

Review Article

COVID-19 MUTATION AND IMPACT ON VARIOUS ORGANS

ABSTRACT

BACKGROUND: COVID-19 is the continuously evolving pandemic affecting billions of people. The viruses are notorious for mutations in them. Novel coronavirus is no exception to mutation and mutated into various strains according to geographical locations.

SUMMARY: The recent second and third wave which is actually a resurgence in COVID-19 cases after a steep fall is attributed to the mutation that is occurring in novel coronavirus. Various strains has been isolated and is being under study to tackle their menace. But blaming completely the mutant version of the virus is unjust as there are other factors such as lax implementation of preventive measures, negligence on account of people by not wearing masks and not following physical distancing. The impact of COVID-19 on human organ system is almost negative and affects the functioning of the organ adversely. Therefore proper care must be taken to ensure the safety of oneself.

CONCLUSION: Mutations in viruses cannot be stopped and solution lies within us. By following preventive measures and guidelines issued by WHO and other competent authority can a key to keep oneself self. Also balance diet along with proper exercise can help in these pandemic. More study needs to be done to establish various correlation so than containment plan of COVID-19 can be modifies accordingly.

KEYWORDS: Covid-19, Mutation, Double Mutation, Liver, Cardiovascular Ailments, Renal Ailments, Vaccine, Second Wave.

INTRODUCTION

Coronavirus disease 2019 or COVID-19 is an ongoing pandemic caused due to novel coronavirus of the coronaviridae family. The virus family is not new and has already caused the previous outbreaks of severe acute respiratory syndrome (SARS) and Middle Eastern respiratory syndrome (MERS). Since its inception in Wuhan city of Hubei province in China, it has spread every nook and corner of the globe. More than a year has been passed, the virus recently is catching up and registering huge number of cases due to mutant version activity. As of April 24, 2021, 145,759,060 infection cases has been reported from all over the world and 3,089,162 case fatalities has been registered due to COVID-19 related complications(1). The pandemic is one of its kind medical emergence which was not noticed in past hundred years. World health Organization has already declares it as pandemic(2), one of its kid declaration by the said

institution since its inauguration. Unites states of America, India, Brazil, Russia, France and Turkey are the top countries having more than half of all infection reported and case fatalities due to COVID-19(3). Recently, India was struck by second wave of COVID-19 registering more than 300000 cases every day from past two days, highest in the world. These second and third wave are being attributed to the mutation in the viral strain(4). Various mutations originating from different countries has been crossing borders and are now creating double and triple mutations which are said to be more virulent and lethal. The impact of the novel coronavirus disease 2019 on human body need to be studied thoroughly as pandemic is still evolving day by day. Although various studies on preliminary data shows that there is net negative impact on various organs and systems of the human being. Vulnerable sections of society like comorbid patients, elderlies and pregnant women are more prone to catching infection and developing severe clinical outcomes(5).

NOVEL CORONAVIRUS MUTATION

More than a year has been passed since the inception of the novel coronavirus induced COVID-19, still it is haunting the whole world. Coronaviruses are not new to the world. In fact the first strain of the coronavirus was identified in mid-1970 in Western Europe when unknown fever with cold was grappling some countries. Back by then it was considered as non-lethal and non-harming virus. In fact it had been found in nasal passage of every people in concerned geography without producing any symptoms. Till 2003 less research was being done but after the outbreak of severe acute respiratory syndrome in several Asian as well as other countries which took a big toll on human lives, the research accelerated on the behavioral pattern of the COVID-19. SARS-COV infected nearly 8000 people and the case fatalities stands at 10 percent of the infections which was a serious cause of concern(6). Scientists and researchers was curious as how a non-lethal virus can behave in such a fatal way killing many people. The link was established with the virus's mutating ability. The coronavirus which was named as such due to its resemblance to the crown are notorious for mutating themselves and making themselves more lethal and adaptable in various hosts. Also they are more likely to multiply quickly and spread through various parts of human organ system. The next outbreak in 2012 of Middle Eastern respiratory syndrome (MERS) which took place in gulf countries also proved to be lethal creating a recurring reappearance of the virus after certain years(7). Although it infected less people as compared to SARS-COV-2, the case fatality rate stood at around 30 percent which was huge. Acute respiratory distress syndrome (ARDS) was the common apathy that was found among infected patients. Also the transmissibility of the virus was also a serious cause of concern. In both the outbreaks, the geographical extent was limited to few countries in a particular region.(8)

