

COVID 19: a frugal approach?

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The COVID-19 pandemic poses unprecedented challenges to our healthcare system, particularly in its capacity to absorb a sudden influx of critically ill patients with Acute Respiratory Distress Syndrome (ARDS). The multiple constraints of equipment, personnel and organization seem insurmountable with a conventional approach if the pessimistic provisions came about. Access to ventilators may become a limiting factor, but the availability of qualified personnel to manage intubated, ventilated and sedated patients could be even more challenging. For example, posting 1 intensive care nurse requires in practice 6 nurses for rotation.

Cushioning the shock on intensive care units?

The important influx of critically ill patients appears to play a major role in destabilizing the exiting critical care during the COVID-19 pandemic, both in China and Italy. Any solution that would slow down the speed of health aggravation of the patients, even for a few hours or days, could be useful, as it would reduce the pressure on intensive care units.

Intermediate care units could play this role of shock absorber, by taking care of the patients at risk of worsening, presenting an isolated respiratory failure. If these units were able to stabilize patients at risk of respiratory distress for a few days, this could possibly:

- 1) marginally, allow rare patients to overcome the disease
- 2) and more importantly to delay, even for a few days, the transfer to intensive care and therefore the pressure on these units.

Doing more with less for more patients?

The expected volume of patients requires special management, and the frugal approach could meet the constraints of the situation. The three main criteria that define frugal innovation are: focus on the need, optimized performance and substantial cost reduction. The frugal solution is thus focused on meeting the need, without compromising on quality, but without unnecessary additions. This approach is particularly interesting for critical care in the context of high constraints [1]. It would therefore be necessary to implement a simple, inexpensive and physiologically relevant solution for

the management of respiratory distress in intermediate care units used to manage a significant volume of patients in respiratory distress, such as cardiac intensive care units for example.

CPAP Boussignac example

In the case of the COVID19 pandemic, the Boussignac CPAP device could prove to be interesting for the following reasons:

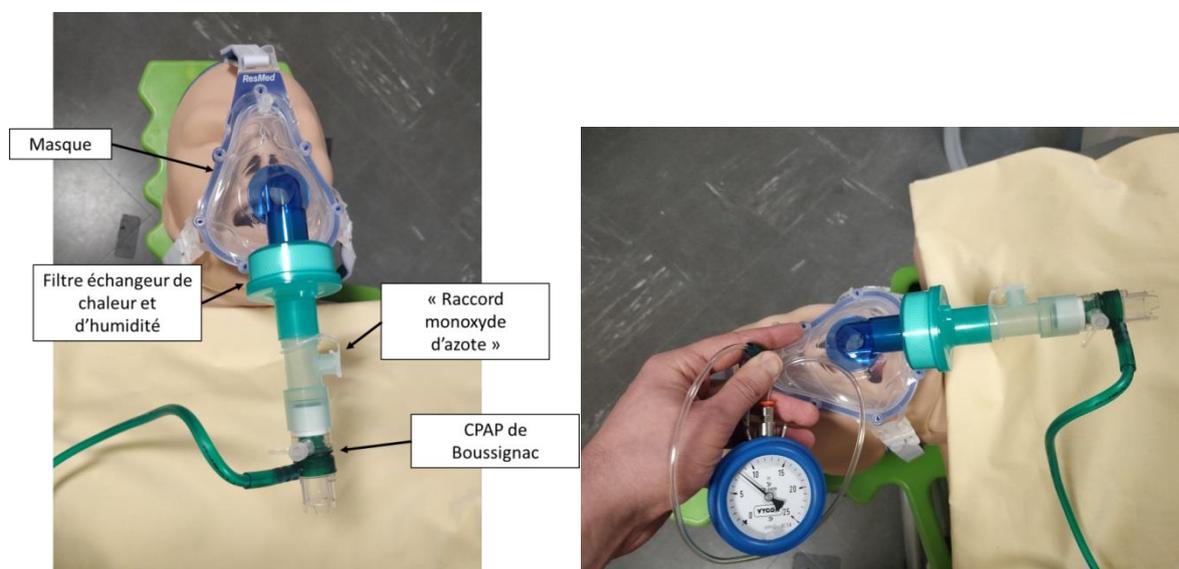
- It is adapted to the respiratory physiological profile of COVID19 patients who have both good pulmonary recruitability and moderate impairment of respiratory compliance. Under these conditions, it allows delivery of sufficient positive expiratory pressure (unlike high flow oxygen therapy), while avoiding the over-distension that would be induced by an inspiratory support (as with conventional non-invasive ventilation).
- It can deliver up to 100% of the inspired fraction of oxygen, making it perfectly adapted to COVID-19 patients who are very often severely hypoxemic.
- It is extremely simple to use by any healthcare professional, with a brief and quick training, outside the context of intensive care.
- It is compatible with the use of a heat and humidity exchange filter, which allows both humidification of the inhaled gases for the patient and antimicrobial filtration to protect the health care workers. Therefore, it does not present any particular risk of contamination of the clinical staff members.

