Effectiveness and Managing Patients with Covid-19 Disease with Monoclonal Antibodies

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Modern antibody drugs have fewer adverse effects because they are highly specific. Hence, therapeutic healthcare professionals predominantly use therapeutic antibodies as a new class of drugs developed over the past decades. The pharmaceutical market has experienced a surge in the use of antibody drugs. During the Covid-19 pandemic, healthcare professionals adopted monoclonal antibodies (mAbs) to treat patients with Coronavirus infection. The rationale for monoclonal antibody therapy is that most common antiviral drugs proved less effective in treating Covid-19. Besides, the virus had different strains. As a result, it was necessary to develop antigen-specific antibodies by developing monoclonal antibodies specific to the Covid-19 virus. Understanding the development of monoclonal antibodies for Covid-19 treatment is vital in determining monoclonal antibody therapy's effectiveness, benefits, and risks.

Therapeutic Monoclonal Antibody technique

B cells produce monoclonal antibodies (mAbs) that target specific antigens. Lu et al. (2020) report that Köhler and Milstein introduced the hybridoma technique in 1975 to obtain pure monoclonal antibodies in large amounts. The hybridoma technique improved basic research and the potential for the clinical therapeutic use of monoclonal antibodies (mAbs) (Lu et al., 2020). The United States Food and Drug Administration (US FDA) has approved approximately 19 currently on the market (Lu et al., 2020). Over the past 25 years, therapeutic monoclonal antibodies (mAbs) have become a more predominant treatment method for various diseases (Lu et al., 2020). Monoclonal antibodies are divided into humanized, human, murine, and chimeric. However, humanized and human monoclonal antibodies (mAbs) are the predominant forms of therapeutic antibodies (Lu et al., 2020). Lu et al. (2020) state that the generation of fully human antibodies occurs through transgenic mice, phage display, and single B cell antibody isolation.

The phage technique is the most commonly used in-vitro antibody selection. Antibody-library construction helps in the identification of monoclonal antibodies (mAbs) from the phage-displayed library. The phage technique involves the isolation of fully human-derived monoclonal antibodies (mAbs) from large Ig gene repertoires displayed on the surfaces of bacteriophages (Alfaleh et al., 2020). Filamentous phages can display peptides of interest on their surfaces following the interstation of a foreign DNA fragment into the protein gene coat of the filamentous phage (Alfaleh et al., 2020). One of the most commonly used phages for antibody display is M13, a filamentous bacteriophage of Escherichia Coli (E. coli) (Alfaleh et al., 2020). Alfaleh et al. (2020) report that the antibody phage display is a highly versatile in vitro selection technique for discovering high-affinity antibodies that specifically target many antigens. As a result, Alfaleh et al. (2020) report that therapeutic mAbs successfully treat specific diseases due to high affinity, specificity, viscosity, solubility, thermal and long-term stability, and expression yield.

Application of monoclonal antibodies to treat Covid-19

Due to the specificity of monoclonal antibodies in targeting specific antigens, they have proven to be valuable therapeutic tools for treating Covid-19. The National Institute of Health [NIH] (2023) reports that monoclonal antibodies (mAbs) that target the Covid-19 antigen, known as SARS-CoV-2 spike proteins, have clinical benefits for treating the SARS-CoV-2 infection. The Food and Drug Administration (FDA) provided Emergency Use Authorizations (EUA) for four anti-SARS-CoV-2 mAb products, including casirivimab plus imdevimab, sotrovimab, bamlanivimab plus etesevimab, and bebelovemab for treating outpatients suffering from mild to moderate Covid-19 (NIH, 2023). The FDA provided an EUA for using tixagevimab plus cilgavimab as a Covid-19 pre-exposure prophylaxis in 2021 (NIH, 2023). NIH (2023) reports

that tixagevimab plus cilgavimab contains two recombinant human monoclonal antibodies (mAbs) that bind to nonoverlapping epitopes of the spike protein receptor of SARS-CoV-2.

Therefore, the monoclonal antibodies (mAbs) prevent the attachment of the SARS-CoV-2 by blocking the binding of the virus to human angiotensin-converting enzyme 2 (ACE2) receptors abundantly expressed on the respiratory epithelium (Wood et al., 2022). For example, Sotrovimab (VIR-7831) is a potent anti-spike neutralizing mAb with in vitro activity against all four variants of Covid-19 (Wood et al., 2022). One dose of sotrovimab reduces the risks of death and hospitalization due to Covid-19 by 85% among high-risk non-hospitalized patients suffering from mild to moderate Covid-19 (Wood et al., 2022). Using monoclonal antibodies is vital in managing mild to moderate cases of Covid-19. As a result, monoclonal antibodies can be effective in the early stages of Covid-19 infection by preventing the binding of the Covid-19 antigens. Therefore, the healthcare system should use monoclonal antibodies as a preventive measure against infection by Covid-19.