In case of novel coronavirus, it surpasses all the criteria of figures in every aspects, whether it is infection cases, case fatalities, geographical extent and so on. The extremely high transmissibility, the lethal nature and medical complications arising out of infection are the main reason for the coronavirus disease 2019 to be upgraded from epidemic to pandemic. As it is already known that viruses mutate quite frequently, the recent mutation has caused the second wave in many countries and third wave in others which are wreaking more havoc than the first or

previous waves. Almost all the tests are showing mutations in viral strain. Mutations are varying according to geographical locations and conditions(9). In fact one can find different strains in same country itself which is a serious cause of concern. Novel coronavirus induced COVID-19 is also known for changing the clinical manifestation of the disease from time to time. Initially the disease was known to produce the symptoms like fever, cough and cold. Later more varied symptoms got added to the list and the list is changing day by day. This consequences is linked to mutation in viral strain. The daily infection cases has been lowered after the New Year started but is now gaining traction. Many big nations like India are reeling under the pressure of second wave. More than 300000 case are being registered daily which is highest among world. The new mutant variant of the virus is said to be more virulent than the previous ones. Worst hit countries like India have reported double and triple mutant virus strain. Small mutations are always happening in the virus when passing from one person to another. It does not affect the way the virus works. But if the major mutation happens like changes in spike protein which helps the virus to enter in to the cell then it may produce severe clinical outcomes. Indian variant which are named as E484Q and L452R have their connections with the south African as well as USA variant also known as California variant. During initial days of the pandemic of COVID-19, there was only one mutation that was D614G. But it is normal to have more than one mutants functioning at the same time. In fact there might be more than two mutations which are yet to be discovered. The mutations have some underlying risks attached to it. If it sufficiently modify it self and abled itself to evade antibodies, it can re infect the person who recovered from COVID-19. But it is seen that virus re infecting persons is either of mild nature or does not produce the symptoms at all. In some cases, infected person does not even know if he or she got infected second time. But reinfection can make dent in herd immunity concept which is supposedly to be achieved by mass vaccination which is underway. But this can be tackled as most of the vaccine candidate are able to fight the new variant successfully. Although the high virulent nature and fatal outcome producing capacity is yet to be established through empirical data, but the brunt is more severe than the previous one can be felt. But blaming the double and triple mutant variant completely for the second wave is not justifiable as merely 20 percent cases of the hardest hit state of Maharashtra in India was linked to double mutation, rest 80 percent were of normal variant. The Kent or UK variant also known as B.1.1.7, which has been spread all over the world. India also reported many cases of this variant. The higher intensity of the second wave is linked to this variant of the viral strain. According to studies, this variant of the virus from UK is 50 percent more virulent and 60 percent more fatal than the previous ones.

The resent resurgence of the COVID-19 cases in various countries are not only attributed to mutant versions of the virus but also negligent behavior of the people in following various preventive norms for COVID-19. Lax implementation of physical distancing and wearing masks is what has been resulted into tsunami like wave registering hundreds of thousands of cases each day.

