TechNote TN-08

Juli 2021

Verification of immune response after SARS-CoV-2 vaccination Vaxzevria (COVID-19 Vaccine AstraZeneca) using TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test

Summary

The rapid increase in prophylactic vaccinations against the SARS-CoV-2 virus requires simple, scalable and cheap methods for detecting immune status in the population. So-called antibody rapid tests allow for rapid detection, but are generally less sensitive than laboratory-based methods. The aim of this study was to test the sensitivity of the TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test, which targets the RBD domain of the S1 protein to detect an immune response in vaccinated individuals.

The results show that the test was able to reliably detect IgG antibodies in the capillary blood after the second partial vector vaccination in 100% of the participants. Noteworthy, the IgG can also be detected 3 weeks after the first vaccination, but dropped again below the detection limit until the second part of the vaccine was applied.

Introduction

Coronavirus disease 2019 (Covid-19) has affected more than 100 million people (https://coronavirus.jhu.edu/map.html) worldwide since it was declared a pandemic by the World Health Organization (WHO) on March 11, 2020. Effective prophylactic vaccines are urgently needed to contain this pandemic and to curb potentially devastating medical, economic and social consequences. Many vaccine candidates are in clinical development and by July 2021, four vaccines have been approved in the European Union for use in patients.

Prophylactic vaccinations are vector or mRNA-based and aim to form neutralizing antibodies against the receptor-binding domain of the SARS-CoV-2 virus. This is to block the absorption of the virus into the target cells via the ACE-2 receptor and thus to suppress the reproduction of the virus in the host organism.

The effectiveness of these vaccines can therefore be demonstrated by the specific detection of antibodies against the RBD domain of the spike protein.

The TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test is an immunochromatographic test for fast (<15 min), qualitative detection of the IgM and IgG antibody against SARS coronavirus 2 (SARS-CoV-2) in human whole blood, serum or plasma. In an independent validation study of the Medical University of Innsbruck with 350 samples, a sensitivity of 98.25% and a specificity of 100% was demonstrated. Thus, the test is comparable to the quality of ELISA tests, with

the advantage that the TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test can be performed on site without laboratory infrastructure.

Aim

The aim of the study was to measure the immune response after vaccination with the Vaxzevria (Adenovirus-vaccine/formerly AstraZeneca) in adult healthy volunteers using the antibody rapid test system produced by TAmiRNA.

- The main objective of this study was to determine whether the TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test is sufficiently sensitive to detect the IgM and IgG mediated immune response to the Vaxzevria vaccine with the RBD domain of the S1 protein in capillary blood samples.
- The secondary objective of this study was to determine the time of the first/second vaccination from which IgM and/or IgG antibody levels are detectable using the rapid antibody test directed against the S1 protein.

Study protocol

All participants were voluntarily, older than 18 years, and had been tested exclusively negatively for SARS-CoV-2 since the start of the pandemic, and thus seronegative with respect to SARS-CoV-2 S1 IgG and IgM antibodies at the beginning of the study. All participants were trained at the beginning of the study in the safe and correct application of the antibody rapid test. After the training, all participants received nine antibody tests and the necessary accessories for self-use, as well as a template for documenting the test results.

Antibody tests were carried out weekly from day 7 after the first partial vaccination up to 14 days after the second partial vaccination (see Figure 1). All participants were tested weekly for SARS-CoV-2 infections using PCR during the study.

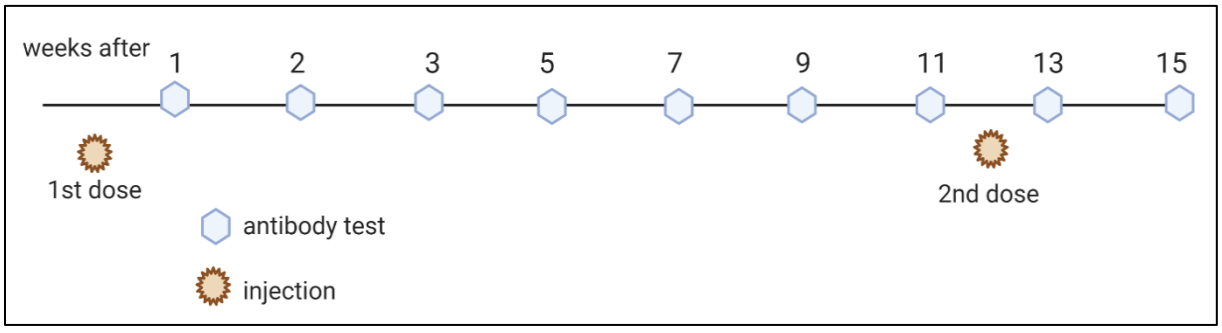

Figure 1: Timeline of the study

Material and methods

TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test

This test is based on the principle of immunochromatographic detection of SARS-CoV-2-IgG/IgM antibodies with specificity against the S1 protein in human whole blood, serum and plasma.
The sample is absorbed into the cassette by capillary action after dropping into the sample window, mixes with the SARS-CoV-2 antigen dye conjugate and flows through the pre-coated membrane (see Figure 2).

