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# Blood Bank Practices During Coronavirus Pandemic

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**Abstract**

COVID 19 pandemic which has affected the world is caused by SARS-CoV-2 virus that rapidly spread from a single city in China to all parts of the world. The disease is highly infectious with every infected patient infecting other two to three persons. The World Health Organization declared COVID-19 in China as a Public Health Emergency of International Concern. Due to the unusual presentations of the virus and a big clinical spectrum, many of the infections remain unnoticed but viral shedding in plasma or serum is still common. Therefore, there is still a theoretical risk of transmission of coronaviruses through the transfusion of whole blood and blood products. In this review, we provide an understanding of the transmission of SARS-CoV through blood products, and discuss pathogen inactivation methods on coronaviruses

**Keywords**: Covid-19, Blood, Transfusion, SARS-CoV-2

## INTRODUCTION

Coronaviruses (CoVs) are enveloped non segmented positive sense RNA viruses belonging to the Nidovirales order, which includes Coronaviridae, Arteriviridae, Mesoniviridae, and Roniviridae families. The coronaviridae family comprises of two subfamilies- The Coronavirinae and the Torovirinae. The Coronavirinae are further subdivided into four genera, the alpha, beta, gamma, and delta coronaviruses.[1] α- and β-CoVs infect mammals, whereas the other two genera can infect birds and could also infect mammals [2]. Four of seven coronaviruses infecting humans[HCoV-229E, HCoV-OC43, HCoV-NL63, and HCoV-HKU1] usually lead to common self-limited upper respiratory disease and occasionally cause more serious disease in young, elderly, or immunocompromised individuals.

The pathogen responsible for outbreak of acute atypical respiratory infections in Wuhan city of Hubei province of China in December 2019 was discovered to be a novel coronavirus belonging to the family Coronaviridae and was named as the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) and the disease caused by this virus was termed as coronavirus disease 2019 or simply COVID-19 by the WHO[1,2]. This virus was homologous to the SARS coronavirus (SARS-CoV), which was responsible for the respiratory pandemic during the 2002–2003 period[3,4]. The outbreak started via zoonotic spread from the seafood markets in Wuhan, China. And Subsequently, human-to-human transmission lead to the community spread of the disease.[5,6] After being broadcast as a public health emergency on January 30, 2020, COVID-19 was subsequently declared a pandemic on March 11, 2020 by the WHO.

### Virus Life Cycle And Host Cell Invasion

The virus is transmitted via respiratory droplets and aerosols from person to person. Once inside the body, the virus binds to host receptors and enters host cells through endocytosis or membrane fusion. The coronaviruses are made up of four structural proteins,

namely, the spike (S), membrane (M), envelop (E) and nucleocapsid (N) proteins[7,8]. The S protein is seen to be protruding from the viral surface and is the most important one for host attachment and penetration. This protein is composed of two functional subunits (S1 and S2), among which S1 is responsible for binding to the host cell receptor and S2 subunit plays a role in the fusion of viral and host cellular membranes.6 ACE-2 has been identified as a functional receptor for SARS-CoV and is highly expressed on the pulmonary epithelial cells.[9] It is through this host receptor that the S protein binds initially to start the host cell invasion by the virus.[10] After binding of SARSCoV-2 to the ACE-2, the S protein undergoes activation via a two-step protease cleavage: the first one for priming at the S1/S2 cleavage site and the second cleavage for activation at a position adjacent to a fusion peptide within the S2 subunit.[11] The initial cleavage stabilises the S2 subunit at the attachment site and the subsequent cleavage presumably activates the S protein causing conformational changes leading to viral and host cell membrane fusion.[12] Postmembrane fusion, the virus enters the pulmonary alveolar epithelial cells and the viral contents are released inside. Now inside the host cell, the virus undergoes replication and formation of a negative strand RNA by the pre-existing single-strand positive RNA through RNA polymerase activity (transcription). This newly formed negative strand RNA serves to produce new strands of positive RNAs which then go on to synthesise new proteins in the cell cytoplasm (translation).[13,14] The viral N protein binds the new genomic RNA and the M protein facilitate integration to the cellular endoplasmic reticulum. These newly formed Nucleocapsids are then enclosed in the ER membrane and transported to the lumen, from where they are transported via golgi vesicles to the cell membrane and then via exocytosis to the extracellular space. The new viral particles are now ready to invade the adjacent epithelial cells as well as for providing fresh infective material for community transmission via respiratory droplets.[6]

