



Does the exhaust air from oxygenator during open-heart surgeries in COVID-19 positive patients cause operating room air contamination? A case report

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Abstract

Introduction: New findings regarding COVID-19 are reviewed and reported daily, and safety protocols are changed regularly. In COVID-19 positive patients, the exhaust air coming from oxygenator's gas outlet may be a potential source of air contamination in an operating room. This may also cause health issues for operating room staff. As there has been no research regarding this issue, this study will reveal whether the exhaust air from the oxygenator in COVID-19 positive patient may cause air contamination or not.

Case Presentation: A COVID-19 positive patient underwent emergency cardiopulmonary bypass. After surgery, polymerase chain reaction (PCR) swab was taken from the oxygenator exhaust, which evacuated the air inside the oxygenator into the operating room theatre. The positive PCR test for COVID-19 may suggest the possibility of air contamination by oxygenator.

Discussion: This may be the first study suggesting the possibility of room air contamination by oxygenator exhaust air during cardiopulmonary bypass. This study shows some current protocols may need to be reviewed in order to ensure increased safety within the operating room and amongst the personnel, therefore permanent changes may be applied to some procedures.

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Introduction

The information about coronavirus disease 2019 (COVID-19) is rapidly changing and updating daily (1,2). Since the first reported case in China in December 2019, new information continues to be provided frequently (3). The high prevalence of COVID-19 in the operating room and amongst staff are issues that needed further studies (4). As new variants of the virus are emerging and the virus spread is changing, health protocols may need to be revised, and a variety of changes may be applied to existing practices. According to the nature of heart diseases, open-heart surgeries are inevitable during the pandemic. Therefore, in order to ensure safety of the surgical team, it is necessary to find and change all possible sources of air contamination in the operating room (1). One of the possible sources of air contamination in open-heart surgeries, is the air evacuated from the oxygenator in cardiopulmonary bypass (CBP) machine, which is normally distributed in the operating

Key point

In COVID-19 positive patients exhaust air coming from oxygenator's gas outlet may be a potential source of air contamination in an operating room. In COVID-19 era, some current protocols may need to be reviewed in order to ensure increased safety within the operating room and amongst the personnel, therefore permanent changes may be applied to some procedures.

room (5). For the first time, this study will reveal whether the exhaust air from the oxygenator in COVID-19 positive patient undergoing emergency open-heart surgery may cause contamination of operating room air or not.

Case Presentation

During open-heart surgeries, when the CBP is applied, the patient's blood enters the oxygenator and after oxygenation, it will return to the patient's body. The evacuated air from the oxygenator, which is in contact

with the patient's blood and secretions, releases through two outputs (reservoir exhaust and oxygen exhaust) to the room. The reported COVID-19 positive patient needed emergency open-heart surgery due to deteriorating condition. The patient was undergoing CPB for almost 2 hours and during this period his blood entered the oxygenator and returned to his body after oxygenation and excretion of waste products. The contaminated air was then evacuated from oxygenator to operating room through two ports; O.E. and R.E (reservoir exhaust and oxygen exhaust). After disconnecting the patient from CPB, PCR swab was taken from both OE and RE. The result of the test was positive for COVID-19, which may suggest the room air contamination during surgery.

Discussion

After the onset of COVID-19 disease and the need for emergency or semi elective open-heart surgeries, the hypothesis was proposed (1), which theoretically suggested the possibility of air contaminating through the oxygenator (5,6), but more research is needed. As the virus diameter is about 60-140 nm (7) and the pore size of oxygenator's membranes is less than 200 nm (6), the virus can pass through the blood and secretions in the oxygenator and also through the holes in the microporous membrane and the gas fibers. In addition, there is the possibility of the gas fibers damages during CPB (6-8) which may cause the virus passing through the gas fibers and evacuated through the oxygenator's gas outlet into the operating room (5,8). Although this theory was proposed after detailed study of the subject (5), but the possibility of room air contamination through the oxygenator has not been proven and no study has been designed yet to prove it.