Proof of Concept

Rapid implementation of this concept requires demonstration of its physiological efficacy, safety, and feasibility.

- Physiological efficacy

The effectiveness of the Boussignac CPAP in delivering a positive expiratory pressure of the order of 5 to 10 cm H₂O has been demonstrated. Last week, Dr. CARTEAUX conducted a bench study with the assembly including an antimicrobial filter and heat and moisture exchanger. It is necessary to interpose a connector (usually used to connect nitric oxide) to ensure the connection between the different elements.



- Feasibility

The technical clinical feasibility was tested in the COVID intensive care unit at Henri Mondor last week, with a very good satisfaction of the nurses in terms of achievement. The price of a Boussignac CPAP set is very small compared to conventional resuscitation methods, and the available stocks are large (> 10,000 valves at the last point made on 16.03.20 with the Vygon Company).

- Security

The use of the Boussignac CPAP with the antimicrobial filter and heat-moisture exchanger and an oxygen flow rate of 20 l/min meets the safety requirement because the set-up and removal procedures are very simple. For set-up: attach the mask to the harness and then open the oxygen flow. For removal: close the oxygen flow and then remove the mask.

Requirements specifications for set-up (derived from those published for intensive care units)

Area requirements

- One area is dedicated to the ICU COVID-19
- This area is tightly separated (e.g. partition wall) or at best geographically separated from other parts of the unit.
- Access to this area is strictly restricted to personnel working there.
- All the equipment needed to manage an ICU patient is available
- The area must be capable of operating autonomously
- Positive pressure ventilation can be switched off: obligatory
- It is best to place the rooms under negative pressure, otherwise the rooms can be ventilated by opening the windows.
- The rooms can be closed, but allow a permanent visualization of the patient.
- The chambers are equipped with wall-mounted oxygen and a pulsed oxygen saturation monitoring system, at best centralized.

Circuit

- The admission and discharge circuit for patients infected with COVID-19 is defined according to the different services (EMS, A&E, medical service).
- For monoblock buildings, there is a dedicated (or defined) system of elevators
- There is a written procedure for entry to and exit from the rooms.
- Chest X-rays are done in bed; the indication of other radiological examinations is discussed on a case-by-case basis.
- Continuity of care is ensured by on-call medical services.
- The number and quality of medical and paramedical staff dedicated to this activity is defined
- The paramedical staff is at least 1 nurse and 1 nurse's assistant for every 4 patients.

- The personnel dedicated to this activity have previously been trained by the operational hygiene team in the barrier precautions necessary for the management of COVID-19 patients.
- The personnel dedicated to this activity have been previously trained by the resuscitation team in the management of acute respiratory distress in COVID-19 patients.

Specific procedures

- Written procedures exist for specific aspects of the management of COVID-19 patients, including
 - COVID-19 ICU admission criteria (isolated respiratory failure)
 - Boussignac CPAP ventilation (HME filter, start and stop sequence...)
 - Criteria for calling the anaesthesiologist in case of worsening

References

1. Mekontso Dessap A (2018) Frugal innovation for critical care. Intensive Care Med. <https://doi.org/10.1007/s00134-018-5391-6>