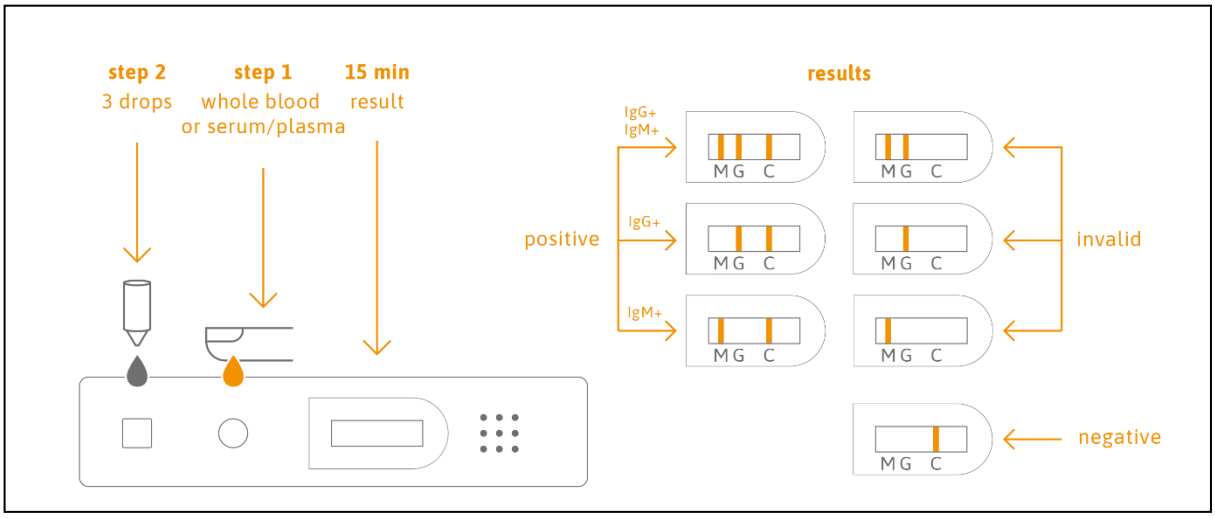

Figure 2: Test method and evaluation of test results

The antibodies of class IgM/IgG formed by the immune system of the infected against the SARS-CoV-2 in the sample react with the recombinant SARS-CoV-2 antigen bound to gold particles. This complex travels along the membrane and reaches the test lines to which a monoclonal anti-human IgM/IgG antibody directed against the SARS-CoV-2-IgM/IgG complex is bound. If the SARS-CoV-2 antibody level in the sample is zero or below the target limit, there is no visible colored band. This indicates a negative result.

Collection of capillary blood with a lancet

A safety lancet was used to make a finger prick. 20µL (one drop) whole blood was collected and with the help of the pipette included in the test and dropped into the sample window of the test cassette. Afterwards, 120µL (3 drops) sample buffer was applied in the buffer window. The results were evaluated after 15minutes.

Evaluation

The results of the antibody tests were independently read, photographed and documented by all test subjects.

Only valid test results (with visible C-band) were considered for the evaluation. IgM and IgG bands were interpreted as negative or positive.

Results

In total, 9 patients were evaluated, however not all test persons were able to provide data from all 9 time points.

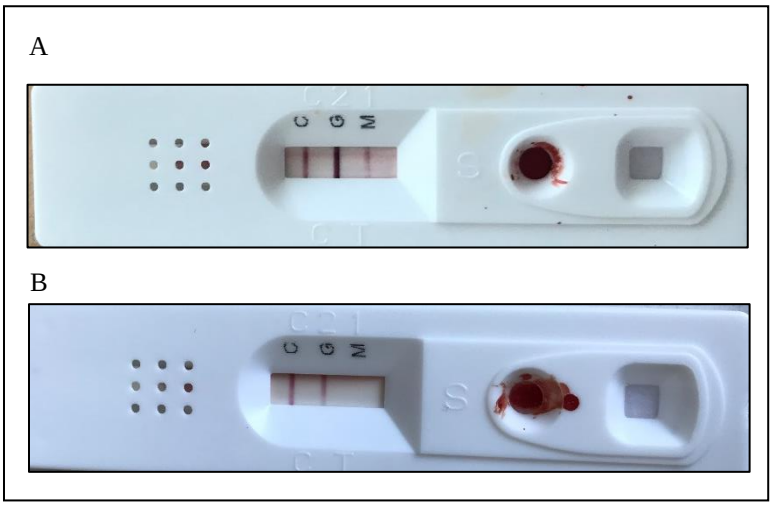

Figure 3: Representative TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test Results. 3A: IgM/IgG positive test on week 15 3B: IgG positive / IgM negative test on week 7 the first vaccination.