## VIRAL TRANSMISSION AND CLINICAL FEATURES

COVID-19 virus mainly spreads from person to person via respiratory droplet transmission, which occurs when a person is in close contact with someone who is actively coughing or sneezing. This occurs through exposure of the mucosal surfaces of the host, that is, eyes, nose, and mouth, to the incoming infective respiratory droplets.[15,16] Transmission of the virus may also occur through fomites used by or used on the infected individual such as bedsheets, blankets, kitchen utensils, thermometers, and stethoscopes. Airborne transmission has not been reported for COVID-19, except in specific circumstances in which procedures that generate aerosols are performed, that is, endotracheal intubation, bronchoscopy, open suctioning, nebulisation with oxygen, bronchodilators or steroids, bag and mask ventilation before intubation, tracheostomy and cardiopulmonary resuscitation.[17,18] The incubation period of COVID-19, which is the time period from exposure to the virus to symptom onset, is 5–6 days, but can be up to 14 days. During this period, also known as the 'pre-symptomatic' period, the infected individuals can be contagious and transmit the virus to healthy individuals in the population.[19] The patients of COVID-19 belong mostly to the 40–70 years age group, and most commonly present with fever, body aches, breathlessness, malaise and dry cough, although patients may present with asymptomatic, mild, moderate or severe disease.[20-2] Some patients may also present with gastrointestinal symptoms such as abdominal pain, vomiting and loose stools.[23]The complications seen in patients with COVID-19 infection are caused mostly due to the 'cytokine storm'.

## BLOOD PRODUCTS AND RISK OF CORONAVIRUS TRANSMISSION

Coronaviruses are enveloped, positive-sense, single-stranded RNA viruses. Usually, coronaviruses are vulnerable to acid-pH, basic-pH, and heat but seem to be more stable at 4°C. These viruses have never been reported to be transmitted via blood or blood products and the risk of transmission is only theoretical.[24] However, it seems that the possibility of transmission of these viruses through blood transfusion during the incubation period or from asymptomatic individuals needs further investigation.[25] The virus RNA has been detected in blood samples of 15%patients.[26] There are strategies proposed to diminish the risk of transmission of SARS-CoV-2 via blood and blood products. Donors



Volume 4, Issue 5; September-October 2021; Page No 1191-1196

with signs and symptoms of fever, cough or shortness of breath are avoided to donate blood and potential donors should be educated to inform in case of developing a respiratory disease within 28 days of blood donation. Also, individuals who have recently recovered from confirmed Covid-19 and those with a history of direct exposure to a confirmed case should avoid blood donation for 28 days. In situations with widespread illness, an option for reducing the risk of transmission via transfusion is the quarantine of blood components with delayed release into the blood bank pool. This strategy may be problematic for platelet concentrates due to the short half-life of this component. The staff working in blood bank centres should be educated about signs and symptoms of Covid-19 and refrain from working if they feel unwell.[27] Donors with a history of Covid-19 could donate blood 28 days after complete recovery. Moreover, the collection of convalescent plasma is possible from these donors for the treatment of patients with Covid-19.[28]

## VIRAL INACTIVATION METHODS

Viral inactivation methods used for blood products need to be safe for injection and must not compromise the stability of the proteins. Various methods that can be used include the following.[29]

Pasteurization at 60°C for 10 hours is used to inactivate potential viruses in plasma-derived products. An advantage of this technique is that it is effective against both enveloped and nonenveloped viruses.[30] Stabilizers to protect the protein product, however, may also protect or mask the virus. Neoantigens may be formed from partial denaturation of human serum components that may appear foreign to the immune system. This could be deleterious, because it may result in the onset of autoimmune disease.[31]

