Intranasal Vaccine for Covid-19: Incovacc

[1]Archana Singh Yadav, [2]Nishi Kumari

[1,2]Assistant Professor
M.L.B Government Paramedical Training College, Jhansi, U.P

Abstract: The corona virus disease 2019 (COVID-19), which is caused by infection with the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), has already claimed more than 6.8 million lives worldwide. Most COVID-19 vaccines target the spike protein of the ancestral SARS-CoV-2 strain. Due to the presence of numerous mutations on SARS-CoV-2 variant spike proteins, the efficacy of these vaccines has been significantly reduced. Therefore, scientists are looking to improve current vaccine formulations to provide better protection against SARS-CoV-2 infection. An effective intranasal vaccine could be extremely beneficial in managing the COVID-19 pandemic by eliciting both mucosal protective immunity at the site of infection and systemic immunity. India on the 74th Republic Day got its first intranasal COVID-19 vaccine iNCOVACC. On Thursday, Union Health Minister Mansukh Mandaviya and Science and Technology Minister Jitendra Singh 2023 launched the first intranasal COVID-19 vaccine, developed by Bharat Biotech. Nasal vaccines can be more effective at preventing infections because the shots target the mucosal linings of the nasal airways, which is the point of entry for the coronavirus. By protecting these linings, the vaccine can block the infection and transmission of the virus in both the upper and lower respiratory tracts. There is no doubt that IN vaccines have their own set of potential advantages over the IM vaccine. IN vaccine is a promising preventive strategy for SARSCoV-2 considering the remarkable protective immunity in the mucosal sites.

Keywords: COVID-19, SARS-CoV-2, VOCs, SIgA, NTAGI, NALT

INTRODUCTION

The corona virus disease 2019 (COVID-19), which is caused by infection with the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2), has already claimed more than 6.8 million lives worldwide. Despite the rapid development and widespread distribution of COVID-19 vaccines, the pandemic persists due to the continual emergence of new SARS-CoV-2 variants. Some of these variants, such as the Delta and Omicron variants of concern (VOCs), can evade the immune response induced by vaccination or natural infection. Therefore, scientists are looking to improve current vaccine formulations to provide better protection against SARS-CoV-2 infection.

BACKGROUND

Most COVID-19 vaccines target the spike protein of the ancestral SARS-CoV-2 strain. Due to the presence of numerous mutations on SARS-CoV-2 variant spike proteins, the efficacy of these vaccines has been significantly reduced. SARS-CoV-2 must overcome both anatomical and immunological barriers presented by the nasal mucosa to establish infection. Mucosal immunity has a crucial role in blocking SARS-CoV-2 infection to prevent its transmission; however, all currently available COVID-19 intramuscular vaccines primarily elicit systemic immunity, with a limited impact on mucosal immunity. An effective intranasal vaccine could be extremely beneficial in managing the COVID-19 pandemic by eliciting both mucosal protective immunity at the site of infection and systemic immunity.

HOW DOES THE IMMUNE SYSTEM FIGHT PATHOGENS?

The immune system has two distinct components: mucosal and circulatory.

The mucosal immune system provides protection at the mucosal surfaces of the body. These include the mouth, eyes, middle ear, the mammary and other glands, and the gastrointestinal, respiratory and urogenital tracts. Antibodies and a variety of other anti-microbial proteins in the sticky secretions that cover these surfaces, as well as immune cells located in the lining of these surfaces, directly attack invading pathogens.

The circulatory part of the immune system generates antibodies and immune cells that are delivered through the bloodstream to the internal tissues and organs. These circulating antibodies do not usually reach the mucosal surfaces in large enough amounts to be effective. Thus, mucosal and circulatory compartments of the immune system are largely separate and independent.

WHAT ARE THE KEY PLAYERS IN MUCOSAL IMMUNITY?

Most of the people may be familiar with the immune components like proteins known as antibodies, or immunoglobulins. The immune system generates antibodies in response to invading agents that the body identifies as “non-self,” such as viruses and bacteria. Antibodies bind to specific antigens: the part or product of a pathogen that induces an immune response. Binding to antigens allows antibodies to either inactivate them, as they do with toxins and viruses, or kill bacteria with the help of additional immune proteins or cells.

The mucosal immune system generates a specialized form of antibody called secretory IgA, or SIgA. Because SIgA is located in mucosal secretions, such as saliva, tears, nasal and intestinal secretions, and breast milk, it is resistant to digestive enzymes that readily destroy other forms of antibodies. It is also superior to most other immunoglobulins at neutralizing viruses and toxins, and at preventing bacteria from attaching to and invading the cells lining the surfaces of organs.