COVID-19 IMPACT ON ORGAN SYSTEM

The physiological impact of novel coronavirus on various organs is different according to the viral load present in the infected person. Clinical manifestations of the disease is different according to the symptomatic or asymptomatic condition of the patient. The novel coronavirus or any virus for that matter enters into the human body via bodily openings like nose, eyes, mouth etc. The respiratory pathway is the primary point of contact for the virus after entering into the body. At cellular level, virus have spike proteins which gets attached to angiotensin converting enzyme 2 (ACE 2) receptors acting as a gateway for the virus to enter into the cell. Respiratory system is the most affected system in COVID-19. Lungs especially are more vulnerable than any other organs in COVID-19 infection. The viral load which produces symptoms like cough and cold can be a hindrance in the normal functioning of the lungs as cough accumulation may leads to blocking the alveolar tissues. The breathing capacity of the lungs can be affected by the viral infection. Hypoxia can be seen in vulnerable group of patients such as elderly, persons with comorbidities, pregnant women and so on. Acute respiratory distress syndrome (ARDS) is one of the prime cause of increasing case fatalities and is one of the severe clinical manifestation of the COVID-19 which is related to lungs. Also Diffusion level of carbon dioxide as well as oxygen gets affected resulting in lack of supply of oxygen to various parts of the body via blood. Inflammation can be seen in moderate to severe patients of COVID-19 in lungs due to swollen tissues. In the long COVID-19 condition inflammation in alveolar tissue and reduced diffusion capacity has been seen. The reduction in physical capacity is linked to reduced oxygen supply to various parts of human body. Proper rehabilitative care is needed to successfully reestablish the patient(10).

The angiotensin converting enzyme 2 (ACE 2) receptors which acts as a gateway to the cell for virus is present on various major organs and one such organ is heart. Therefore it becomes vulnerable in infection. Although the impact on heart during the COVID-19 infection can be seen generally in severe cases but it is important to study that as it is one of the vital organs and needs to be healthy for overall functioning of the body. In severe cases the inflammation of heart muscles also known as myocarditis has been reported which hampers the normal functioning of the human heart. Other abnormalities related to cardiovascular system is irregular beating of heart, cardiac arrest which can make the patient prone to severe clinical manifestation. Patient having heart condition prior to the COVID-19 infection are as vulnerable as persons which does not. Many adverse effects has been seen and it is one of the main contributor in the overall case fatalities due to COVID-19 related complications. Medical professionals are not shocked as there is always an increasing trend of reporting of heart ailments which gets raised during viral infection period. The major impact can be seen post recovery which is categorized as condition of long COVID-19. As considerable amount of time has been passed post inception of pandemic, many patients were reportedly complaining of persistence of some of the symptoms post recovery. It includes intermittent loss of taste and smell, reduced physical capacity, muscle ache etc. These condition of COVID-19 patients post recovery is being called as long COVID-19. After through medical examination it was found that many organs as well as organ systems are also being affected by novel coronavirus in long term. Heart also is one such organ. In fact COVID-19 survivor of severe clinical symptoms have often seen with reduced heart muscle capacity, myocarditis, and persistence of inflammation(11).

Brain and nervous system are also affected by the novel coronavirus infection. In fact there is sufficient amount of data available to imply that viruses do have impact on brain and nervous system. Widespread symptom of loss of taste and smell is the prime indicator that novel coronaviruses affects the brain. During the outbreak of SARS-COV and H1N1 similar observations were recorded. Olfactory indicators are extremely prone to the viral infection and is being attacked by novel coronavirus therefore we see a widespread symptom of loss of smell. The virus mainly enters through nasal and oral cavity. Olfactory indicators are situated in nose which are directly in contact with hippocampus of the brain. Also viral load can reach the brain via blood stream. Another condition of brain fogging which basically is a state of confusion often seen among COVID-19 patients. Also chances of delirium and coma increases after the admission of patient into intensive care unit ward. Also strong sedatives and visits from the family members also have role in producing such outcomes. Cognitive ability has been seen suffering in severe COVID-19 patient in observational studies. Cohort study has been awaited to establish the correlation between the said two(10).