Both UVC and UVA, in conjunction with psoralen, can be used to inactivate pathogenic viruses in plasma derived products. 3 J per cm2 UVA light for 3 to 4 minutes with the addition of 150 µmol per L psoralen was sufficient to inactivate SARS virus. The addition of intercalating agents, such as psoralen, may be required to increase the efficiency of UVA viral inactivation and may be appropriate for treatment of PLTs or red cells. Ultraviolet (UV)-A and UV-B light in the presence of amotosalen or riboflavin could inactivate the pathogens' nucleic acids, whereas a third PRT method uses UV-C light only. These commercial systems could reduce the activities of SARS and MERS virus in plasma or platelet concentrates to different degrees. Methylene blue plus visible light also can inactivate coronaviruses in plasma. Cost remains a major administrative obstacle to PRT use.[32]

Solvent/detergent(S/D) methods are not used for inactivation of viruses in cellular blood components because S/D treatment damages cell membranes.[33] The S/D method causes a disruption of the structural integrity of lipid-enveloped viruses. The S/D treatment has the advantage of being highly efficient at inactivating enveloped viruses, while being nondenaturing on proteins, and yielding a high recovery of protein activity. The disadvantages include requiring an extra manufacturing step to remove the S/D agents and the inability to inactivate nonenveloped viruses.[34]

## ORGANIZING THE DEMAND FOR BLOOD

In the situation of Covid 19 pandemic, blood supply has been affected adversely. So, the management of demand for blood and blood products is a critical decision. During the situation of pandemic, the health care system shifts toward infected patients. In this phase, the cancellation of all elective surgeries and non-urgent medical interventions has been strongly recommended. However, in emergency situations such as trauma, post-partum hemorrhage and urgent surgeries, blood transfusion is necessary and lifesaving.[35] Also, in hemoglobinopathies such as thalassemia and sickle cell disease, patients are transfusion-dependent and need repeated blood transfusions to survive. Therefore, decision making about indications of blood transfusions within outbreaks of Covid-19 is an important topic.[36-7]

## MODIFICATIONS TO PRODUCTION, SPECIFICATION, AND STORAGE OF BLOOD COMPONENTS TO HELP PREVENT BLOOD SHORTAGE

Changes to processing and storage of blood components might contribute to maintaining the blood supply during a pandemic. Modification of donor and component testing criteria, including any additional safety measures for groups, might have to be addressed. A more complete consideration of the



Volume 4, Issue 5; September-October 2021; Page No 1191-1196

different options should be based on factors such as the likely magnitude of gain, the perceived effect on clinical risk, the regulatory requirements, and the extent of complexity and ability to deliver change in the system. Focus should be on changes which do not require substantial efforts or resources hence making simplicity the key to management.

A first step is to review measures to minimise wastage. This strategy might support the temporary extension of component shelf life. Red blood cell shelf life is of 35–42 days for most of the blood banks and an attempt can be made to increase the shelif life by addition of preservatives if manufacturers can provide after thorough review.[35-6]

Cold storage of platelets at 2–6°C could also be considered, as this method can increase the shelf life of platelets from 5-7 days to 7–14 days without the need for agitation.[37] Stocks of frozen platelets, if available and expanded, might provide a haemostatic effect, in part because of the content of platelet microparticles.[38] To increase platelet supply for prophylactic transfusions, one option could be to reduce the dose of platelets by splitting existing components.[39]

Frozen plasma components have a longer shelf life (several years) and hence the ability to build and maintain stocks is more flexible than for cellular components. Liquid plasma (never frozen), which has a shelf life of 7–40 days, might be useful in the context of reduced freezer capacity, a shortage of staff to freeze plasma, or to produce convalescent plasma.[40]

## CONCLUSION

SARS-CoV-2 is an infectious agent transmitted mainly by respiratory route that has become a global health threat. The probability of transmission by transfusion is just a matter of theory. According to the current knowledge, there is no evidence that this virus may be transmitted by blood or blood products; however, Covid-19 is a novel viral agent and the risk of transmission of SARS-CoV-2 by transfusion of blood products cannot be excluded with confidence. On the other hand, decreased availability of blood donors could result in the shortage of blood supply, which could be a significant hazard for blood services in every country. It seems that a lot of time is necessary to answer key questions regarding blood safety in the field of Covid19. Meanwhile, because coronaviruses RNA could be detected in plasma or lymphocytes, staff in blood centers and laboratories should improve biosafety protection during the epidemic

