

Modelli di pluridisciplinarietà al Policlinico di Milano

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COVID-19 multidisciplinary high dependency unit: the Milan model

REVIEW

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COVID-19 multidisciplinary high dependency unit: the Milan model



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Abstract

COVID-19 is a complex and heterogeneous disease. The pathogenesis and the complications of the disease are not fully elucidated, and increasing evidence shows that SARS-CoV-2 causes a systemic inflammatory disease rather than a pulmonary disease. The management of hospitalized patients in COVID-19 dedicated units is advisable for segregation purpose as well as for infection control. In this article we present the standard operating procedures of our COVID-19 high dependency unit of the Policlinico Hospital, in Milan. Our high dependency unit is based on a multidisciplinary approach. We think that the multidisciplinary involvement of several figures can better identify treatable traits of COVID-19 disease, early identify patients who can quickly deteriorate, particularly patients with multiple comorbidities, and better manage complications related to off-label treatments. Although no generalizable to other hospitals and different healthcare settings, we think that our experience and our point of view can be helpful for countries and hospitals that are now starting to face the COVID-19 outbreak.

Keywords: COVID-19, High dependency unit, Multidisciplinary approach, Management

Healthcare professionals involved in the multidisciplinary team

Respiratory physician	• Initial evaluation of patient • Choice of respiratory support • Evaluation and placement of central venous catheter and/or arterial catheter • Identify signs of sepsis or multi-organ failure • Setting of sedative therapy, nutritional therapy, anti-thrombotic prophylaxis, hydration, antiviral and antibiotic therapy
Fellow	• Initial evaluation of patient • Placement of arterial catheter • Blood and microbiological tests request • Arterial blood gas test • Pneumonia follow-up with lung ultrasound
Nurse	• Preparation of medical devices to support respiratory insufficiency • EKG • Placement of peripheral venous catheter • Placement of bladder catheter • Collection of vital parameters • Therapies administration
Respiratory physiotherapist	• Evaluation with respiratory physician of ventilator/oxygen support • Early mobilization
Cardiologist	• Evaluation and placement of central venous catheter and/or arterial catheter • Identification and management of cardiac complications • Anti-hypertensive therapy • Inotropic support
Infectious disease specialist	• Identification of patients candidate to anti-viral or anti-inflammatory therapy • Choice of antiviral drugs • Choice of antibiotic therapy • Identification and treatment of sepsis • Super-infection identification and management
Rheumatologist	• Identification of patients candidate to the anti-inflammatory and specific anti-cytokine treatment • Definition of a tailored anti-inflammatory strategy according to the patient characteristics
Intensivist	• Multidisciplinary discussion to early identify patients candidate to intensive care management • DNI/DNR status

Abbreviations: EKG Elettrocardiogram, DNI Do not intubate, DNR Do not resuscitate

Minimum bundle of tests that are performed on HDU admission

Minimum bundle of test on HDU admission

Vital parameters (body temperature, blood pressure, respiratory rate, diuresis, ventilator/oxygen parameters) on admission and after 1, 3 and 6 h after admission.

BGA on admission and after 1 and 3 h after admission

Blood tests: blood cell count, CRP, PCT, transaminase, creatine phosphokinase (CPK), lactate dehydrogenase (LDH), total bilirubin, gamma-glutamyl transferase (GGT), alkaline phosphatase (ALP), creatinine, serum sodium, serum potassium, serum clorum, glycemia, albumin, prothrombin time (PT), activated partial thromboplastin time (aPTT or APTT), D-dimer, ferritin, fibrinogen, triglycerides, proBNP, troponin T, IL-6)

Microbiological tests: *L. pneumophila* and *S. pneumoniae* urinary antigen; blood cultures (preferably during fever)

EKG

Chest-X ray if not performed in the last 3 days

Lung ultrasound

Lower extremity venous ultrasound

Inferior vena cava ultrasound

Additional test

Thorax CT based on clinical status and risk of superinfection/pulmonary complications (contrast medium should be strongly considered if clinical suspicion of pulmonary embolism is present).

Throat cultures for MRSA and **rectal swab for multi-resistant pathogens** in case the patient is transferred from an intensive care unit or any other unit

Echocardiography in case of clinical suspicion of myocardial/pericardial involvement or heart failure

Abbreviations: HDU High dependency unit, CT Computed tomography, BGA Blood gas analysis, MRSA Methicillin-resistant Staphylococcus aureus, EKG Elettrocardiogram

Proposed respiratory support based on the severity of acute respiratory failure

Acute Respiratory failure	Alternative
▪ P/F ratio > 300 and respiratory rate (RR) < 30	▪ Low-flow nasal cannula oxygen or Venturi Mask or Reservoir Mask set with the aim of target SpO₂ 92–96% ▪ HFNC 40 L/min and FiO₂ set with the aim of target SpO₂ 92–96%
▪ P/F ratio 100–300 and RR < 30	▪ Helmet CPAP with PEEP 5 or 7.5 cmH₂O and FiO₂ set with the aim of target SpO₂ 92–96%
▪ P/F ratio < 100 and RR < 30	▪ Helmet CPAP with PEEP 5 or 7.5 cmH₂O and FiO₂ set with the aim of target SpO₂ 92–96%
▪ P/F ratio < 100 and RR ≥ 30 and/or respiratory distress	▪ NIV (Also to consider in case of: CPAP failure, hyper-capnia). NIV starting parameters: PEEP 12–16 cmH₂O PS set with the aim of Vt 4–6 ml/kg and FiO₂ set with the aim of target SpO₂ 90–95%

