Are mRNA Vaccines Contributing to the Rise of Heart Conditions in Young Adults?

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Introduction

SARS-CoV-2, was originally discovered in Wuhan, China, in December 2019. The virus is spread from person to person through respiratory droplets when an infected person talks, coughs, or sneezes. It is thought to have originated from bats. Since then, the virus has quickly spread over the globe, causing the ongoing COVID-19 pandemic. All ages are affected by COVID-19, which can cause minor symptoms like fever, coughing, and exhaustion as well as severe ones like pneumonia and respiratory failure. This has lead to an increase in heart problems among young adults, this is the analysis of different studies done on various Covid mRNA vaccine brands and how they affected the human body.

Background

mRNA, also known as messenger RNA, is a molecule that holds the instructions or recipe that tells the cells to use their natural machinery to build a protein. mRNA travels inside a protective bubble known as a Lipid Nanoparticle that allows it to enter cells smoothly. Once inside, our cells use the mRNA as a set of instructions to create proteins that resemble antigens, which are components of the pathogen. These foreign antigens are seen by the immune system as intruders, prompting the dispatch of T-cells and antibodies as well as conditioning the immune system for potential future assaults. Therefore, if and when the true virus appears, the body may be able to identify it and raise the alert to help the body fight off infection and disease.

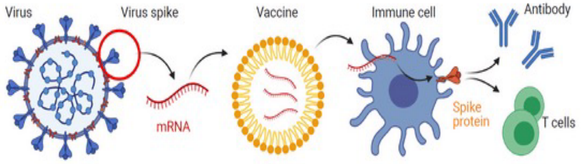

Figure 1: This shows shows how the mRNA vaccine works to create antibodies. The genetic sequence of the virus spike is used to make a synthetic mRNA sequence - the instructions make the spike protein. The mRNA is packaged into nano particles the vaccine which can deliver the mRNA to immune cells. The immune cells follow the mRNA code to produce spike protein, which is displayed on the cell surface. This stimulates an immune response

Methodology

- Few studies discussed will highlight some of the most observed heart complication seen in patients that received the covid 19 vaccines doses.
- According to study research published in the BMJ journal they analyzed risks of Thrombocytopenia and Thromboembolism after COVID-19 vaccination and SARS-Cov-2.
- self-controlled case series study of individuals who received vaccinations in England between December 1, 2020, and April 24, 2021, was conducted.
- 28 days after three exposures—the first dosage of Astra-Zeneca (ChAdOx1nCoV-19), and the first dose ofBNT162b2 mRNA
- positive SARS-CoV-2 test—the key outcomes were hospital admission for or death from thrombocytopenia and venous and arterial thromboembolic events
- They carried out pre-specified analyses for the secondary outcomes, including myocardial infarction, ischemic stroke, cerebral venous sinus thrombosis (BMJ et al. 2021)

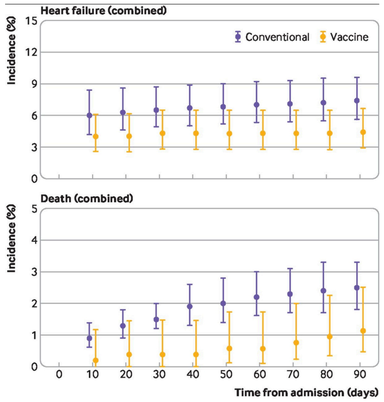

Figure 2: Cumulative incidences of heart failure and death, combined from all countries, during follow-up (at multiples of 10 days) in the Nordic myocarditis cohort, for patients with myocarditis associated with SARS-CoV-2 mRNA vaccination and patients with conventional myocarditis

Results

As seen from all the studies, reviews, and research mentioned above the different types of vaccines are having different reactions on people. Whether it be in the U.S or in other countries the mRNA vaccines are leading to cardiac complications in old and young adults.

- SARS-CoV-2 virus, which causes COVID-19, has a protein on its surface. MRNA vaccines are a new type of vaccine that employ a portion of messenger RNA (mRNA) to direct cells in the body to create that protein.
- The immune system generates an immunological reaction to this protein because it perceives it as being alien.
- immune system learns to identify and recall the virus as a result of this reaction, which can help ward off further infection.
- The body's cells use their internal machinery to generate viral protein after absorbing the mRNA. The immune system responds to this by producing antibodies against the virus.
- The mRNA is subsequently broken down and expelled from the body. When taking these vaccines the body's immune system produces antibodies against the SARS-CoV-2 virus that causes COVID-19.
- some cases, this immune response can also cause the immune system to attack the heart muscle or the lining around the heart which can lead to clots and other cardiac complications.
- Throughout we have seen studies that indicate numbers to increased risk of VTE and CVST along with thrombosis, thromboembolisms, myocarditis and pericarditis.

