely to benefit them.

The cohort that required organ support within a critical care environment locally closely matched the epidemiological characteristics of patients in other areas, according to the Intensive Care National Audit and Research (ICNARC) data.[8] Their data showed that critically ill patients had a mean age of 59 years, with a male preponderance (72%), and that the majority of patients previously lived independently (93%) prior to admission. Commonly reported comorbidities included hypertension and type 2 diabetes mellitus.[2]

Our initial experience was that patients requiring critical care presented early in their illness, then subsequently deteriorated slowly on the ward with an increasing oxygen requirement and work of breathing, which allowed time for a planned transfer to critical care. However, following government-enforced lockdown on 23 March 2020,[9] we found that patients were remaining at home whilst unwell in self-isolation and subsequently presenting to hospital later in their illnesses in extremis, requiring immediate transfer to a critical care environment.

At the start of the outbreak our practice was to proceed to invasive ventilation early. However, as the outbreak developed we used more non-invasive oxygenation techniques such as continuous positive airway pressure (CPAP) or high-flow nasal cannula (HFNC). The precise role and timing of these techniques remains unclear.[10] Patients requiring invasive ventilatory support met the diagnostic criteria for ARDS,[11] and were managed in an evidence-based manner with lung-protective tidal volumes, avoidance of high plateau pressures, and moderate-to-high levels of positive end-expiratory pressure (PEEP), adjusted to response.[12] Cumulative positive fluid balances were avoided, with patients kept in a neutral to slightly negative fluid balance. Proning has a strong evidence base in ARDS,[13] and patients with COVID-19 pneumonitis who were on more than 60% oxygen with a P/F ratio of <20 kPa underwent a trial of proning. Patients remained in the prone position for at least 16 hours and could be proned on multiple occasions. Patients with COVID-19 pneumonitis were notably responsive to proning, with many requiring multiple proning episodes over the course of several days. Those who failed a trial of proning and who remained deeply hypoxic despite optimisation of ventilation were referred to the UK Extracorporeal Membrane Oxygenation (ECMO) network for consideration of veno-venous extracorporeal membrane oxygenation. As the pandemic developed, ECMO capacity was rapidly expanded within the existing clinical network. As demand grew, guidance was published outlining revised criteria for ECMO referral in COVID-19.

In addition to severe respiratory failure, many patients went on to develop multiple organ failure, particularly a requirement for renal replacement therapy (RRT).[8] As would be anticipated, a number of patients additionally suffered setbacks throughout their stay with development of secondary bacterial infections and ventilator-associated pneumonia. Their course within critical care was often protracted, with a large proportion requiring tracheostomy to facilitate respiratory weaning.

In common with other centres,[14] a large proportion of our COVID patients suffered thrombotic complications during their critical illness. As a consequence we worked closely with haematology colleagues to develop bespoke protocols for thromboprophylaxis in COVID disease.

The initial outcomes from our unit for COVID-19 patients seem to closely mirror the ICNARC data from other units,[8] which reported an overall survival at 30 days of 48.9% for patients admitted to critical care. However, notably, survival for patients who received invasive ventilation fell to 32.6% at 30 days, and in those with multiple organ support requiring RRT, 30-day survival was 19.9%. In addition, poorer outcomes are noted in patients with increasing age, a higher Sequential Organ Failure Assessment (SOFA) score, and an elevated D-dimer on admission.[2]

Whilst initial outcome data has been reported, there is not yet an effective pharmacological therapy for COVID-19, and a vaccine is yet to be developed. In addition, the long-term outcomes for survivors of COVID-19 illness are not yet known. Survivors of critical illness and their families are at risk of post intensive-care syndrome, a constellation of physical, cognitive and psychological morbidity which can have a considerable impact on quality of life for patients and their families.[15] Following ICU discharge there may be a role for intensive multidisciplinary follow-up clinics rehabilitation of COVID-19 patients, although their role is yet to be established fully. The provision of debriefing and psychological support for staff will also have to be considered to support those who have worked through this period of unprecedented uncertainty within healthcare.

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