REVIEW

SARS-CoV-2 delta variant : A literature review

Le variant delta du SRAS-CoV-2 : revue de la littérature

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ABSTRACT

The ongoing pandemic of COVID-19 is causing more health, economic and social issues worldwide. As of July 5, 2021, the world registered more than 184 million cases across 222 countries; more than 4 million have died from the deadly infection. The SARS-CoV-2 continues spreading globally; new variants emerge randomly due to errors in the virus' gRNAs replication process. The present paper treats the new delta variant of concern, also known as B.1.617.2 lineage. The study highlights transmissibility, vaccine effectiveness, pathogenicity, and the likelihood of hospital admission related to delta variant infection based on a literature review of 10 indexed databases. The findings indicate high transmissibility of the B.1.617.2 lineage, approving it to be the dominant strain worldwide. Also, reduced vaccine effectiveness is confirmed. However, approved vaccines for emergency use remain valuable against COVID-19's delta variant. Finally, the risk of hospitalization seems to be twice in the case of delta variant infection. A combined approach of vaccination and non-pharmaceutical interventions is the leading way to contain the ongoing pandemic of COVID-19.

Keywords: SARS-CoV-2; delta variant; literature review.

RÉSUMÉ

La pandémie actuelle de COVID-19 cause de nombreux enjeux sanitaires, économiques et sociaux dans le monde entier. Au 5 juillet 2021, le globe a enregistré plus de 184 millions de cas dans 222 pays ; plus de 4 millions de personnes sont mortes de cette infection létale. Le SRAS-CoV-2 continue de se propager dans le monde ; de nouvelles variantes apparaissent de manière aléatoire suite à des erreurs dans le processus de réplication des ARNg du virus. Le présent article traite le sujet de la nouvelle variante delta préoccupante, également connue sous le nom de souche B.1.617.2. L'étude met en évidence la transmissibilité, l'efficacité du vaccin, la pathogénicité et la probabilité d'admission à l'hôpital liées à l'infection par la variante delta, à partir d'une analyse documentaire de 10 bases de données indexées. Les résultats indiquent une transmissibilité élevée de la lignée B.1.617.2, ce qui en fait la souche dominante dans le monde. L'efficacité réduite des vaccins est également confirmée. Cependant, les vaccins approuvés pour une utilisation en urgence restent valables contre la variante delta de COVID-19. Enfin, le risque d'hospitalisation semble être doublé en cas d'infection par le variant delta. Une approche combinée de vaccination et des interventions non pharmaceutiques est la meilleure façon de contenir la pandémie actuelle de COVID-19.

Mots clés : SRAS-CoV-2 ; variante delta ; revue de littérature.

INTRODUCTION

Early in December 2019, massive pneumonia with an unknown etiology spread in Wuhan, Hubei Province, China [1,2]. The viral agent was identified as a new coronavirus and was named "Novel Corona Virus" (2019-nCoV [3]. Within several weeks, the new virus spread to other Asian countries then crossed continents, becoming a worldwide outbreak due to its high transmissibility [4,5]. Afterward, and on January 30, 2020, the World Health Organization (WHO) considered the emerging COVID-19 a Public Health Emergency of International Concern (PHEIC) [6]. On March 11, 2020, the WHO categorized the COVID-19 outbreak as a pandemic [7]. As of June 25, 2021, the SARS-CoV-2 virus has already infected over 181 million people worldwide and has resulted in the death of over 3.9 million [8]. These numbers are underestimated and could represent the tip of an iceberg [9].

SARS-CoV-2 is an enveloped virus with a spherical shape (see figure1); it is relatively a massive particle with a diameter varying from 80 to 120 nm [10] holds linear positive single-stranded RNA genomes [5,11]. Due to the high mutation rate in the replication process of gRNAs, RNA-based viruses have a potential sequence range that enables a significant emergence of new variants [12]. Therefore, new variants continue to arise and spread at an increasing rate worldwide since the beginning of the COVID-19 pandemic [13,14].

Mutations in the SARS-CoV-2 genome have contributed to the appearance of various highly infectious variants via errors in its RNA replication and recombination [15,16]. Mutations can give the virus an advantage in several ways; increased transmissibility or evasion of immune responses are two potential examples [17].