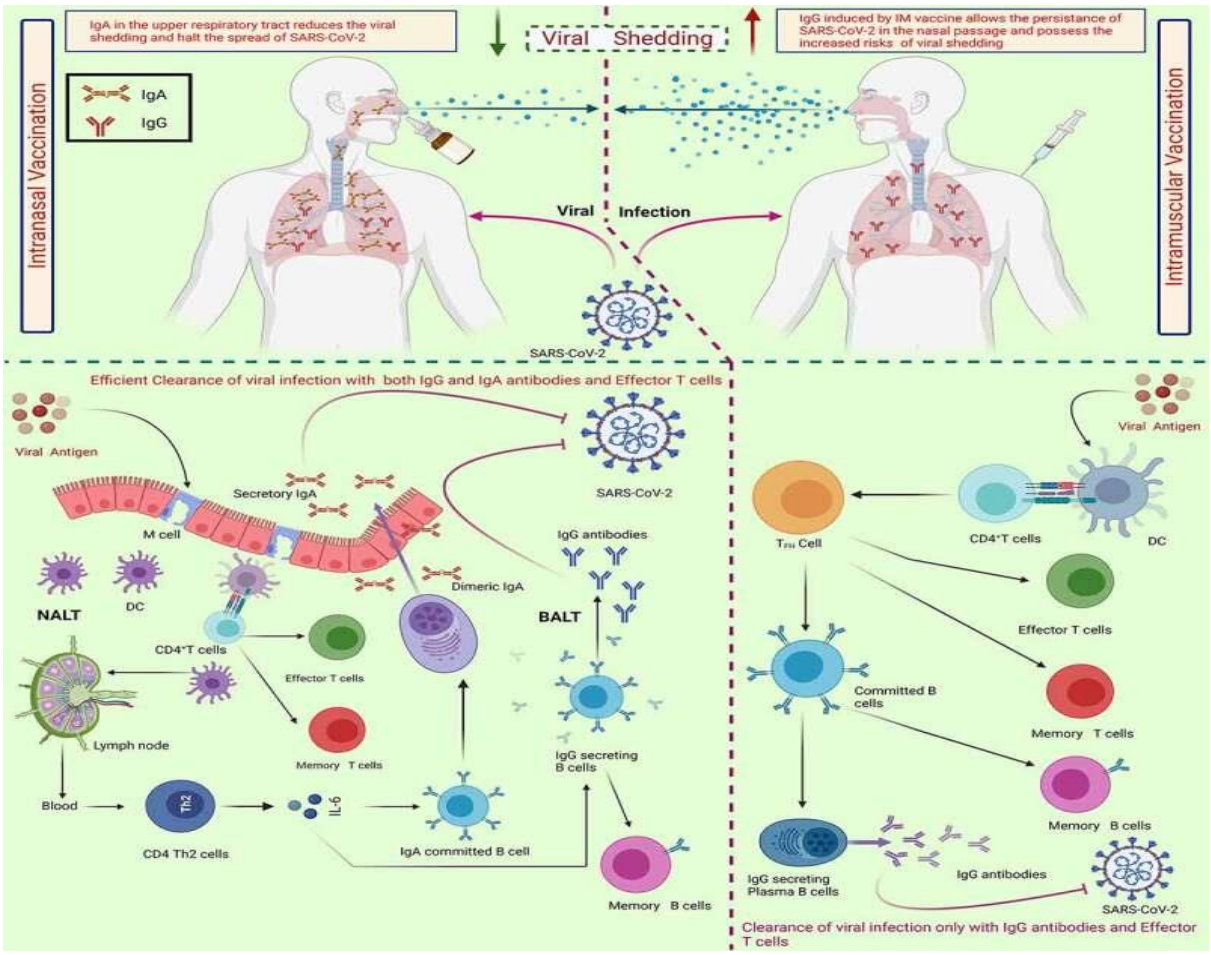
There are also many other key players in the mucosal immune system, including different types of anti-microbial proteins that kill pathogens, as well as immune cells that generate antibody responses.

HOW DOES THE COVID-19 VIRUS ENTER THE BODY?

Almost all infectious diseases in people and other animals are acquired through mucosal surfaces, such as by eating or drinking, breathing or sexual contact. Major exceptions include infections from wounds, or pathogens delivered by insect or tick bites.
The virus that causes COVID-19, SARS-CoV-2, enters the body via droplets or aerosols that get into your nose, mouth or eyes. It can cause severe disease if it descends deep into the lungs and causes an overactive, inflammatory immune response. This means that the virus's first contact with the immune system is probably through the surfaces of the nose, mouth and throat. This is supported by the presence of SIgA antibodies against SARS-CoV-2 in the secretions of infected people, including their saliva, nasal fluid and tears. These locations, especially the tonsils, have specialized areas that specifically trigger mucosal immune responses.
Some research suggests that if these SIgA antibody responses form as a result of vaccination or prior infection, or occur quickly enough in response to a new infection, they could prevent serious disease by confining the virus to the upper respiratory tract until it is eliminated.

