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Do antibacterial or antiviral filters protect operating room staff by preventing COVID-19 virus spread from cardiopulmonary bypass machine during open hear surgeries? A case report

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Abstract

Open heart surgeries are inevitable during pandemic and there is the possibility of corona virus transmission through oxygenated exhaust during cardiopulmonary bypass (CBP). In this study, researchers try to test the hypothesis by placing an antiviral and antibacterial filter in the air outlet of the oxygenator in order to prevent spread of COVID-19 virus in operating room.

The COVID-19 positive patient needed emergency open-heart surgery due to her critical situation. The patient was under cardiopulmonary bypass for almost two hours. Antibacterial and antiviral filters were placed in oxygenator outlet. At the end of the procedure, polymerase chain reaction (PCR) swab was taken from both sides of the filter. The result of the test behind the filter was positive, but at the other side of the filter was negative. This may suggest, the exhaust air from the oxygenator can spread viruses into the room and the antibacterial and antiviral filters may be able to prevent operating room contamination. The installation of filter in the oxygenator exhaust can prevent the spread of COVID-19 viruses into the operating room air. Using this cheap and affordable method, operating room staff safety can be assured.

Keywords: COVID-19, Cardiac surgery, Personal protection, Antivirus and anti bacterial filter, Cardio pulmonary bypass

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Introduction

New dimensions of the emerging COVID-19 virus are recognizing everyday, although the transmission and spread of virus is not fully known. As open-heart surgeries are inevitable during pandemic, it is important to find or change all possible sources of contamination in the operating room to protect surgical staff (1,2). Although theoretically, it is possible for virus to pass through oxygenator membranes (3-5). In most research studies it is believed that in long-term oxygenators such as extracorporeal membrane oxygenation (2), installation of antiviral and antibacterial filters in the oxygenator outlet during open heart surgery can prevent the spread of corona virus in the operating room. In this study researchers will test this hypothesis.

Case Presentation

In this study, patient was a 53-year-old female with severe mitral stenosis and tricuspid regurgitation who had COVID-19 disease a month before her visit. Patient had fever and chills with chest computerized tomography (CT) scan showed 15% of lung injury. The nasopharyngeal swab was taken and polymerase chain reaction (PCR) for COVID-19 was negative. The patient was hospitalized and treated with ceftriaxone and hydroxychloroquine for one week. She was discharged with azithromycin prescription and quarantine at home for few weeks. She became a candidate for surgery after two months. Three negative nasopharyngeal PCR reported with IgG=0.1and IgM=9.1 before surgery. Open heart surgery was conducted due to progressive heart condition. Mitral valve replacement with mechanical ST No=29 and tricuspid valve repair was performed successfully. During the surgery, a cardio pulmonary bypass was conducted. The patient's venous blood as well as suctioned blood entered the oxygenator for oxygenation and CO_2 excretion. Then, it was returned

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Implication for health policy/practice/research/ medical education

The installation of filter in the oxygenator exhaust can prevent the spread of COVID-19 viruses into the operating room air. It is important to find or change all possible sources of contamination in the operating room to protect surgical staff.

to the patient through the aortic cannula. The air inside the oxygenator evacuated through two exhaust outlets: oxygenator exhaust (OE) and reservoir exhaust (RE). The research team attached a 1/4-inch tube to the RE outlet. They also connected the OE outlet to a 1/2 or 3 /8-inch tube and attached both tubes to the three-way connector by using an antibacterial and antiviral filter in between (Figure 1). Then the outlet of cardiopulmonary bypass (CPB) machine was connected to the ventilator outlet through a 3-way connector which then directed the exhaust air outside the operating room. After disconnecting the patient from the CPB machine and before the surgery completion, the filter was separated from the tubes and two samples were taken from both sides of the filter. Sample number one was taken from the inner surface which transfer air from OE (behind the filter). Swab number two was taken from the other side of the filter which evacuate air to the room. Then the samples were sent to the laboratory and the patient was transferred to the ICU. The PCR test was positive for sample number one and it came back negative for sample number two. This may suggest that air evacuated from oxygenator is able to contaminate operating room with COVID-19 virus and installation of filters can prevent it.

Discussion

Although SARS-CoV-2 is apparently transmitted through respiratory particles (6) it is also present in the blood, feces and urine (7), while different studies show the virus is isolated from patients' blood (8, 9). Although theoretically the blood inside the oxygenator is not in contact with air, due to the size of the pores which is less than 200 nanometer and the size of the corona virus which is 60 to 140 nanometer (3, 4). There is the possibility of coronavirus exhaustion from blood to the air (5). There is also a large number of hollow fiber through which blood passes and some of which are likely to be damaged (10) and therefore the air inside the oxygenator is likely to be contaminated.

Reverse transcription PCR (RT-PCR) is a laboratory method which is recognized as a diagnostic test by World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) (11). The sensitivity of this test is not known yet, but it has been reported as 60% in some studies (12). Although the preoperative PCR test was reported negative in this patient, there is still the possibility of having corona disease or the availability of virus in her blood.

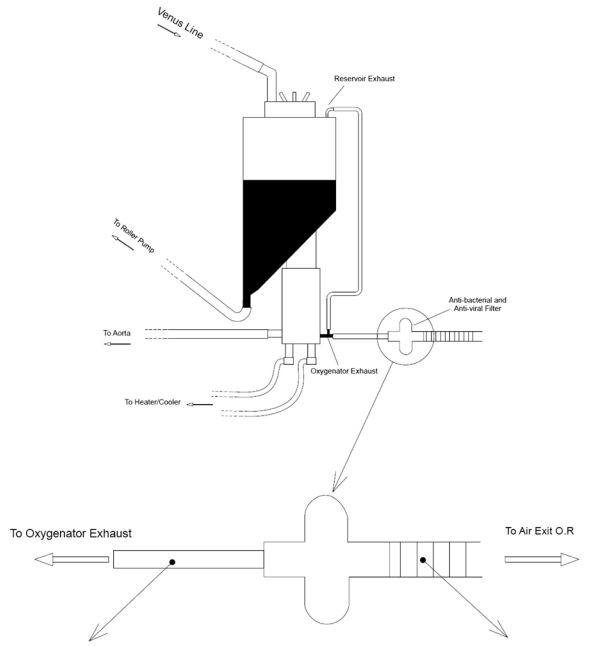

Figure 1. The evaluation of the effectiveness of antibacterial and antiviral filters (number one is the place to take the PCR sample behind the filter and number two is the place to take the PCR sample after the filter).

Conclusion

The PCR test results show the COVID-19 virus is able to spread into the operating room through the oxygenator exhaust and the placement of the antibacterial and antiviral filters in the outlet path can prevent the room air contamination. This cheap and accessible method is very effective in order to protect operating room staff and it tested in this study.

It is recommended that this study be repeated with a larger sample size. Due to the unknown nature of this virus and its pathogenicity and also in order to protect Perfusionists and operating room staff during CBP, it is recommended to install a filter in the exhaust path of the oxygenator.

If this approach proven in several studies, regulatory agencies and manufacturers may change the existing protocols and the installation of antibacterial and antiviral filters in the oxygenator outlet may become mandatory.

We hope that by using this new approach, the health and safety of the health care team will be adequately ensured.

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Authors' contribution

Conceptualization, methodology, investigation, visualization: MH.
Validation, supervision, project administration, writing—original draft preparation: HG.
Formal analysis, resources: SAM.
Data curation, writing—review and editing: ZAA.
Funding acquisition: RT.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors. The patient gave the consent for publication. A consent was taken from the patient to publish as a case report.

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