Renal functions are also at down side during the ongoing pandemic. Especially patients with renal ailments and are on regular dialysis. In Britain, 15 percent of case fatalities due to COVID-19 complications were having chronic renal ailments. ACE 2 receptors which acts as gateways for the virus to enter the cell are present on kidneys. Cytokine storm which is uncontrollable immunological response of the human body which can damage the good cells can result into kidney injury and hypo perfusion. Long hauls and hyper ventilation during COVID-19 also can cause acute kidney injury also certain antivirals such as **Remdesivir** may also have similar impact on severely ill patients. Post recover the acute kidney injury (AKI) haunts the patient and delays the healing process. Patient may have to be regularly consulted so as to avoid any complications arising out of situation. In fact AKI is notorious for spiraling into severe illness especially in COVID-19 infection. Various studies are ongoing about the long term implications of COVID-19 which can give better understanding of the situation(12).

Another important organ that is liver also contains the gateway receptors, ACE 2 receptors which makes it more vulnerable. A study shows that there was abnormal levels of Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) which liver enzymes. Also liver ailments predating COVID-19 can have potential of creating medical complications. Alcohol abuse is the prevalent cause of liver ailments along with non-alcoholic fatty liver, hepatitis etc. Also medications of COVID-19 have found to be crossing with medicines of preexisting liver ailments which make the patient management more difficult. Liver transplanted patients are not more vulnerable as it was thought of and safe transplantation can be ensures. In fact the medications that are prescribed for liver ailments may prevent the cytokine storm from taking place. Comorbidity is one of the biggest hurdle and decide whether the patient will develop severe illness or not(13).

PSYCHOLOGICAL IMPACT OF COVID-19

It is one of the most undermines and neglected issue which has prominently felt during the ongoing COVID-19 pandemic. There was huge psychological toll which was taken by the pandemic due to various reasons. The novelty of the infection itself induces the widespread social distress as the unknown virus can culminate into anything. The lockdowns and physical distancing norms which were imposed to curb the viral spread also made people psychologically stressed as their family members and loved ones were apart from them. The patients of the COVID-19 felt the most amount of psychological stress as there involves isolation in hospital facility, family members are not allowed to meet their patient as the chance of spread of disease increases. The long COVID-19 helps to persist these symptoms as post traumatic syndrome disorder can kick in(14). The reduction in physical as well as other capacity of the bodily functions also affects the mental state of the patient as they are worried about their career prospects. Almost every section of the society was affected in a negative way which creates a general negative perception about current situation and outlook towards life changes to negative. In these tough times, such disorders need to be tackled at professional level with utmost priority. Denial is no answer. Designated psychological expert and medical professionals can be deployed in order to rehabilitate the patient completely. Medical professionals and allied health care professionals along with front line workers dealing with the containment of the pandemic are also in distress as they are first point of contact for infected persons. They also fear about transmitting the viral infection unknowingly to their family members after duty hours. Long working hours without adequate rest with donning personal and protective equipment kit (PPE) is extremely tiring and creates fatigue. All these factors can culminate into mental stress and work life balance along with balance composure can adversely affected creating less efficient workforce(15). Various studies on different aspects of Covid -19 and its impact on health were reported. Phansopkar et. al.(16) reported on physical well-being in lock-down. Prasad et. al. reported about adverse effect of Covid pandemic on the care of patients with kidney diseases(17). Singh et. al. reported about Covid-19 associated coagulopathies(18). Spoorthy et. al. reflected on mental health problems faced by healthcare workers(19). Wanjari et. al. reported a case of young covid 19 presenting as fatal subarachnoid hemorrhage(20). Godhiwala et. al. reported about leukemoid reaction in a Covid-19 patient(21). Hande et. al.(22) addressed on cases of oral cancer whereas Kute et. al.(23) detailed on NOTTO Transplant Specific Guidelines.

