

**SHORT COMMUNICATION**DOI: <https://doi.org/10.3329/mediscope.v9i2.61709>**Air refiner breather/disinfection unit (water seal system) is a clinically useful and cost-effective device for COVID-19 patients**Faruquzzaman¹**Abstract**

Coronavirus disease-2019 (COVID- 19) pandemic declared by the World Health Organization (WHO) on 11th March 2020, caused by the SARS-CoV-2 virus is at an exponentially rising state across the globe. Bangladesh is also facing the toll of this highly transmissible zoonotic disease with community transmission (at a different rate) across the country. This is a new coronavirus, still evolving, and has put the scientific authority in a puzzle. Prevention of transmission and contamination (especially via air-borne route) is the main aim here. Moreover, prevention of contamination of Intensive care unit (ICU) and operation theater (OT) equipment and environment is an optimal target. Gas and smoke evacuation during laparoscopy and pneumoperitoneum is also a big question. Cost-effectiveness is another important aspect. Different processes, techniques, devices, etc. have been tried so far. Here, a new device is going to be reported in this paper in such relation.

Keywords: Air refiner breather, Disinfection unit, Contamination, Air-borne, Laparoscopy, pneumoperitoneum, ICU, Mechanical ventilation.

Introduction

COVID-19 infection has made a great impact on the health and economy of many countries. Low-middle-income countries are yet to experience the worst of it. There are lots of issues, such as appropriate resource management that will come alongside the infection that can make the condition even worse. For how long this virus will stay with us is yet to be known.¹ COVID-19 epidemic has shaken the whole world immensely. Even the best health care systems are struggling to fight this condition in terms of management, resources and manpow-

er. Many first-world countries have already seen the surge and in the upcoming weeks, less-developed countries like Bangladesh, Nepal, and India are about to experience a peak in the number of cases.¹⁻³

Contamination of the OT, ICU, other patients, doctors, nurses and staff is a major concern here. A dedicated operating room only for patients with COVID-19 must be separated with a clear notification as “infectious surgery” outside of the entrance.⁴ A dedicated surgery team including anesthesiologists is only allowed to enter the operating room.⁵ No one should

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come out of the room before the operation is finished. The number of team members should be kept as minimal as possible.⁶ The functionality of the theater must be confirmed by technical personnel including the functional high-efficiency filter and the appropriate operation of laminar flow.⁷ The theater needs to be well prepared with a negative pressure system.⁵ If negative pressure operating rooms are unavailable, operations can be done cautiously with the positive pressure system with a high air exchange cycle rate (>25 cycles/h); however, air conditioners must be turned off.⁵⁻⁶ A dedicated anesthesia machine must be ensured in the operating room. There is a lack of consensus regarding the disinfection of the machine before it can be used for non-infected patients.⁷ Surgical equipment used in the operation for COVID-19 positive or suspected cases should be cleaned separately from other surgical equipment.⁷

If a positive or suspected COVID-19 patient is stable after surgery, the patient should be directly sent back to the negative-pressure ward, not to the post-operative room once extubation is completed in the operating room.⁷ The patient should be covered with one disposable operating sheet and then taken to the isolation ward through a dedicated passage. During the transfer, the patient must wear a surgical mask or N95 mask. The passageways should be properly cleaned and covered.⁷ If the patient needs to be kept intubated, a single-patient-use respiratory bag must be used during shifting. The ventilator is not recommended during the transfer.⁷ The main aim of all these is to prevent contamination.

So far, many devices have been tried in our country to prevent air-borne contaminations. One of such devices has been shown in figure 01 to evacuate laparoscopy/pneumoperitoneum-induced gas and smoke.



Figure 01: Gas (smoke) evacuator in laparoscopic surgery

The main mechanism of this device is like the mechanism of the conventional water seal drainage system (Figure 02).



Figure 02: Water seal drainage system

Description of the device

“Air refiner/disinfection unit” is a disinfection mechanical unit of air, which consists of:

1. Main unit/refiner unit.
2. Connector channel.

There are two types of refiner:

- A) Static unit model.
- B) Dynamic unit model.

1. Main unit/refiner unit/disinfection unit:

The whole unit is a one-way system. The main unit consists of an inspiratory tube, expiratory tube, main unit, filter, etc. The main unit acts like a water seal drainage system. Disinfecting agents can be used in fluid or air in the main unit. This is a portable unit.