Effectiveness of Monoclonal Antibodies in Managing Covid-19 Patients

Monoclonal antibody therapy has proven effective in hospitalizations and deaths among patients with mild to moderate cases of the Covid-19 disease. According to Mutoh et al. (2022), administering monoclonal antibody therapy via a risk-scoring system significantly reduces the number of hospitalizations and severity of the Covid-19 disease. Besides, monoclonal antibody therapy for Covid-19 disease does not result in any severe adverse events (Mutoh et al., 2022). Ideally, monoclonal antibody therapy curbs the replication of SARS-CoV-2 by blocking its binding to the ACE2 receptors. As a result, the treatment technique leads to the gradual death of the virus due to the lack of ACE2 receptor binding sites. Monoclonal therapy is highly effective in preventing infection as pre-exposure prophylaxis. The therapy also prevents the Covid-19

disease from developing to severe levels, possibly increasing the risk of hospitalization and death.

Ideally, a medication that prevents infection is the best strategy to manage the infection. O'Horo et al. (2022) report that anti-spike monoclonal antibodies have been highly effective in preventing severe outcomes of the Covid-19 disease, such as hospitalization and death. However, monoclonal antibodies target specific strains of the SARS-CoV-2 variants. Therefore, monoclonal antibodies targeting sing strains may be less effective in areas with numerous variants of the SARS-CoV-2. Wood et al. (2022) counter the challenge above by stating that monoclonal antibodies like Sotrovimab (VIR-7831) have an in vitro activity against all the four variants of the Covid-19 disease, including "Alpha (B.1.1.7), Beta (B.1.351), Gamma(P1), and Delta (B.1.617.2)". As a result, one dose of the drug is effective in minimizing the risk of hospitalization and deaths in areas with many variants of the SARS-CoV-2 making it highly effective in preventing and managing patients with mild to moderate cases of Covid-19 disease.

Nursing Process

Nursing practice and healthcare practice are constantly evolving. Monoclonal antibody administration typically requires a specialized subset of RNs who have completed dedicated training in the administration of these agents. In some instances, this training may be met by completion of antineoplastic training programs. This ensures a safe administering of the treatment. The nurses are trained for Infusion procedures, drug/dose verification procedures, monitoring considerations, anticipated side effects, procedures for safe handling and disposal. Two professionals deemed competent in the administration of monoclonal antibodies are present to have independent verification of patient identification, dose name and dose, and the route and rate of administration. Staffing provisions need to account for the high vulnerability of patients

with compromised immune systems in proximity to COVID-19 positive patients. Patients with a known COVID-19 diagnosis should be cared for by a designated cohort of nurses to prevent the risk of cross-contamination throughout the nursing staff.

Administration of the drug for at least 28 days after admission was demonstrated to decrease hospitalizations, especially in patients at the highest risk of deterioration (Graham et al., 2022). However, administration of the drug in hospitalized patients receiving oxygen therapy is associated with poor outcomes (Graham et al., 2022). This study established that emergency department embedded infusion centers could be successfully implemented to provide optimal care for patients receiving monoclonal antibody treatment (Graham et al., 2022). Nurses at the infusion centers are best equipped to manage such conditions, and the patients can benefit from the positive effects of monoclonal antibody treatment.

Benefits and Risks of Monoclonal Antibodies in Treating Covid-19

The primary benefit of monoclonal antibody therapy is the prevention of the severity of Covid-19 disease. According to Brobst & Borger (2021), monoclonal antibody therapy is beneficial because it reduces hospitalizations, viral load, and death. Indeed, monoclonal antibody therapy saves lives by curbing the severity of the Covid-19 disease. Addressing the infection in its early stages and preventing its proliferation via the monoclonal antibody technique has been beneficial in reducing mortality due to the Covid-19 disease. Moreover, the monoclonal antibody technique has facilitated social distancing by preventing hospital crowding. Another benefit of monoclonal antibody therapy is that one drug can target all four variants of SARS-CoV-2. For instance, sotrovimab prevents the binding of all four strains of SARS-CoV-2 from binding to the human ACE2 receptors.