CONCLUSION

Mutations in virus are inevitable and unavoidable. Also previous pandemic of Spanish flu showed that second waves are more lethal and destructive than first wave of influenza viruses. Lax implementation of the non-pharmacological interventions (NPI) and negligence on account of general masses by not wearing masks and not following physical distancing has been resulted in huge second wave. Although many vaccine candidates has been approved for vaccination of COVID-19, the coverage has been low in major countries. Priority groups has been first vaccinated. Shortage of medical oxygen along with collapsing health care infrastructure are also contributing to the rising case fatalities all across the world. Shortage of vaccine and manpower for vaccination are some of the hurdles in achieving mass vaccination targets. Preliminary results

shows that vaccines considerably reduces the chance of collapsing into severe clinical symptoms. Therefore mission mode level planning is needed to ramp up the vaccination and allowing all age groups to be vaccinated. Organs have adverse impact of the COVID-19 has long term implications only worsens the situation. Therefore it is important to protect oneself by various measures and following guidelines issued by competent authorities. Also approved prophylactics after proper consultation with medical professionals can be consumed in order to ward of the virus.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

REFERENCES

1. COVID-19 Map [Internet]. Johns Hopkins Coronavirus Resource Center. [cited 2021 Apr 24]. Available from: <https://coronavirus.jhu.edu/map.html>
2. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020.pdf.
3. WHO Coronavirus (COVID-19) Dashboard [Internet]. [cited 2021 Apr 24]. Available from: <https://covid19.who.int>
4. Abdullahi IN, Emeribe AU, Ajayi OA, Oderinde BS, Amadu DO, Osuji AI. Implications of SARS-CoV-2 genetic diversity and mutations on pathogenicity of the COVID-19 and biomedical interventions. J Taibah Univ Med Sci [Internet]. 2020 Aug [cited 2021 Apr 23];15(4):258–64. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7351386/>
5. Guan W-J, Liang W-H, Zhao Y, Liang H-R, Chen Z-S, Li Y-M, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J. 2020;55(5).
6. Wu L-P, Wang N-C, Chang Y-H, Tian X-Y, Na D-Y, Zhang L-Y, et al. Duration of Antibody Responses after Severe Acute Respiratory Syndrome. Emerg Infect Dis [Internet]. 2007 Oct [cited 2021 Apr 24];13(10):1562–4. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2851497/>

7. COVID-19, MERS & SARS | NIH: National Institute of Allergy and Infectious Diseases [Internet]. [cited 2021 Apr 24]. Available from: <https://www.niaid.nih.gov/diseases-conditions/covid-19>
8. Dushyant Bawiskar, Pratik Phansopkar, Ayurva Vilas Gotmare. COVID-19 Facets: Pandemics, Curse and Humanity. *ijrps*. 2020 Aug 6;11(SPL1):385–90.
9. Grubaugh ND, Hanage WP, Rasmussen AL. Making Sense of Mutation: What D614G Means for the COVID-19 Pandemic Remains Unclear. *Cell*. 2020 Aug 20;182(4):794–5.
10. Mallick AK, Ahsan M. Impact of COVID-19 on different organ systems and prognosis: A scoping review. *Journal of Acute Disease* [Internet]. 2021 Jan 1 [cited 2021 Apr 23];10(1):1. Available from: <http://www.jadweb.org/article.asp?issn=2221-6189;year=2021;volume=10;issue=1;spage=1;epage=7;aulast=Mallick;type=0>
11. Li Q, Wu J, Nie J, Zhang L, Hao H, Liu S, et al. The Impact of Mutations in SARS-CoV-2 Spike on Viral Infectivity and Antigenicity. *Cell* [Internet]. 2020 Sep [cited 2021 Apr 23];182(5):1284-1294.e9. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0092867420308771>
12. Lenti MV, Borrelli de Andreis F, Pellegrino I, Klersy C, Merli S, Miceli E, et al. Impact of COVID-19 on liver function: results from an internal medicine unit in Northern Italy. *Intern Emerg Med* [Internet]. 2020 Jul 10 [cited 2021 Apr 24];1–9. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7348571/>
13. Pun BT, Badenes R, Calle GHL, Orun OM, Chen W, Raman R, et al. Prevalence and risk factors for delirium in critically ill patients with COVID-19 (COVID-D): a multicentre cohort study. *The Lancet Respiratory Medicine* [Internet]. 2021 Mar 1 [cited 2021 Apr 24];9(3):239–50. Available from: [https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(20\)30552-X/abstract](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(20)30552-X/abstract)
14. Blake H, Bermingham F, Johnson G, Tabner A. Mitigating the Psychological Impact of COVID-19 on Healthcare Workers: A Digital Learning Package. *Int J Environ Res Public Health*. 2020 26;17(9).
15. COVID-19 Facets: Pandemics, Curse and Humanity | International Journal of Research in Pharmaceutical Sciences [Internet]. [cited 2020 Oct 17]. Available from: <https://pharmascope.org/ijrps/article/view/2731>.
16. Phansopkar, Pratik Arun, Waqar Mohsin Naqvi, and Arti Isherkumar Sahu. “COVID-19 Pandemic- A Curse to the Physical Well-Being of Every Individual in Lock-Down.” *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, no. 35 (August 31, 2020): 2561–66. <https://doi.org/10.14260/jemds/2020/556>.
17. Prasad, Narayan, Mansi Bhatt, Sanjay K. Agarwal, H. S. Kohli, N. Gopalakrishnan, Edwin Fernando, Manisha Sahay, et al. “The Adverse Effect of COVID Pandemic on the Care of Patients With Kidney Diseases in India.” *KIDNEY INTERNATIONAL REPORTS* 5, no. 9 (September 2020): 1545–50. <https://doi.org/10.1016/j.ekir.2020.06.034>.