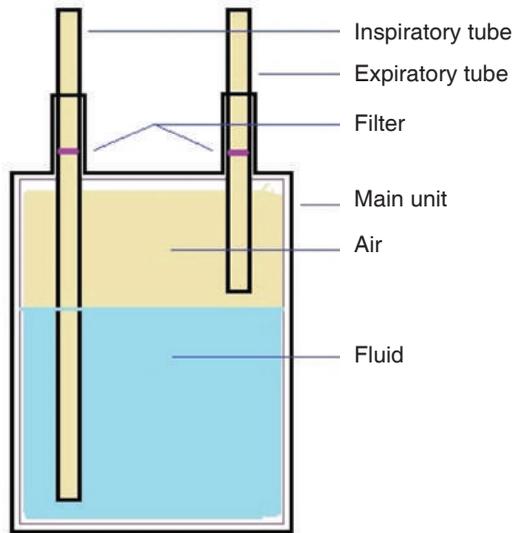


Figure 03: Main unit/refiner unit (static)

In the case of the dynamic unit, air flow and fluid exchange systems are seen in figure 04.

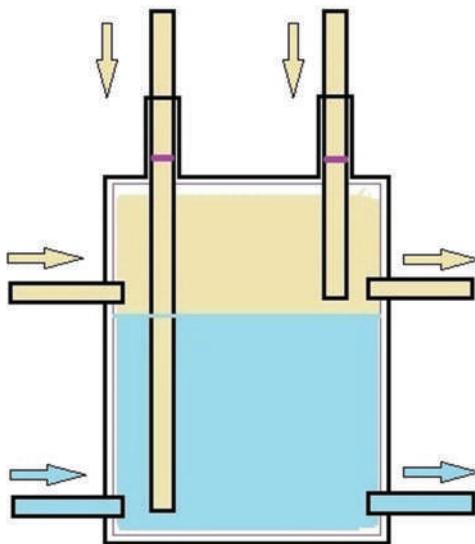


Figure 04: Main unit/ refiner unit (dynamic) with the flow

2. Connector channel:

Connecting channels are of two types: connecting tubes with patients or equipment (mechanical ventilator) and connecting tubes between units. End A of the channel (common channel) connects with the nasal/face mask or equipment. And end B connects with the main unit/refiner unit.

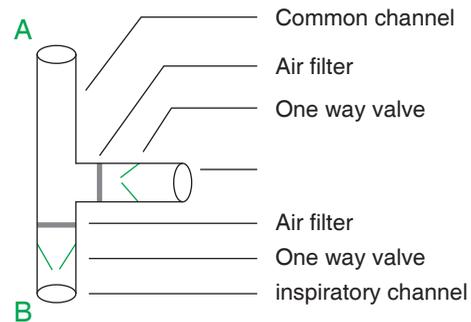


Figure 05: connecting tube with patient or equipment.

The beauty of this system is that more than one unit can be connected in series to achieve optimal power and effect.

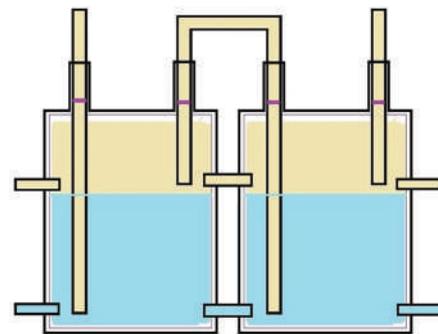


Figure 06: Two (02) main units/refiner units in series.

Cost-effectiveness:

The total cost of the device is only BDT 200-500 (USD 2.4-5.9).

Main uses:

1. In the case of COVID-positive patients (or infectious patients), this unit can be connected to the nasal/face mask of the patients to refine air and prevent contamination.

2. In the case of patients (who require mechanical ventilation), this device can be connected with the mechanical ventilator to prevent contamination of the ICU devices, equipment, environment, other patients and staff.

3. This device can also be used in OT with the patients routinely to prevent further contamination.

4. In the case of laparoscopic surgery and pneumoperitoneum, smoke and gas from the patient's body cavity can be safely evacuated by using this device.

Conclusion

This is a highly effective device. Contamination can be minimized in many clinical circumstances and set-up (ICU, postoperative block, operation theatre, general wards, domestic set-up, etc.). Prevention of transmission can be also minimized. Moreover, this is a very low-cost device. Therefore, the ultimate cost-effectiveness is remarkable.

Conflict of interest

The author declares no conflict of interest.

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