

## Oxygen therapy using Bain's Circuit as an alternate option for moderate COVID-19 patients in resource-limited set-ups

Habib Md Reazaul Karim

Department of Anaesthesiology and Critical Care, All India Institute of Medical Sciences Raipur, India

Dear Editor,

Coronavirus disease of 2019 (COVID-19) has been slowly engulfing society since December 2019. Many parts of the world are facing the second and third waves of the pandemic. The virus is rapidly getting mutated, posing a significant challenge. Oxygen therapy is required in most symptomatic patients, and most mild-to-moderate cases are managed by supportive therapy using a face mask. Non-Rebreathing Facemask (NRBM) is frequently used as it can provide a higher fraction of inspired Oxygen ( $F_{iO_2}$ ). However, it cannot deliver a Positive End-Expiratory Pressure (PEEP). Even the positive pressure generated inside the mask is nearly zero.

On the other hand, COVID-19 patients' lung shows atelectasis and pathophysiology somewhat like acute respiratory distress syndrome (ARDS), yet with better lung compliances.<sup>1</sup> The ability of PEEP to improve oxygenation in ARDS is well known. COVID-19 patients are also likely to be benefitted, and even relatively lower PEEP might be helpful from pathophysiological viewpoints. NRBM cannot produce PEEP. It can be solved to some extent by using Bain's circuit in place of NRBM. If connected with Noninvasive Ventilation (NIV) mask, it can provide high  $F_{iO_2}$ , PEEP, and minimal positive pressure during inspiration, mimicking Continuous Positive Airway Pressure (CPAP) device. The expired gas outlet can also be connected to a viral filter to reduce the environmental contamination with the virus. The L-connector connecting the circuit with the mask (NIV mask with harness) can also have a port for end-tidal carbon-di-oxide sampling when the monitoring facility is available. The arrangement is shown in schematic Figure 1a. The proposed assembly will require a Bain's Circuit, an NIV mask with a harness, and a bacterio-viral filter. If End-Tidal Carbon Dioxide ( $EtCO_2$ ) monitoring is planned, an 'L' connector with an  $EtCO_2$  sampling port or monitoring device can be connected between the patient end of the Bain's Circuit and NIV mask as shown in Figure 1a and 1b. It is preferable to have a

Bain's Circuit whose adjustable PEEP valve has markings for the amount of pressure exerted. The filter needs to be connected to the gas exit outlet of the Bain's Circuit.

Flow inflating devices like Bain's circuit are effective as indigenous CPAP and have also been used to provide CPAP.<sup>2,3</sup> The fresh oxygen flow rate required to minimize the rebreathing in Bain's circuit is 10-15L/min (150-200mL/kg) for a 70kg person, which is similar to the requirement for NRBM to keep the bag inflated.<sup>4,5</sup> The authors have also used the proposed device for managing post-operative respiratory failure in COVID-19 recovered patients,<sup>9</sup> as well as for transferring patients from COVID-19 ICU to step down facilities.

The assembled device will also create a positive pressure zone outside and around the nasal cavity, which can mimic the favorable pressure niche created by a High-Flow Nasal Cannula (HFNC) in the pharynx. The requirement of fresh gas flow in HFNC is also very high. It is imperative when many countries are facing acute crises for medical Oxygen during this pandemic. The cost of HFNC is also reasonably higher, especially in the context of mass requirements. Besides, the viral filter attachment is also not possible in HFNC. Therefore, Bain's circuit can be a crucial armamentarium in supportive oxygen therapy for COVID-19 patients in low resource set-ups.

The device, however, has limitations. If the length of the circuit is increased, it can increase resistance and work of breathing to a minimal extent.<sup>5</sup> Additionally, this set of devices will be slightly costlier than NRBM. If the NIV mask interface leaks, the fresh Oxygen entering from the bedside-side outlet

Correspondence: Habib Md Reazaul Karim, Department of Anaesthesiology and Critical Care, Faculty Room A001, Block-A, Ground Floor, All India Institute of Medical Sciences, Raipur, GE Road, Tatibandh, 492099 India. Tel.: +91.9835521686. E-mail: drhabibkarim@gmail.com

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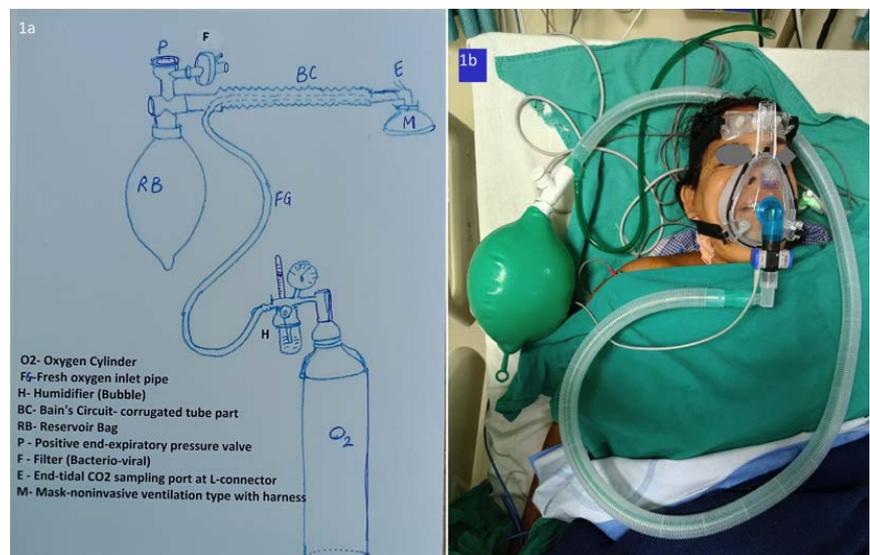
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or cylinder might be inadequate to keep the bag inflated. Further, accidental complete closure of the PEEP valve in the face of the air-tight interface might cause barotrauma.



**Figure 1.** Schematic representation of Bain's circuit arrangement to be used for COVID-19 patients and 1b showing the attachment connected to a postoperative patient with respiratory failure.

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