18. Singh, Nihaal, Ashish Prakash Anjankar, and Shivangi Garima. "The Urgent Need to Understand Covid-19 Associated Coagulopathies and the Significance of Thrombotic Prophylaxis in Critically Ill Patients." *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 9, no. 33 (August 17, 2020): 2381–85. <https://doi.org/10.14260/jemds/2020/516>.
19. Spoorthy, Mamidipalli Sai, Sree Karthik Pratapa, and Supriya Mahant. "Mental Health Problems Faced by Healthcare Workers Due to the COVID-19 Pandemic-A Review." *ASIAN JOURNAL OF PSYCHIATRY* 51 (June 2020). <https://doi.org/10.1016/j.ajp.2020.102119>.
20. Wanjari, A. K., Ayush Dubey, Sourav Chaturvedi, and Sunil Kumar. "Young COVID 19 Presenting as Fatal Subarachnoid Hemorrhage: Association or Chance?" *MEDICAL SCIENCE* 24, no. 104 (August 2020): 2712–15.
21. Godhiwala, Parth, Sourya Acharya, Gaurav Jagtap, Arvind Bhake, and Samarth Shukla. "Leukemoid Reaction in a COVID-19 Patient." *JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS* 10, no. 6 (February 8, 2021): 399–400. <https://doi.org/10.14260/jemds/2021/88>.
22. Hande, Alka, Archana Sonone, Amol Gadabail, Madhuri Gawande, Swati Patil, and Preethi Sharma. "Modalities to Restrain the Progression of Oral Potentially Malignant Diseases and Oral Squamous Cell Carcinoma in COVID-19 Pandemic." *ORAL ONCOLOGY* 114 (March 2021). <https://doi.org/10.1016/j.oraloncology.2020.105072>.
23. Dr. Ahmed N.(2016) The Impact of Nutrition Education on Community Health Outcomes . *International Journal of Respiratory Care*, 12(1), 19–22.
24. Dr. Antino N.(2016) Trends in Medical-Related Sentinel Events During Hourly Rounding . *International Journal of Respiratory Care*, 12(1), 23–27.
25. Kute, Vivek, Sandeep Guleria, Jai Prakash, Sunil Shroff, Narayan Prasad, Sanjay K. Agarwal, Santosh Varughese, et al. "NOTTO Transplant Specific Guidelines with Reference to COVID-19." *INDIAN JOURNAL OF NEPHROLOGY* 30, no. 4 (August 2020): 215–20. https://doi.org/10.4103/ijn.IJN_299_20.