## References:


1. Yin Y, Wunderink RG. MERS, SARS and other coronaviruses as causes of pneumonia. Respirology 2018; 23: 130-7.
2. Chen Y, Liu Q, Guo D. Emerging coronaviruses: genome structure, replication, and pathogenesis. J Med Virol 2020.
3. Yuki K, Fujiogi M, Koutsogiannaki S. COVID-19 pathophysiology: a review [published online ahead of print, 2020 Apr 20]. Clin Immunol. 2020; 215:108427.
4. Ksiazek TG, Erdman D, Goldsmith CS, et al. Group A novel coronavirus associated with severe acute respiratory syndrome. N Engl J Med 2003;348:1953–66.
5. Zhang J, Litvinova M, Wang W, et al. Evolving epidemiology and transmission dynamics of coronavirus disease 2019 outside Hubei province, China: a descriptive and modelling study. Lancet Infect Dis 2020;20:793–802.
6. Cascella M, Rajnik M, Cuomo A, et al., Features, evaluation and treatment coronavirus (COVID-19). Stat pearls [internet]. Treasure Island (FL): Stat Pearls Publishing, Jan 2020
7. He Y, Wang J, Li F, et al. Main clinical features of COVID-19 and potential prognostic and therapeutic value of the microbiota in SARS-CoV-2 Infections. Front Microbiol 2020;11:1302.
8. Bosch BJ, van der Zee R, de Haan CA, et al. The coronavirus spike protein is a class I virus fusion protein: structural and functional characterization of the fusion core complex. J Virol 2003;77:8801–11
9. Li W, Moore MJ, Vasilieva N, et al. Angiotensin-converting enzyme 2 is a functional receptor for the SARS coronavirus. Nature 2003;426:450–4.




Volume 4, Issue 5; September-October 2021; Page No 1191-1196

10. Walls AC, Park YJ, Tortorici MA, et al. Structure, function, and antigenicity of the SARS-CoV-2 spike glycoprotein. Cell 2020;181:281–292.e6.
11. Belouzard S, Chu VC, Whittaker GR. Activation of the SARS coronavirus spike protein via sequential proteolytic cleavage at two distinct sites. Proc Natl Acad Sci U S A 2009;106:5871–6
12. Belouzard S, Millet JK, Licitra BN, et al. Mechanisms of coronavirus cell entry mediated by the viral spike protein. Viruses 2012;4:1011–33.
13. Lai MM, Cavanagh D. The molecular biology of coronaviruses. Adv Virus Res 1997;48:1–100.
14. Yang N, Shen HM. Targeting the endocytic pathway and autophagy process as a novel therapeutic strategy in COVID-19. Int J Biol Sci 2020;16:1724–31
15. Liu J, Liao X, Qian S, et al. Community transmission of severe acute respiratory syndrome coronavirus 2, Shenzhen, China. Emerg Infect Dis 2020
16. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506.
17. Burke RM, Midgley CM, Dratch A, et al. Active monitoring of persons exposed to patients with confirmed COVID-19: United States, January–February 2020. MMWR Morb Mortal Wkly Rep 2020.
18. Ong SW, Tan YK, Chia PY, et al. Air, surface environmental, and personal protective equipment contamination by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from a symptomatic patient. JAMA 2020;323:1610.
19. Donnelly CA, Ghani AC, Leung GM, et al. Epidemiological determinants of spread of causal agent of severe acute respiratory syndrome in hong kong. Lancet 2003;361:1761–6.
20. Goyal P, Choi JJ, Pinheiro LC, et al. Clinical characteristics of COVID-19 in New York city. N Engl J Med 2020;382:2372–4.
21. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708–20.
22. Young BE, Ong SWX, Kalimuddin S, et al. Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore. JAMA 2020;323:1488–94.
23. Cheung KS, Hung IF, Chan PP, et al. Gastrointestinal manifestations of SARS-CoV-2 infection and virus load in fecal samples from the hong kong cohort and systematic review and meta-analysis. Gastroenterology 2020
24. APBN. Rapid Brief White Paper 2019 Novel Corona virus (SARS-CoV-2); Expected challenges and risks to blood safety. 2020
25. Thalassaemia International Federation. The covid-19 pandemic and hemoglobin disorders .A contribution of Thalassemia International Federation to its global patients' community Version III (Updated). 2020.
26. AABB's Transfusion Transmitted Diseases Committee. Update: Impact of 2019 Novel corona virus and Blood Safety. 2020.
27. Chen L, Xiong J, Bao L, Shi Y. Convalescent plasma as a potential therapy for COVID-19. The Lancet Infectious Diseases. 2020;20(4):398–400. doi: 10.1016/s1473-3099(20)30141-9.
28. Shen C, Wang Z, Zhao F, Yang Y, Li J, Yuan J, et al. Treatment of 5 Critically Ill Patients With COVID-19 With Convalescent Plasma. Jama. 2020;323(16). doi: 10.1001/jama.2020.4783.
29. Darnell MER, Taylor DR. Evaluation of inactivation methods for severe acute respiratory syndrome coronavirus in noncellular blood products. TRANSFUSION 2006; 46: 1770-7.
30. Seltsam A, Muller TH. Update on the use of pathogen-reduced human plasma and platelet concentrates. Br J Haematol.