Within 3 weeks after the first vaccination, IgG antibodies were detected using the TAmiRNA SARS-CoV-2 IgM/IgG antibody test in 100% of the participants. However, between week 7 and 11 the antibody titer dropped so that 11 weeks after the first vaccination (= one week prior to the second vaccination) only 62.5% of the tests were still positive for IgG while none were positive for IgM. One week after the 2nd vaccination the detection rate of IgG had again reached 100%, while IgM antibodies were only detected in 57% (Figure 4).

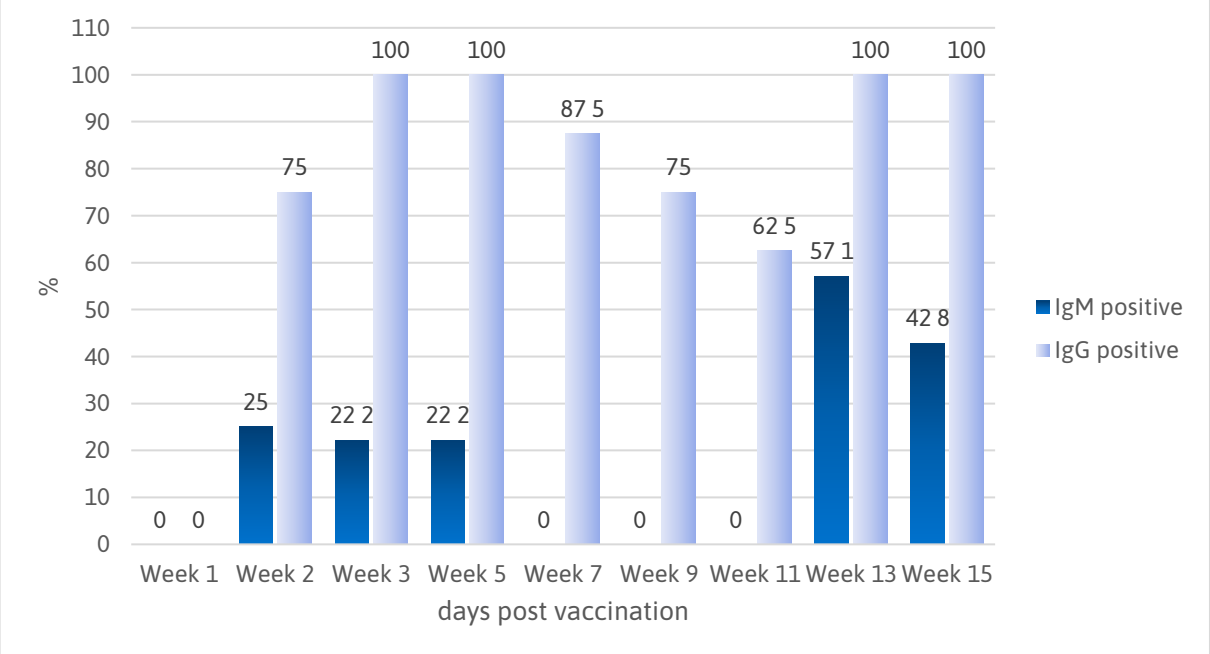

Figure4: Overview of the time-dependent detectability of IgM and IgG antibodies over the entire duration of the study. The frequency of positive results for IgM (dark blue) and IgG antibodies (light blue) is given in percent.

Discussion

The aim of this study was to investigate whether SARS-CoV-2 antibody rapid tests using S1 protein are sufficiently sensitive to detect the immune responses of subjects after immunization with the Vaxzevria vector vaccine. It has been demonstrated that the TAmiRNA SARS-CoV-2 IgM/IgG Antibody Rapid Test can detect IgG antibodies against S1-RBD in capillary whole blood.

However, when using the test for the detection of antibodies in regard to the Vaxzevria vaccination there is a time dependent effect. It is advised to use the rapid test to confirm the antibody-based immune response after the administration of the second vaccine dose. This recommendation is based on the observed decrease of IgG antibody titers below the detection limit in 40% of the tested subjects. IgM detection rates were low throughout the observation period of 15 weeks, with a peak of 57.1% positive tests one week after the second immunization with Vaxzevria.