The presented patient was a confirmed COVID-19 case, who needed emergency open-heart surgery. The patient blood, suction machine content and the surgical field blood entered the reservoir, and returned to patient's body after oxygen exchange through the gas fibers. The adjacent air was also evacuated to the operating room through the oxygenator exhaust.

After CPB, RT-PCR (reverse transcription - polymerase chain reaction) test was performed by swabbing the inner surface of the oxygenator gas outlet. RT-PCR is a laboratory method which is recognized as a diagnostic test by the World Health Organization (WHO) and the Center for Disease Control and Prevention (CDC) (9). In this study, the positive result suggested the possibility of operating room air contamination by the oxygenator exhaust air.

Due to emerging of COVID-19 disease, it is suggested that researchers repeat this study by using larger sample size. Safety protocol revision may be needed, if air contamination is proven in other studies and the necessary precautions should be followed (5). It will help operating

room staff to not only provide high quality patient care, but also ensure their safety.

Conclusion

This may be the first study suggesting the possibility of room air contamination by oxygenator exhaust air during cardiopulmonary bypass. This study shows some current protocols may need to be reviewed in order to ensure increased safety within the operating room and amongst the personnel, therefore permanent changes may be applied to some procedures.

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Authors' contribution

ManH was the head of the surgical team who managed this complication. ZAA as a member of surgical team helped in data collection. SAM contributed to the literature search and preparation of the discussion. HG participated in drafting of the manuscript, administrative, technical, and material support. MahH edited the final draft. All authors edited the final draft and signed the final manuscript.

Ethical considerations

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

Conflicts of interest

The authors declare that they have no competing interests.

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References

1. Gunaydin S, Stammers AH. Perioperative management of COVID-19 patients undergoing cardiac surgery with cardiopulmonary bypass. *Perfusion*. 2020; 35:465-473. doi: 10.1177/0267659120941341.
2. Engelman DT, Lothar S, George I, Funk DJ, Ailawadi G, Atluri P, et al. Society of Thoracic Surgeons COVID-19 Task Force. Adult Cardiac Surgery and the COVID-19 Pandemic: Aggressive Infection Mitigation Strategies Are Necessary in the Operating Room and Surgical Recovery. *Ann Thorac Surg*. 2020;110:707-11. doi: 10.1016/j.athoracsur.2020.04.007.
3. Folesani G, Botta L, Pacini D. Cardiac Surgery Model During COVID-19 Pandemic: Now It's Time to Ramp Up. *Ann Thorac Surg*. 2021;111:737-8. doi: 10.1016/j.athoracsur.2020.07.001.
4. Aghagoli G, Gallo Marin B, Soliman LB, Sellke FW. Cardiac involvement in COVID-19 patients: Risk factors, predictors, and complications: A review. *J Card Surg*. 2020;35:1302-5. doi: 10.1111/jocs.14538.
5. Hekmat M, Ghaderi H, Ansari Aval Z, Fani K, Foroughi M, Mirjafari, S et al. Introducing a Method for Safe Air Evacuation from Oxygenator in Cardiac Surgery Operating Rooms During COVID-19 Pandemic. *J Cell Mol Anesth* 2020;5:125-8. DOI: doi: 10.22037/jcma.v5i2.30415.

6. Squicciarro E, Rociola R, Haumann RC, Grasso S, Lorusso R, Paparella D. Extracorporeal Oxygenation and Coronavirus Disease 2019 Epidemic: Is the Membrane Fail-Safe to Cross Contamination? *ASAIO J.* 2020;66:841-843. doi: 10.1097/MAT.0000000000001199.
7. Chang L, Yan Y, Wang L. Coronavirus Disease 2019: Coronaviruses and Blood Safety. *Transfus Med Rev.* 2020;34:75-80. doi: 10.1016/j.tmr.2020.02.003.
8. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al. China Novel Coronavirus Investigating and Research Team. A Novel Coronavirus from Patients with Pneumonia in China, 2019. *N Engl J Med.* 2020 Feb 20;382:727-33. doi: 10.1056/NEJMoa2001017.
9. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. China Medical Treatment Expert Group for Covid-19. Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med.* 2020;382:1708-1720. doi: 10.1056/NEJMoa2002032.