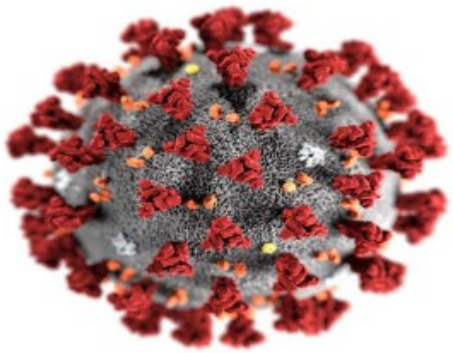

Figure 1. Illustration of SARS-CoV-2 virion

A variant of concern (VOC) refers to a mutation linked to increased infectiousness, more severe illness, and a significant decrease in neutralization by antibodies generated in prior infections or vaccinations, reduced effectiveness of treatment, or diagnostic test deficiencies [18–20]. The WHO implemented names for significant variants of concern using the Greek alphabet to facilitate public communication about variants and to provide a geographically neutral citation for variants [21,22], including Alpha variant (B.1.1.7 UK), Beta (B.1.351 S. Africa), Gamma (P.1 Brazil), Epsilon (B.1.429 California), Iota (B.1.526 New York) and, Delta (B.1.617.2 India) [23,24].

Since March 2021, lineage B.1.617 has been dominant in India's most considerable COVID-19 infection, receiving international attention [25,26]; this mutation consists of three siblings: B.1.617.1, B.1.617.2, and B.1.617.1.3 [27]. However, it is now clear that only sublineage B.1.617.2 is linked to a higher public health threat [19]. As a result, the WHO and the Center for Disease Control and Prevention (CDC) have declared it a variant of concern [21,23]. The delta variant has caused a large wave of COVID-19 infections, straining health services in a never experienced way [28]; it is also considered to be the cause of the devastating second wave of the pandemic in India, which has led to the breakdown of its health care infrastructure and resulted in thousands of deaths daily [29,30].

In this study, we aimed to review and highlight the new risk factors related to the B.1.617.2 lineage; we hope to raise awareness among the population and help even with simple participation in the containment of the ongoing pandemic.

METHOD

The authors conducted a literature review from May 2021 to June 2021, using 10 indexed databases. We used the following keywords in research: "Delta variant" or "Delta mutation" or "B.1.617.2 lineage" or "COVID Indian variant" in combination with "transmission" or "vaccine effectiveness" or "hospitalization" or "hospital admission." The research was limited to articles written in English, and the focus was on studies published in 2021 based on full-text papers. Duplications are frequent and were unconcerned. Moreover, studies that didn't address the topic of research were excluded.

The review was conducted through PubMed, The Lancet: 2019-nCoV Resource Centre, science, The Scientist, ScienceDirect, Scopus, Base (Bielefeld academic search engine), Google scholar, Doaj, and Cochrane library; two authors finally selected a total of 42 studies; then data were extracted by three authors. Although the fact that no scale was used to rate the selected studies, the research was based on recent and credible evidence in the literature. Notably, the number of studies is increasing rapidly, so a daily update is required.

FINDINGS

The review's main findings are described in the section below; results are divided into three axes; transmissibility of the new Delta variant, vaccination efficiency, and hospital admission in no particular order.

Transmission

SARS-CoV-2 high transmissibility is responsible for its worldwide spread; it could be transmitted mainly through the air via respiratory droplets within a distance of 2m [31]. Studies suggest another route through "hidden transmission," in which carriers with no or mild symptoms could unintentionally transmit the virus to naive people [6]. Asymptomatic transmission could be one of the reasons for the continuous spread of SARS-CoV-2 until now.

The new delta variant of SARS-CoV-2 has a higher infectivity rate; as a result, it is currently dominating over the antecedent variants worldwide [32]. Therefore, the delta variant has already spread to all countries in South Asia [30]. The number of cases is rapidly increasing in Indonesia, Bangladesh, Thailand, Iraq, Japan, Myanmar, Malaysia, Kazakhstan, Pakistan, Vietnam, Iran, and South Korea [33]. A research study conducted in Scotland revealed that infection with the Delta variant had been detected so far in 96 countries worldwide [34]. The Public Health England data registration shows that subvariant B.1.617.2 has become epidemiologically dominant [27]; this could be due to natural selection and genetic displacement of the SARS-CoV-2 genome [35,36]. The rapid dominance of delta in the UK shows how quickly this variant can spread, even in a country with high vaccination rates [37]. According to a recent study, the delta variation is linked to over 90% of new COVID-19 cases in the UK [39], and it is expected to be in charge of 90% of cases in the European Union by the end of August [37].

