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Early View

Research letter

Covid19: minimising risk to healthcare workers during aerosol producing respiratory therapy using an innovative constant flow canopy

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Covid19: minimizing risk to healthcare workers during aerosol producing respiratory therapy using an innovative constant flow canopy.

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Noninvasive ventilation (NIV), continuous positive airway pressure (CPAP) and high flow nasal cannula (HFNC) can be used as the first line of treatment in COVID19 patients with respiratory failure, postponing and maybe even avoiding the need for intubation and mechanical ventilation (1). Recent systematic review and meta-analysis demonstrated that HFNC reduces the need for intubation compared with conventional oxygen with no change of the death risk or ICU length of stay (2-3), while no direct evidence supports the use of NIV due to a high failure rate (4). However, when resources become limited with no option of invasive ventilation, the use of NIV may be justified. The major caveat of using noninvasive respiratory support in the face of the COVID19 pandemic is the generation of aerosols composed of small virus containing particles which may remain suspended in the air, with increased risk of health care workers (HCW) (7-8). The risk of aerosolization depends on many variables, including duration of use, flow velocity, mask leakage and patient coughing and cooperation.

At the current crisis with a limited number of ventilators and of negative pressure facilities we developed a novel way to reduce, and even eliminate, this exposure to potentially dangerous aerosol by using a constant flow canopy over the upper part of the patient bed, thus creating a confined area surrounding the patient in which non-invasive respiratory support can be safely used.

The system is composed of three parts: (i) A flexible plastic canopy that covers the upper part of the patient body, (ii) A fan filtering unit (FFU) composed of (a) a pre-filler in the air inlet (b) an electrical fan and a (c) HEPA filter in the air outlet (identical to those installed in biological cabinets). The filtering system is manufactured by LPA Cleanrooms & Laboratories Ltd, Israel. and (iii) an exhaust system (electrical fan) creating negative pressure and transfering the filtered air out to the open atmosphere. Each filtering unit can support up to 4 patients in parallel.

The polyethylene canopy serves as physical barrier between the HCW and the patient. The canopy should ensure maximum enclosure of patients upper body, however, a gap of 5-7 cm between the patients body and the canopy is designed enabling safe treatment. The system enables rapid acsess in case of an emergency from either the direction of the chest or head enabling rapid intubation or CPR.

The unit was evaluated by two techniques: 1. Face velocity and smoke direction: speed (m/sec.) of air flowing perpendicular to the hood's opening inside the enclosure, and smoke flow in the direction of the enclosure back part (per US ASE/ASHRAE Standard 110). 2. Integrity test of the HEPA filtering unit, using photometery, to measure leakage of particles (0.3-0.5 um in size) through the filters. (per EN 12469 - European Standard for Microbiological Safety Cabinets).

The results of our evaluation demonstrated that the average air flow velocity was 4.4 m/sec and the smoke clearly flows very fast into the back side of the canopy.The integrity results measured 0.0006% particles (maximum standard requiremet 0.01%).

In order to assess the satisfaction of the medical staff in the corona unit from the system we asked 9 physicians and nurses to fill a short 6 questions questioner. The overall impression score of the system was 9.1 (out of 10).

In summary this innovative negative pressure canopy allows us to administer NIV, CPAP or HFNC to patients with moderate to severe lung injury due to SARS-CoV-2 infection with minimal risk to HCW. The system has been installed in the Corona unit of the Carmel, Lady Davis MC, Haifa Israel.

Figure-1

The constant flow canopy system.

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Control panel
Filtering system
Canopy