

## CASE REPORT

## Improvised Hand-Held Respirator: Life-Saving in The Management of Moderate to Severe COVID-19

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## DISCLOSURE

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ABSTRACT

The consumables and materials including the hospital space required for supportive therapies are in short supply with respect to COVID-19 management. To this end, an alternative supportive measure is needed for the patients to hang on, until optimal condition is made available. It is in this vein, that we describe a hand-held-respirator improvised for oxygen supplementation in a 51-year-old COVID-19 positive patient diagnosed of moderately severe disease.

**Keywords:** SARS COV2, EarPopper®, Corona virus disease, Respirator

## INTRODUCTION

Severe acute respiratory syndrome corona virus 2 (SARS-COV2-virus) responsible for the Corona virus disease of 2019 (COVID-19), was discovered in Wuhan China at the twilight of 2019.<sup>1</sup> Since then, it has been associated with different severity of the illnesses ranging from asymptomatic, mild,

moderate, severe to complicated diseases. The elderly (65 years and above), people with underlining illnesses (e.g. Diabetes mellitus, hypertension, asthma and severe airway disease) have been the most susceptible and most of the time come down with moderate-severe disease.<sup>2</sup> The moderate-severe-complicated cases often require supportive

therapy such as oxygen supplementation, respirators and or mechanical ventilations.

Records had shown that most time, the consumables and materials including the hospital space required for these supportive therapies were in short supply. To this end, an alternative supportive measure is needed for the patients to hang on, until optimal condition is made available.<sup>3</sup> It is in this vein, that we describe a hand-held-respirator improvised for oxygen supplementation in a 51-year old COVID-19 positive patient diagnosed of moderately severe disease.

#### CASE REPORT

TSI is a 51year old medical doctor, who presented with a three-day history of sore throat, non-productive cough, generalized myalgia, splitting headache, fever (high grade and persistent), loss of sense of smell(anosmia) and taste (ageusia), and bouts of hiccups. The above symptoms started about after his routine surgical theatre session, clinical meetings and ward rounds in the hospital.

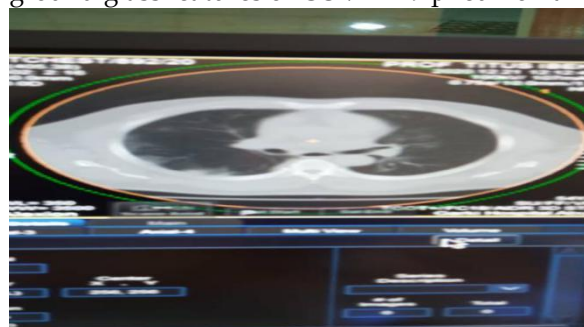
He tested positive for COVID-19 and was asked to go on self-isolation and commence the drugs prescribed for the COVID-19. This he carried out diligently for 7-days and got better. The fever, cough and headache were abated at this stage.

On the 9<sup>th</sup> day of developing symptoms he developed difficulty with breathing-shortness of breath, hunger for air and generalised dippy feeling. The oxygen saturation at this stage was consistently reading below 90%. He got ready for a chest Computerised Tomography(CT) scan but needed an oxygen support in order to get to the radiologists safely for the procedure.

To this end, the EarPopper<sup>®</sup> machine (Figures 2a&b) was deployed as hand-held respirator. The machine was switched on and the nose piece fitted into one of the nasal cavities while the machine was delivering generated gas.

This was inhaled, and after application for about three minutes the oxygen saturation would rise from below 90 to 96-98%. This persisted as long as the improvised machine was in place and also lasted for about 15 minutes after each switch, before the SpO<sub>2</sub> drops back to the base line (below 90%). No special adjustment was made on the EarPopper<sup>®</sup> machine in order to function as a hand-held respirator except that no fluid is swallowed when the machine is switched on with the nasal piece fitted in the nasal cavity. A lot of relief was also obtained following each exposure, the respiration improved, the light-headedness cleared and the dizzy sensorium improved. This was continued till the CT scan was performed. A ground glass appearance of the lungs originating from the peripheries were noted on the chest CT (Figure 1).