The delta variant (B.1.617.2) is highly infectious, with a transmission rate of 60 percent higher than the Alpha variant (B.1.1.7), which was 50 percent higher than the original Wuhan virus strain [39,40]. Delta's estimated reproduction number R0 is higher than the Alpha variant [32], which explains its dominance. When an infected person infects more than one person on average, the infection rates increase exponentially [32]. This situation could lead to the collapse of the healthcare system [41]. Notably, infections were significantly more common in non-vaccinated persons than in persons identified as vaccinated [42].

Vaccination effectiveness

To halt the pandemic, many safe and effective vaccines have been used against SARS-CoV-2 and were approved by the WHO as emergency use vaccines. Coronaviruses' main surface glycoprotein is spike protein (S); thus, COVID-19 vaccines are designed to trigger antibody (and T cell) responses to S using S sequences extracted from the wild virus originated in Wuhan [43]. Vaccines deliver S in a variety of different formats: RNA (Pfizer BNT162b2 and Moderna), viral vectors (AstraZenzca and Sputnik V), recombinant protein (Novavax), or inactivated virus (Sinopharm and Covaxin) [43]. Nevertheless, there is a rising concern that virus variants may escape the antibody responses elicited by vaccination. The S sequence of the variant viruses is different from the one used in the vaccination trials [43]. However, some findings suggest that vaccination of infected individuals previously could probably protect them against various circulating viral mutations, including the delta variant [26].

The WHO has confirmed that all the vaccines approved for emergency use are effective against variant delta. Still, the vaccines do not prevent people from becoming infected with SARS-CoV-2, and their efficiency against long COVID-19 is not

yet evident [34,44]. In contrast, the emerging viral variants with modified antigen patterns can decrease the vaccine's effectiveness [15,45]. Recent data reported by Public Health England indicate that after exposure to B.1.617.2 lineage, the vaccination efficacy of Pfizer's BNT162b2 is significantly reduced to 33.5% after one dose compared to 51.1% against Alpha variant (B.1.1.7), and 87.9% after receiving the second dose compared to B.1.1.7 lineage (93.4%) [13,46]. In addition, the 2-dose efficacy of the ChAdOX1 Oxford-AstraZeneca vaccine is decreased from 66.1% with alpha variant to 59.8% after being exposed to B.1.617.2 [47], the Oxford-AstraZeneca vaccine seemed to be less effective than the Pfizer-BioNTech vaccine in preventing SARS-CoV-2 infection among people infected by delta variant [48]. Delta is somewhat resistant to vaccines, particularly those who have received only one dose [32].

Hospital admission

Despite a successful vaccine campaign in the first six months of 2021, cases and hospital admissions have increased by the end of May as the B.1.617.2 lineage of SARS-CoV-2 becomes more prevalent [42]. As of June 9, 2021, the number of people admitted to hospitals in the United Kingdom for COVID-19 had surpassed 1,000, up from a few hundred in mid-May during the previous wave [49]. According to many studies, patients infected with the Delta variant are two times more at risk of hospitalization than those infected with the Alpha variant [32,50]. Increasing hospital admission rates will put more pressure on the already burdened health care system and overwhelm its capacity. Fortunately, vaccines are very effective in reducing hospitalizations and deaths from SARS-CoV-2 infection [45].

a posted study found high levels of vaccine protection against COVID-19-related hospitalizations; the Pfizer vaccine was 94 percent effective in preventing hospitalizations due to Delta or Alpha variants after one dose and 96 percent effective after two doses [16]. The AstraZeneca vaccine showed 71% effectiveness against hospitalizations after one dose and 92% effectiveness after two doses [16,49]. The oxford-AstraZeneca and Pfizer-BioNTech COVID-19 vaccines have both significantly reduced the risk of SARS-CoV-2 infection and hospital admissions for COVID-19 among individuals infected by the Delta variant [48].