HOW DO NASAL VACCINES WORK?

Vaccines can be given through mucosal routes via the mouth or nose. This induces an immune response through areas that stimulate the mucosal immune system, leading mucosal secretions to produce SIgA antibodies. There are several existing mucosal vaccines, most of them taken by mouth. Currently only one, the flu vaccine, is delivered nasally.



INTRANASAL VACCINE "INCOVACC" BY BHARAT BIOTECH

India on the 74th Republic Day got its first intranasal COVID-19 vaccine iNCOVACC. On Thursday, Union Health Minister Mansukh Mandaviya and Science and Technology Minister Jitendra Singh 2023 launched the first intranasal COVID-19 vaccine, developed by Bharat Biotech. iNCOVACC® is the world's first Intranasal vaccine for Covid to receive approval for the primary 2-dose schedule. It has also got a go-ahead as a heterologous booster dose, administered as nasal drops.
iNCOVACC has been rolled out as a booster dose for people above 18 years of age. The vaccine can be purchased for Rs 325 per shot at government hospitals and centres, and for Rs 800 per shot at private vaccination centres.
The approval provided that iNCOVACC vaccine can be taken by any individual above 18 years who has already received two regular doses of available vaccine – whether Covaxin, Covashield or any other duly licensed product. The intranasal vaccine is a recombinant adenoviral vectored vaccine, developed in partnership with Washington University, St Louis.
"Since the vaccine is needle-free, administration of two drops of vaccine through nasal passage would also reduce the burden on trained health care workers for its ease of use. At the same time the vaccine also eliminates the needle-associated risk of injuries or infections too," said a senior official from the Hyderabad-based Bharat Biotech.

WHY NASAL VACCINES

Nasal vaccines can be more effective at preventing infections because the shots target the mucosal linings of the nasal airways, which is the point of entry for the coronavirus. By protecting these linings, the vaccine can block the infection and transmission of the virus in both the upper and lower respiratory tracts. INCOVACC is recommended as the first booster shot. The vaccine will be administered to people twice with a gap of 28 days.

COVID-19 NASAL VACCINE CAN'T BE ADMINISTERED TO THOSE WHO TOOK BOOSTER DOSE

COVID-19 vaccination: NTAGI chief Dr NK Arora said the indigenously developed CoWIN platform will not accept bookings for a fourth dose. Those who have taken the booster dose of the COVID-19 vaccine cannot take Bharat Biotech's nasal coronavirus vaccine– iNCOVAAC, head of India's coronavirus task force group National Testing Advisory Group (NTAGI), Dr. NK Arora, said. He mentioned that the nasal vaccine can be used as a first booster while adding the indigenously developed CoWIN platform will not accept bookings for a fourth dose.

ADVANTAGES OF INTRANASAL COVID-19 VACCINES OVER THE INTRAMUSCULAR VACCINES

- A single dose of an effective SARS-CoV-2 vaccine candidate via IN route may induce the substantial amount of neutralizing antibodies, boosts mucosal IgA and T cell responses, and almost completely protects viral infection in both the upper and lower respiratory tracts .
- Intranasal immunization can be an effective approach to minimize viral shedding and spread, which might be advantageous over IM vaccines.
- The viral load in the upper and lower respiratory tract tissues can be reduced by IN immunization.
- Nasal vaccinations are appealing as an alternative to injectable vaccinations since they may allow for a lower dosage than IM administration.
- The IN vaccine can be administered at the appropriate region, such as nasal-associated lymphoid tissues (NALT), to induce a substantial amount of mucosal immunity.
- Owing to ease of administration, nasal vaccinations may not always need to be given by a health-care professional.
- It is indeed a better option for infants who do not like injections in nature. Additionally, nasal vaccinations may be administered using simple devices, which eliminates the requirement for sterilized settings during vaccination, which is particularly beneficial for immunization programs in developing nations.
- Dry powder nasal vaccines have been created, which may allow the easy storage and transportation of the vaccines. In addition, IN vaccinations permit self-administration and may be manufactured to persist at room temperature, easing transportation and storage procedures. This approach can be highly advantageous in developing countries such as India. However, the preliminary studies are yet to be approved in the coming time.