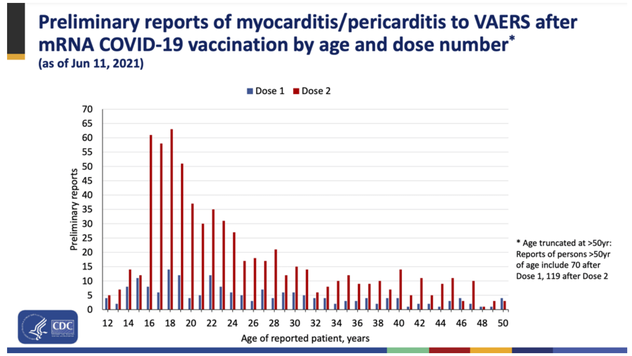

Figure 3: there have been 267 cases of myocarditis or pericarditis reported after receiving one dose of the mRNA vaccines and 827 reported cases after two doses through June 11. There are 132 additional cases where the number of doses received is unknown. CDC,

Conclusions

Different study's findings can help practicing doctors and other healthcare professionals by enabling them to better counsel patients on the safety and potential negative effects of vaccines.

- Before selecting a particular type of vaccine, healthcare professionals should discuss all potential risk factors (CDC et al 2021).
- Patients with a higher risk of myocarditis/pericarditis or those with a history of cardiomyopathy may opt instead for the viral vector vaccine.
- Pfizer-BioNTech and Moderna COVID-19 vaccines are examples of mRNA vaccines that represent a new approach to vaccine development.
- These vaccines direct the body's cells to create a portion of the virus' spike protein using genetic material (mRNA).

Future Directions

Info we need to prevent these complications include knowing more about what and how the heart reacts to the vaccine in live time.

- Many more studies with people that already have complication in the heart vs. people who do not and see what changes occur after receiving both covid vaccines.
- potential implications in the creation of vaccines for various infectious diseases and potentially some non-communicable diseases, mRNA technology is likely to remain an area of intense study and development in the future (Guan et al 2020).
- To completely comprehend the long-term safety and efficacy of mRNA vaccines, regular monitoring and study will also be carried out (Guan 2020).
- Newer studies and experiments are needed to further investigate side effects of mRNA vaccines and its connection to cardiac dysfunctions.
- To prevent these complications more study is needed on the mRNA vaccines specifically in how it functions and why it affects the heart so much.
- newer studies should include people of all different ages and backgrounds and be tested for a certain amount of time after getting the covid doses.

References:
Cari, Luigi et al. "Cardiovascular, neurological, and pulmonary events following vaccination with the BNT162b2, ChAdOx1 nCoV-19, and Ad26.COV2.S vaccines: An analysis of European data." *Journal of autoimmunity* vol. 125 (2021): 102742. doi:10.1016/j.jaut.2021.102742
Chowdhury, Mohammad Asaduzzaman et al. "Immune response in COVID-19: A review." *Journal of infection and public health* vol. 13,11 (2020): 1619-1629. doi:10.1016/j.jiph.2020.07.001
Fazlollahi, Asra et al. "Cardiac complications following mRNA COVID-19 vaccines: A systematic review of case reports and case series." *Reviews in medical virology* vol. 32,4 (2022): e2318. doi:10.1002/rmv.2318
Fatima, Maurish et al. "Development of myocarditis and pericarditis after COVID-19 vaccination in adult population: A systematic review." *Annals of medicine and surgery (2012)* vol. 76 (2022): 103486. doi:10.1016/j.amsu.2022.103486
Guan, Wei-Jie et al. "Clinical Characteristics of Coronavirus Disease 2019 in China." *The New England journal of medicine* vol. 382,18 (2020): 1708-1720. doi:10.1056/NEJMoa2002032
Hippisley-Cox J, Patone M, Mei X W, Saatci D, Dixon S, Khunti K et al. Risk of thrombocytopenia and thromboembolism after covid-19 vaccination and SARS-CoV-2 positive testing: self-controlled case series study *BMJ* 2021; 374 :n1931 doi:10.1136/bmj.n1931
Oakley CM, Myocarditis, pericarditis and other pericardial diseases *Heart* 2000;**84:**449-454.
Park, Jung Woo et al. "mRNA vaccines for COVID-19: what, why and how." *International journal of biological sciences* vol. 17,6 1446-1460. 10 Apr. 2021, doi:10.7150/ijbs.59233
Schlake, Thomas et al. "Developing mRNA-vaccine technologies." *RNA biology* vol. 9,11 (2012): 1319-30. doi:10.4161/rna.22269
Sharff, Katie A et al. "Risk of myopericarditis following COVID-19 mRNA vaccination in a large integrated health system: A comparison of completeness and timeliness of two methods." *Pharmacoepidemiology and drug safety* vol. 31,8 (2022): 921-925. doi:10.1002/pds.5439
Singhal, Tanu. "A Review of Coronavirus Disease-2019 (COVID-19)." *Indian journal of pediatrics* vol. 87,4 (2020): 281-286. doi:10.1007/s12098-020-03263-6
Tuvali, Ortal et al. "The Incidence of Myocarditis and Pericarditis in Post COVID-19 Unvaccinated Patients-A Large Population-Based Study." *Journal of clinical medicine* vol. 11,8 2219. 15 Apr. 2022, doi:10.3390/jcm11082219