DISCUSSION

The likelihood of a virus mutating is higher when it is widely circulating in a larger population. The more opportunities a virus has to spread, the more it replicates, and the more mutations can undergo. Therefore, the appearance of variants able to escape the immune system seems to be inevitable, and it would be essential to develop pandemic countermeasures in response [38]. The two main strategies for preventing new variants are vaccination and preventing the virus from spreading at once [51,52]. Vaccination is expected to have a significant impact in mitigating the COVID-19 pandemic [53]. As a result, there is a pressing need to speed up the vaccination process as quickly as possible. Variants of concern should be carefully supervised; results of empirical researches should be interpreted with caution to develop the most suitable strategies. Therefore, research and studies must prioritize those mutations that have greater transmissibility with decreased antibody neutralization [20]. It is a fact that vaccination may take time; non-pharmaceutical interventions (NPIs) are the most crucial step at this time, regardless of the virus variant and its potential impact [51]. Such measures are vital for "flattening the curves" of deaths, infections, reduce viral mutations, and give health organizations more time to increase vaccination rates. It is believed that the earlier an intervention is implemented, the more effective it is [41].

The UK policy of prioritizing vaccination of the population with a single dose, followed by a second dose within 12 weeks, is significantly related to a decrease in deaths and hospitalizations rates caused by SARS-COV-2 infection [46]. Nevertheless, the emergence of the delta variant could require a changed approach to tackle the increased infection rates in the UK, as this delayed dosing strategy is now being challenged by the emergence of the B.1.617.2 strain [46]. Vaccination schedules must be adapted to ensure the delivery of two doses without delay [38]. Data reinforce the need to recognize the increased protection offered by a second vaccine dose as COVID-19 cases associated with the B.1.617.2 variant increase [54]. Thus, the combination of two-dose mass vaccination and non-pharmaceutical interventions enables the control and limitation of the viral spread [55]. Government authorities must become more rigid in applying health and safety measures, giving more time to medical staff to vaccinate populations.

Countries with high access to vaccines, such as those in Europe and North America, hope that the vaccines can slow the exponential rise of variants of concern, such as delta. Conversely, in countries with limited vaccine supplies, particularly in Africa, some scientists are concerned that the outcomes could be devastating since the main danger of the global spread of delta is in countries where vaccination rates are low [32]. Countries with limited availability of the vaccine must rely again on interventions such as physical distancing and mask-wearing. At the same time, they need to increase the testing capacity of COVID-19 and work to obtain vaccines from all potential sources. Also, governments must ensure an adequate oxygen supply, ventilators, and additional hospital beds should be prepared to handle the increased cases of COVID-19.

Furthermore, the authorities have to conduct effective campaigns to raise public awareness and reduce vaccination hesitancy. The ongoing pandemic highlight notably a "Vaccine apartheid" and a "catastrophic moral failure" due to inequivalent vaccine distribution [56]. Despite the WHO, with other parties implemented a global procurement program such as the COVID-19 Global Vaccine Access Facility (COVAX) to provide vaccines for the lowest-income countries, it has had little impact to date [56].

Management and prevention are fundamental approaches to fight against SARS-CoV-2 mutations; the best process is to expand vaccination efforts quickly without ignoring non-pharmaceutical interventions. Behaviors like handwashing with soap and sanitizer, covering the mouth and nose when sneezing, social distancing, and quarantine appear to be traditional and straightforward but effective measures to slow down a pandemic with such high contagiousness.

CONCLUSION

The ongoing pandemic of COVID-19 threatens public health, health care systems, and countries' economics on a global scale. Currently, new SARS-CoV-2 mutations emerge continuously due to errors in the genome replication process. The biggest fear of the scientific community is the appearance of mutations that can surpass the current vaccines taking back humanity to the starting point. Mutations like the B.1.617.2 lineage have already proved high transmissibility, increased risk of hospitalization, and a significant neutralization of antibodies compared to precedent variants so far.

Governments and health organizations should establish the best efficient vaccination approach for every country based on vaccination availability and the epidemiological state of the region. The objective is not simply to prevent the death of people but also to reduce the scope for the virus to spread and mutate further.

The world has to deal with the inequality issue of vaccine distribution by supporting organizations like COVAX, giving all the countries a fair chance of access to vaccines. Until that time, non-pharmaceutical interventions remain a practical approach, specifically in case of limited vaccine availability. Reducing the spread and limiting new variants to appear must contain the ongoing pandemic, but this could be reached only by high vaccination rates and respect of ICPs measures simultaneously.

Conflict of interest

The authors declare that they have no conflict of interests.

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