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Incidence of Myocarditis- Post COVID-19 Vaccination

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Abstract:
The objective of this study is to understand the epidemiological and clinical picture of COVID-19 Vaccine related Myocarditis.
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I. Introduction

Myocarditis is the inflammation seen in the heart muscle and this inflammation leads to reduction in the heart's ability to pump blood. Myocarditis is caused commonly by an infection in the body and can be infections from viruses like common cold, influenzas and COVID 19 or by bacteria, fungus, parasites. [(1)] Myocarditis can weaken the heart muscle as well as the electrical system that keeps the heart pumping normally. Some people with myocarditis require medication just for few months and can resolve fully on its own or with treatment and in some it can lead to lasting heart damage [(2)]. Previous research from around the world, including reports from centers for disease control and prevention has shown a potential increased risk of myocarditis post mRNA covid19 vaccine. It was also observed **i**ncidence of myocarditis was threefold higher after a second dose of the mRNA Moderna Spikevax COVID 19 vaccine when compared to Pfizer or BioNTech COVID 19 vaccine. [(2)]

HISTORY

Myocarditis is reported post COVID-19 vaccination and when reported the cases are seen in adolescent and young adult males, within several days after mRNA COVID-19 Vaccination Pfizer-BioNTech or Moderna [(3)]. In April 2021 increased cases of myocarditis was reported in united states after mRNA COVID-19 Vaccination within 7 days after receiving second dose of mRNA COVID-19 Vaccine Pfizer-BioNTech and Moderna. [(4)]

Components of the vaccine:

mRNA COVID-19 vaccine consists of four main components, a neutral phospholipid, cholesterol, a polyethylene- glycol (PEG)-lipid, and an ionizable cationic lipid. And Moderna COVID-19 Vaccine, Bivalent contain the followingingredients: messenger ribonucleic acid, lipids, cholesterol, and 1,2-distearoyl-sn-glycero-3 phosphocholine. [(5)]

The Moderna doses have more than 3 times the amount of mRNA materials compared to Pfizer also the dose spacing is also different, three weeks apart for Pfizer and four Weeks for Moderna, Also Moderna elicits a stronger immune response and is better at preventing break through infections only demerit founded was it involves in conditions like myocarditis. The Moderna COVID-19 Vaccine is Authorized in individuals in 6 months of age and older as primary dose. [(6)]

SOURCE USED TO MAKE IT:

Most vaccines contain a weakened or dead bacteria or virus. Scientists have developed a new type of vaccine that uses a molecule called messenger RNA (mRNA). mRNA vaccine contains no animal products or preservatives. mRNA vaccine has shown notable effectiveness in disease prevention and have attracted public attention. [(7)]

To make mRNA vaccine, scientists must first identify a protein on the outside of the virus that the body's immune response will respond to the target protein. The protein they choose must be sufficiently different from proteins on the outside of the body's own cells, so the immune system only attacks the virus. They then identify the DNA that has the information for making the target protein [(8)] Scientists use the DNA to produce the mRNA for the target protein. Once enough mRNA has been made, the DNA is broken down to ensure that only the mRNA is packaged in the vaccine. The speed and efficiency of this process can make large amounts of mRNA in a short period of time. mRNA is a fragile molecule, so it is "wrapped" in a fat-based coating to protect it. Other ingredients are added to the vaccine to keep it stable and make sure the vaccine behaves as it should in the body. After packaging, the vaccine is stored and shipped at very low temperatures to

help keep the mRNA intact and the vaccine safe and effective. [9]

TRIALS CONDUCTED

Done in case of young adults: -

KEY INCLUSION AND EXCLUSION CRITERIA

Participants Must:

1. Be 6 months – 5 years old at time of screening visit
2. Be in good health
3. Have parents /guardians willing and able to attend all trial visits.

Participants Must Not:

1. Have ever been Vaccinated against COVID-19
2. Have received or plan to receive any Vaccine 14 days before or after the first or second trial injection.

The Moderna trial exhibited a 6 % higher risk of serious adverse events in the vaccine group. Prior to the COVID-19pandemic, mRNA vaccines targeting infectious diseases including HIV-1, rabies, Zika and influenza were already in clinical trials. [10]

ADMISTRATION OF THE VACCINE

This vaccine is advised to be used by those aged 6 months and above, with an adjustment in the recommended dosage in those aged 6 months – 4 years, and those aged 5-11 years. [11]

WHO recommends countries should consider using the vaccine in children aged 6 months to 17 years only when high vaccine coverage with 2 doses has been achieved in the high priority groups. [12]