CONCLUSION

The intranasal vaccine is an exciting method for preventing COVID-19 since the nasal mucosa provides the first-line barrier to SARS-CoV-2 entrance before dissemination into the lungs. Hence, developing effective and reliable intranasal vaccines is crucial at this time.

There is no doubt that IN vaccines have their own set of potential advantages over the IM vaccine. IN vaccine is a promising preventive strategy for SARSCoV-2 considering the remarkable protective immunity in the mucosal sites. Although all the licensed mucosal vaccines are based on whole pathogens, the investigation of IN COVID-19 vaccines predominantly focused on safer vaccine platforms, especially viral vectors and protein subunits.

Nonetheless, we believe that an intranasal COVID-19 immunization may be available soon. Moreover, in our opinion, the second generation IN vaccines could significantly increase the capacity of several developing countries to restrain the deleterious consequences of COVID-19, where immunization is still a significant concern for the government.

BIBLIOGRAPHY

1. WHO's landscape of COVID-19 vaccine candidates. https://www. who.int/emergencies/diseases/novel-coronavirus-2019/covid-19- vaccines, 24-November 2021.
2. Registry data of COVID-19 vaccine candidates. https://covid19. trackvaccines.org/, 24-November 2021.
3. Tiboni M, Casettari L, Illum L. Nasal vaccination against SARSCoV-2: synergistic or alternative to intramuscular vaccines? Int J Pharm. 2021;603:120686.

4. Moradi-Kalbolandi S, Majidzadeh AK, Abdolvahab MH, Jalili N, Farahmand L. The role of mucosal immunity and recombinant probiotics in SARS-CoV2 vaccine development. Probiotics Antimicrob Proteins. 2021;13(5):1239–1253.
5. Li Y, Jin L, Chen T. The effects of secretory IgA in the mucosal immune system. Biomed Res Int. 2020;2020: 2032057.
6. Hassan AO, Kafai NM, Dmitriev IP, et al. A single-dose intranasal ChAd vaccine protects upper and lower respiratory tracts against SARS-CoV-2. Cell. 2020;183(1):169–184.e13.
7. https://www.news-medical.net/news/20230203/The-effectiveness-of-intranasal-COVID-19-vaccination-in-healthy-adults.aspx.
8. https://www.businesstoday.in/coronavirus/story/india-gets-its-first-intranasal-vaccine-for-covid-for-rs-800-per-dose-367688-2023-01-26.
9. WHO . WHO COVID-19 dashboard - up to date data on pandemic. WHO Heal Emerg Dasboard 2021. https://covid19.who.int/region/searo/country/id [Accessed on February 8, 2022]
10. Dhama K, Khan S, Tiwari R, Sircar S, Bhat S, Malik YS, Singh KP, Chaicumpa W, Bonilla-Aldana DK, Rodriguez-Morales AJ.. Coronavirus disease 2019–COVID-19. Clin Microbiol Rev. 2020;33(4):1–11. doi:10.1128/CMR.00028-20. - DOI - PMC - PubMed
11. Sharun K, Tiwari R, Iqbal Yatoo M, Patel SK, Natesan S, Dhama J, Malik YS, Harapan H, Singh RK, Dhama K.. Antibody-Based immunotherapeutics and use of convalescent plasma to counter COVID-19: advances and prospects. Expert Opin Biol Ther. 2020;20(9):1033–46. doi:10.1080/14712598.2020.1796963. - DOI - PubMed
12. Ghareeb DA, Saleh SR, Nofal MS, Kaddah MMY, Hassan SF, Seif IK, El-Zahaby SA, Khedr SM, Kenawy MY, Masoud AA. Potential therapeutic and pharmacological strategies for SARS-CoV2. J Pharm Investig. 2021;51(3):281–96. doi:10.1007/s40005-021-00520-4. - DOI - PMC - PubMed
13. Wang X, Meng D. Innate endogenous adjuvants prime to desirable immune responses via mucosal routes. Protein Cell. 2015;6(3):170–84. doi:10.1007/s13238-014-0125-1. - DOI - PMC - PubMed
14. Aoshi T. Modes of action for mucosal vaccine adjuvants. Viral Immunol. 2017;30(6):463–70. doi:10.1089/vim.2017.0026. - DOI - PMC - PubMed
15. Gallo O, Locatello LG, Mazzoni A, Novelli L, Annunziato F. The central role of the nasal microenvironment in the transmission, modulation, and clinical progression of SARS-CoV-2 infection. Mucosal Immunol. 2021;14(2):305–16. doi:10.1038/s41385-020-00359-2. - DOI - PMC - PubMed
16. Bharat Biotech’s nasal vaccine can be a gamechanger in fight against Covid: all you need to know.