Volume 4, Issue 5; September-October 2021; Page No 1191-1196

2013;162(4):442–54. doi: 10.1111/bjh.12403. [PubMed: 23710899]

31. Yunoki M, Urayama T, Yamamoto I, Abe S, Ikuta K. Heat sensitivity of a SARS-associated coronavirus introduced into plasma products. Vox Sang. 2004;87(4):302–3. doi: 10.1111/j.1423-0410.2004.00577.x. [PubMed: 15585028]. [PubMed Central: PMC7169306]
32. Eickmann M, Gravemann U, Handke W, Tolksdorf F, Reichenberg S, Muller TH, et al. Inactivation of three emerging viruses - severe acute respiratory syndrome coronavirus, Crimean-Congo haemorrhagic fever virus and Nipah virus - in platelet concentrates by ultraviolet C light and in plasma by methylene blue plus visible light. Vox Sang. 2020;115(3):146–51. doi: 10.1111/vox.12888. [PubMed: 31930543]. [PubMed Central: PMC7169309].
33. Klein HG. Pathogen inactivation technology: cleansing the blood supply. J Int Med 2005;257:224-37
34. Burnouf T, Radosevich M. Reducing the risk of infection from plasma products: specific preventative strategies. Blood Rev 2000;14:94-110
35. AA World Health Organization. Maintaining a safe and adequate blood supply during the pandemic outbreak of coronavirus disease (COVID-19): interim guidance. WHO
36. AB Borgna-Pignatti C, Gamberini MR. Complications of thalassemia major and their treatment. Expert Rev Hematol. 2011;4(3):353–66. doi: 10.1586/ehm.11.29. [PubMed: 21668399].
37. AC Vichinsky EP. Current issues with blood transfusions in sickle cell disease. Semin Hematol. 2001;38(1 Suppl 1):14–22. doi: 10.1016/s0037- 1963(01)90056-3. [PubMed: 11206956].
38. Shah A, Brunskill SJ, Desborough MJ, Doree C, Trivella M, Stanworth SJ. Transfusion of red blood cells stored for shorter versus longer duration for all conditions. Cochrane Database Syst Rev 2018; 12: CD010801.
39. Trivella M, Stanworth SJ, Brunskill S, Dutton P, Altman DG. Can we be certain that storage duration of transfused red blood cells does not affect patient outcomes? BMJ 2019; 365: l2320.
40. Stolla M, Fitzpatrick L, Gettinger I, et al. In vivo viability of extended 4°C-stored autologous apheresis platelets. Transfusion 2018; 58: 2407–13.



Volume 4, Issue 5; September-October 2021; Page No 1191-1196