Monoclonal Antibodies to Disrupt Progression of Early Covid-19 Infection

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By the end of 2020, more than 19 million Americans had received the diagnosis of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection.[1] Although a substantial proportion of these infections remained asymptomatic, complications of coronavirus disease 2019 (Covid-19) had led to more than 330,000 deaths in the United States.[1] During the past year, a remarkable effort has been devoted to the development of vaccines to prevent Covid-19 and to reduce morbidity and mortality among those who are infected. Equally important is the development

of treatments that can prevent the progression of Covid-19 from the inception of infection.

In this issue of the *Journal*, two groups of investigators report the findings of trials of such treatments involving patients with Covid-19. In the first trial, Weinreich et al.[2] report interim results of a trial of a combination of two monoclonal antibodies, casirivimab and imdevimab (together called REGN-COV2), which is directed against the spike protein of SARS-CoV-2[3] for use in patients with early infection. The trial enrolled outpatients who had presented within 7 days after the onset of symptoms and within 72 hours after a positive result on quantitative reverse-transcriptase–polymerase-chain-reaction (RT-PCR) testing of nasopharyngeal swab samples. The patients were randomly assigned in a 1:1:1 ratio to receive a single intravenous infusion of either 2.4 g or 8 g of REGN-COV2 or placebo. Key end points were the change from baseline in viral load from day 1 through day 7 and the percentage of patients who had at least one Covid-19–related medically attended visit through day 29.

In the first 275 patients, those who received either dose of REGN-COV2 had lower SARS-CoV-2 RNA levels than those who received placebo. Patients who had not had an autologous antibody response at the time of randomization had a higher baseline nasopharyngeal RNA viral load and a steeper reduction in viral load after the administration of REGN-COV2 than those who were seropositive at randomization. A small number of patients (12) required a medically attended visit within the 29-day follow-up period, with a larger percentage in the placebo group.

These results complement the findings of a trial by Chen et al.,[4] who evaluated three doses (700 mg, 2800 mg, and 7000 mg) of a single monoclonal antibody, bamlanivimab (LY-CoV555),[5] which was administered to 452 outpatients who presented with Covid-19 a median of 4 days after symptom onset; 309 patients received bamlanivimab, and 143 received placebo. Reductions in nasopharyngeal RNA levels of SARS-CoV-2 were detected after 3 days of treatment in all groups, with a greater decline in the combined-dose bamlanivimab group than in the placebo group. Through day 29, hospitalization was reported in 14 patients: 5 (1.6%) in the bamlanivimab group and 9 (6.3%) in the placebo group. Bamlanivimab was associated with a greater reduction in

symptoms of Covid-19 than was placebo. In a continuation of this clinical trial, patients are now receiving a combination of bamlanivimab and etesevimab (LY3832479) to overcome or prevent antibody resistance (ClinicalTrials.gov number, NCT04427501).

These studies used the measurement of SARS-CoV-2 with RT-PCR as a surrogate for the magnitude of viral infection and perhaps viral replication.[6] The results suggest that monoclonal antibodies serve as an antiviral agent to reduce the viral load in the nasopharynx. The effects of monoclonal antibodies and other drugs on viral load may prove to be an important criterion for the development of agents to treat early Covid-19. In the trial by Chen et al., patients with persistently high nasopharyngeal RNA shedding on day 7 were more likely to be hospitalized than those with lower levels (12% vs. 0.9%). This finding suggests that persistent SARS-CoV-2 replication in the nasopharynx portends progression of Covid-19, which may be limited by early antibody treatment or by a rapid autologous immune response.

The results reported by Weinreich and Chen and their colleagues provided key information for the Food and Drug Administration to consider in its decision regarding emergency use authorization for bamlanivimab[7] and the casirivimab–imdevimab combination[8] for adults and children over the age of 12 years who have mild or moderate Covid-19 and are at high risk for severe disease. No added benefit for these antibodies was shown in trials involving sicker hospitalized patients (NCT04426695 and NCT04342897), perhaps because in later stages of the disease, inflammation and coagulopathy play a greater role in the patient's outcome than viral replication.

Such monoclonal antibodies may also be successful in preventing SARS-CoV-2 infection[9] as an alternative to vaccination for people who cannot take a vaccine or need more immediate prophylaxis either before or after exposure. Trials of such prophylaxis are ongoing in skilled nursing facilities (NCT04497987) and among household contacts of patients with SARS-CoV-2 infection (NCT04452318). Dozens of investigators and companies are working on additional antibodies, which include modifications designed to prolong the in vivo half-life of these drugs or to allow intramuscular or subcutaneous delivery.[10]

The findings from these two clinical trials are provocative and promising. Eli Lilly and Regeneron are greatly expanding their studies to better define the clinical benefits of their monoclonal antibodies, and Operation Warp Speed and the National Institutes of Health plan to compare several such antibodies for treatment in their ACTIV-2 trial involving outpatients with Covid-19 (NCT04518410). If these drugs prove to provide reliable early treatment of Covid-19, they will greatly improve the management of the infection. Such treatments are logistically challenging but should inspire early and rapid testing of persons at high risk for SARS-CoV-2 infection. Interventions that prevent the progression of Covid-19 can then be expected to reduce the morbidity and mortality of infection, the frequency of hospitalizations, and the current unbearable strain on the U.S. health care system.

Disclosure forms provided by the author are available with the full text of this editorial at NEJM.org.

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