Abbreviations: P/F ratio arterial pO₂ divided by the fraction (percent) of inspired oxygen, *HFNC* High-flow nasal cannula, *CPAP* Continuous positive airway pressure, *FiO₂* fraction (percent) of inspired oxygen, *NIV* Non-invasive ventilation, *PEEP* Positive end-expiratory pressure

Other therapies for patients with COVID-19 disease

Antipyretic	• Paracetamol 1 g intravenous/orally every 8 h (with the goal to keep fever under control in patients with respiratory insufficiency) for all patients with body temperature > 37 °C. • Alternative: ◦ Diclofenac 75 mg intravenous in 24 h. ◦ Metamizole 500 mg intravenous every 8 h.
Systemic hypertension treatment	• Patients with systemic hypertension already on medication: antihypertensive therapy should be continued regardless of pharmacologic (ACE-inhibitor, sartan, beta-blocker) [73]. Diuretics should be discontinued to avoid hypovolemic status. • Patients that develop systemic hypertension during the hospitalization: treatment options include potassium-sparing diuretics (spironolactone 50 mg × 2/die or potassium canreonate intravenous with a minimum dose of 100 mg × 2/die) associated with ACE-inhibitors or sartans.
Hydration	• Hydration should be considered in all patients (especially patients with fever). • Before start of treatment with CPAP or NIV hydration should be provided in patients with signs of hypovolemia.
Nutrition	• In patients that are able to eat in HFNC or nasal cannulas: self-sufficient oral feeding • CPAP or NIV-dependent: nasal feeding tube should be placed to provide enteral feeding (e.g.: isosource protein 25 Kcal/kg) • In selected cases parenteral feeding (after positioning of central arterial access): ◦ 1. BMI ≥ 20 provide at least 1080 kcal (speed:1,5 ml/kg/h) ◦ 2. BMI < 20 provide at least 1540 kcal (speed:1,5 ml/kg/h)
Sedation	• Anxious state: Alprazolam (starting dose 0,25 mg × 2/die orally) • Psychomotor agitation, attempt to remove medical devices, tachypnoea: morphine bolus (2,5 mg i.v./s.c., max every 6 h) +/- Alprazolam (starting dose 0,25 mg × 2/die). At least 2 h between administration of alprazolam and morphine.
End of life support	• Starting dose: syringe pump with morphine 10 mg + midazolam 5 mg + haloperidol 5 mg + metoclopramide 10 mg • Dose should be modified according to clinical condition of the patient
Gastric protection	• Omeprazole 20 mg every 24 h orally/intravenous
Home therapy that should not be discontinued during hospitalization	- Levothyroxine - Beta-blockers and others essential cardiological therapies - Insulin in diabetic patients (oral antihyperglycemic should be discontinued in case of P/F ratio < 300 or acute kidney injury) - Corticosteroid therapy (<i>decalage</i> should be encouraged based on clinical condition of underlying condition)

Abbreviations: HFNC High-flow nasal cannula, CPAP Continuous positive airway pressure, NIV Non-invasive ventilation, BMI Body mass index

Infection control procedures

Dressing and undressing procedures for healthcare providers in COVID-19 high-dependency unit [34, 88, 89].

Dressing

- Remove all personal items
- Practice hand hygiene with soap and water or alcoholic solution
- Wear a first pair of gloves
- Wear the disposable gown over the uniform
- Wear FFP2/FFP3 covering the nose and mouth to minimize the space between the face and mask
- Wear protective full face shield or glasses
- Put on a second pair of gloves

Undressing

- Remove the disposable gown and dispose of it
- Remove the first pair of gloves and dispose of them
- Remove the glasses and sanitize them
- Practice hygiene of gloves with alcoholic solutions
- Remove FFP2/FFP3 by handling it from the rear and dispose of it in the container
- Remove the second pair of gloves
- Practice hand hygiene with alcoholic solutions or with soap and water
- Shower including disinfection of the ears and mouth

Protective equipment and recommendations for respiratory devices [34, 90, 91, 89, 92]

Procedures and/or device

Aerosol-generating procedures (airway suction, bronchoscopy)

NIV

Conventional oxygen therapy

HFNC

Recommendation

- Should be performed in negative pressure rooms
- FFP3 mask for operator
- Use a double-limb circuit with a non-vented mask
- Place three filters per ventilator: between the expiratory port and the ventilator; between the inspiratory port and the ventilator; near the patient's mask
- The interface with the lowest risk of aerosol emission is the helmet equipped with an inflatable neck cushion
- Do not use humidifiers
- The patient has to wear the surgical mask to reduce contamination risk
- The patient has to wear the surgical mask to reduce contamination risk
- Nasal cannula must be completely inserted in the nostrils and secured with the elastic bands on the patient's head to minimize lateral losses

Abbreviations: NIV Non-invasive ventilation, HFNC High-flow nasal cannula

Conclusions

- Several patients with COVID-19 disease show the symptoms of a dis-regulated inflammatory response Hypercoagulability seems an important problem leading to pulmonary embolism and DVT
- Lack of highly effective antiviral drug is an important limitation
- There is need for improvement of ventilatory care

A multidisciplinary involvement of several figures is able to better identify treatable traits of COVID-19 disease, early identify patients who can quickly deteriorate, particularly patients with multiple comorbidities, and better manage complications related to off-label treatments