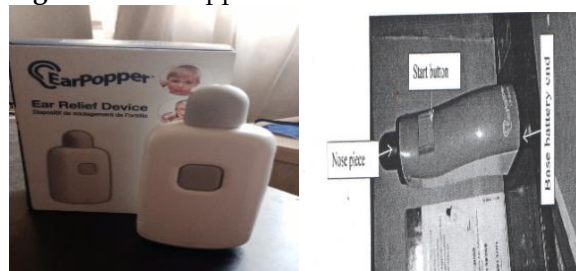
**Figure 1.** CT scan of the lungs showing typical ground glass features of COVID-19 pneumonia



The right lung was almost completely obliterated. There was no pleural effusion.

The improvised hand-held respirator use continued until the patient was admitted to the treatment/isolation centre where standardised therapy including supportive care (oxygen support) were administered.

**Figure 2a.** EarPopper machine



The patient was placed on Remdesivir, Meropenem, Dexamethasone and Clexane until he became asymptomatic by the tenth day.

A repeat chest radio-graph showed a marked improvement and he was discharged home for follow-up treatment.

**Figure 2b.** Use of improvised handheld respirator to boost SpO<sub>2</sub>



## DISCUSSION

The EarPopper® is an Innova product, based on the Politzer physiology principles.<sup>4</sup> It is a medical device that brings about the decongestion of the middle ear cavity via insufflations of the Eustachian tubes. It passed through all necessary stages of scrutiny including clinical trials in the USA and finally got the approval of FDA in 2007.<sup>5</sup> The Valsalva manoeuvres and Politzer have been employed in managing such patients and sometimes decompression may be necessary.

Through Valsalva Manoeuvre, jet of air is generated through the nose piece while the button is switched on. This is capable of delivering the jet of high-pressured air through the nose into the middle ear via the Eustachian tube. It is achieved when fluid (e.g. water or any other drink) are swallowed while the air is delivered. The jet of air insufflates the Eustachian tube to transverse into the middle ear where it is capable of setting the effusion in the otitis media into motion, leading to its gentle drain through the Eustachian tube. This machine is also

capable of stabilizing the Eustachian tubes in cases of Eustachian tube dysfunction especially due to aeroplane ear.

The EarPopper® is also indicated in the treatment of suppurative otitis media, where it generates oxygen to aerate the middle ear leading to the oxygenation of the anaerobic milieu of the middle ear. By so doing healing is faster.

This machine has provided alternative for several avoidable ear tubes (grommet), saved costs and risk of surgery; and also provided convenient platform for free recreational lives such as swimming with undue caution.

The EarPopper® was well adapted as hand-held respirator simply by excluding the swallowing reflexes during the administration of the air jet. By so doing the air streams down the trachea to the lungs unhindered and not to the ear as would be the case if swallowing is included.

We hypothesise that the tension and resistance of airflow within the airway are reduced by the pressurized air stream from the improvised hand-held respirator (EarPopper®). The airflow transverses the anatomical and alveolar dead spaces and by extensions improves the overall physiological dead space of the respiratory tract. This factor, in conjunction with the integrity and compliance of the lungs aids smooth exchange of gases within the alveoli and enhances the active phase of respiration. This indirectly increases the tidal volume and also improves the process of diffusion of inspired air within the lungs through the provision of supplemental oxygen by the hand-held respirator.

The positive inspiratory pressure provided by the hand-held respirator increases the positive end expiratory pressure (PEEP) which raises the alveolar pressure and alveolar/lung volume. The surface area reopens and stabilizes collapsed or unstable alveoli thereby improving the ventilation-

perfusion match. Ultimately, this improved ventilation perfusion and alveolar gas exchange also improves oxygen saturation pressure SPO<sub>2</sub>.

The procedure is safe, non-dose dependent, comfortable and live-saving temporary measure while seeking for a the more definitive supportive care. The EarPopper® is also non-expensive (it costs about \$200 equivalent to ₦96,000). It can be recycled after use.

#### CONCLUSION

The EarPopper® can be used as a hand-held respirator in the management of moderate-severe cases of COVID-19 given its ability to effectively deliver a steady flow of pressurised air-stream with supplemental oxygen, overall reduction of the dead spaces, improved alveolar perfusion and gas exchanges resulting in increased SPO<sub>2</sub>. The use of ear popper might be effective as an improvised respirator in moderate to severe cases of COVID-19 while waiting for a more sustainable therapeutic/support measure.

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