However, monoclonal antibody therapy may pose risks to the patients. Brobst & Borger (2021) report that some patients may experience allergic and non-allergic infusion-related reactions resulting from the activation of the immune system to respond to the antibody. Despite infusion reactions being rare, they can lead to itching, flushing, low blood pressure, and shortness of breath (Brobst & Borger, 2021). Other side effects of receiving monoclonal antibodies intravenously include soreness, pain, and bruising at the site of the injection (Brobst & Borger, 2021). The risks of monoclonal antibody therapy are common side effects of most vaccines and injections and do not put the patients at risk of hospitalization or death. Therefore, the risks should not prevent patients from receiving monoclonal antibody therapy.

Conclusion

Coronavirus disease 2019 (Covid-19) affected many people, and the lives lost were massive. The definitive treatment of the condition has to be discovered and continuous research is the most suitable approach at obtaining functional methods of managing the disease. Various interventions for the disease, including antiviral drugs, anti-inflammatory medications, and antibiotics, have been used to varying degrees of effectiveness. The role of monoclonal antibodies in reducing the progression and severity of the disease is one that has shown massive benefits in the outpatient settings, hence the need to incorporate the drugs in the treatment of the condition. Monoclonal antibodies prevent SAR-CoV-2 spike proteins receptor-binding domains from binding on the human ACE2 receptors. As a result, monoclonal antibodies apply in the pre-exposure prophylaxis of the Covid-19 disease. Monoclonal antibodies effectively prevent the severity of Covid-19 disease in persons with mild to moderate Covid-19 disease. Patients should not shy from getting monoclonal antibody therapy because the risks do not threaten human health.

References

Alfaleh, M. A., Alsaab, H. O., Mahmoud, A. B., Alkayyal, A. A., Jones, M. L., Mahler, S. M., & Hashem, A. M. (2020). Phage Display Derived Monoclonal Antibodies: From Bench to Bedside. *Frontiers in Immunology*, *11*. https://doi.org/10.3389/fimmu.2020.01986

Brobst, B., & Borger, J. (2021). *Benefits And Risks Of Administering Monoclonal Antibody Therapy For Coronavirus (COVID-19)*. PubMed; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK574507/

Graham, J., Ballejos, C., Jenkins, D., & Kelley, C. (2022). Implementation of an emergency department–embedded infusion center for the administration of monoclonal antibody therapy in patients with early COVID-19 infection. *Journal of Infusion Nursing*, *45*(1), 41-48. https://doi.org/10.1097/nan.0000000000000453

Lloyd, E. C., Gandhi, T. N., & Petty, L. A. (2021). Monoclonal Antibodies for COVID-19. *JAMA*, *325*(10), 1015. https://doi.org/10.1001/jama.2021.1225

Lu, R.-M., Hwang, Y.-C., Liu, I-Ju., Lee, C.-C., Tsai, H.-Z., Li, H.-J., & Wu, H.-C. (2020). Development of therapeutic antibodies for the treatment of diseases. *Journal of Biomedical Science*, *27*(1). https://doi.org/10.1186/s12929-019-0592-z

Mutoh, Y., Umemura, T., Ota, A., Okuda, K., Moriya, R., Tago, M., Soejima, K., Noguchi, Y., Bando, T., Ota, S., Sato, T., Hirota, S., Hagimoto, S., Takei, R., Sasano, H., Yamano, Y., Kataoka, K., Yokoyama, T., Matsuda, T., & Kimura, T. (2022). Effectiveness of monoclonal antibody therapy for COVID-19 patients using a risk scoring system. *Journal of Infection and Chemotherapy*, *28*(2), 352–355. https://doi.org/10.1016/j.jiac.2021.11.022

National Institute of Health [NIH]. (2023). *Anti-SARS-CoV-2 Monoclonal Antibodies*. COVID-19 Treatment Guidelines. https://www.covid19treatmentguidelines.nih.gov/therapies/antivirals-including-antibody-products/anti-sars-cov-2-monoclonal-antibodies/

O'Horo, J. C., Challenger, D. W., Speicher, L., Bosch, W., Seville, M. T., Bierle, D. M., Ganesh, R., Wilker, C. G., Arndt, R. F., Arndt, L. L., Tulledge-Scheitel, S. M., Hanson, S. N., & Razonable, R. R. (2022). Effectiveness of Monoclonal Antibodies in Preventing Severe COVID-19 With Emergence of the Delta Variant. *Mayo Clinic Proceedings*, *97*(2), 327–332. https://doi.org/10.1016/j.mayocp.2021.12.002

Wood, D. A., Aleem, A., & Davis, D. (2022). *Providing Access To Monoclonal Antibody Treatment Of Coronavirus (COVID-19) Patients In Rural And Underserved Areas*. PubMed; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK574538/