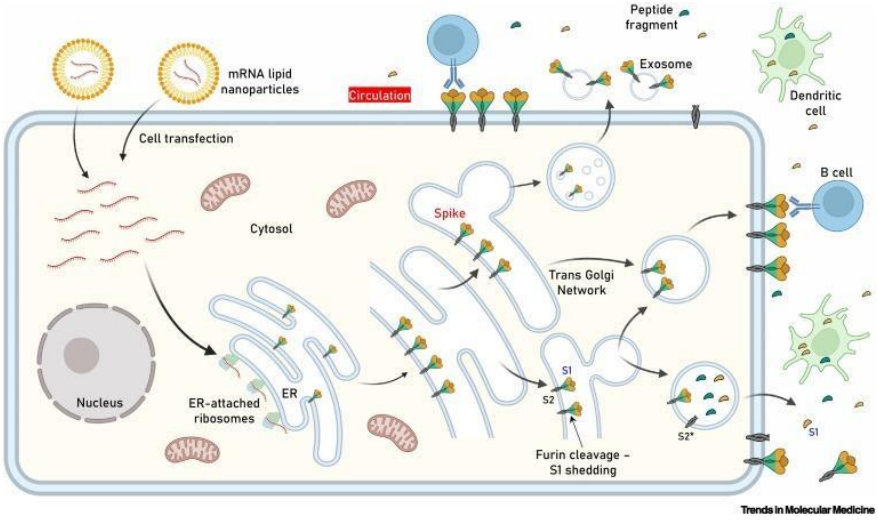
The aim of WHO is to prevent deaths by achieving high vaccine coverage in general, children are at lower risk ofCOVID-19([13]. WHO recommends that countries prioritize vaccinating people who have higher risk first. [14]

DOSAGE RECOMMENDED

For adults aged 17 and above, it is recommended use Moderna mRNA-1273 vaccine at a schedule of two doses (100 µg, 0.5 ml each) 8 weeks apart. For adolescents aged between 12 to 17 years, use 2 doses (100 µg, 0.5 ml each),given intramuscularly, 4 weeks apart. [15] For children aged 6 to 11 years, it is recommended 2 doses (50µg in 0.25 ml each), 4 weeks apart. For children aged 6 months to 5 years, 2 doses (25 µg [0.25 ml each), 4 weeks apart. [16]. WHO recommends that the second dose should be administered 4–8 weeks after the first dose; an interval of 8 weeks between doses is preferred as this interval help in vaccine effectiveness and help in lower risk of myocarditis. [17]

POTENTIAL MECHANISM OF mRNA COVID-19 VACCINE

mRNA vaccines contain nucleoside modified mRNA, encoding the viral spike glycoprotein of SARS-COV2, but not live virus of DNA. They are encapsulated in lipid nanoparticles that act as delivery vehicles to transport mRNA into the cells and may include inactive ingredients such as buffer and salts. [18]. once inside the host cells, the vaccine's mRNA causes the cells to build the spike protein which then stimulates an adaptive immune response to identify and destroy a virus expressing spike protein. Vaccine induced spike protein IgG antibodies prevent attachment of SARS-COV2 to its host cell through spike protein binding to the angiotensin- converting enzyme 2 receptor, and thereby neutralizes the virus. [8] The vaccine cause nucleoside modifications of mRNA and reduce innate immunogenicity. The dendritic cells exposed to RNA may have the capacity to express cytokines and activation markers in some individuals. The immune system may therefore detect the mRNA in the vaccine as antigen, resulting in the activation of proinflammatory cascades and immunologic pathways that may play a role in the development of myocarditis as part of a systemic reaction in certain individuals. [19] It will be important to monitor the possibility of such complications because the revolutionary use of mRNA is being considered for other vaccines and therapies. Antigen translation and presentation of mRNA vaccines occur in host cells. The mRNA encapsulated in lipid carrier molecules transit to the cytosol via endocytosis, then the mRNA is released by endosomal escape. After entering cytosol, cellular translation machinery is utilized to produce an antigen of interest. The antigen of interest secreted to the extracellular domain and is ingested by antigen-presenting cells (APCs), such as dendritic cells, macrophages, and Langerhans cells. Following proteolytic degradation and presentation by MHC class II molecules, the MHC II -epitope complex is recognized by $CD4^+$ T cells to induce the $CD4^+$ mediated immune responses. [20]



CHARECTERISTICS OF mRNA COVID-19 VACCINE

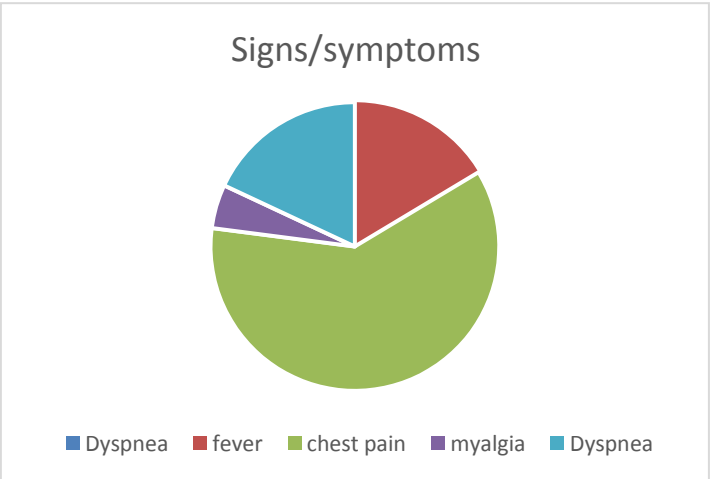
An mRNA Vaccine teach the body how to make a specific protein that can help the immune system prevent diseases and interacts with other components of cell that help to create proteins. mRNA Vaccines are given as injections.

Male predominance of myocarditis is seen post vaccination and the reasons are still unknown an important reason might be associated with the sex hormones. Testosterone is thought to play a role by combined mechanism of inhibition of anti-inflammatory cells and commitment to a Th-1 type immune response. Estrogen has inhibitory effects on the proinflammatory Tells, resulting in decrease in cell-mediated immune responses. Another contributing factor is underdiagnoses in women. Systemic reactions to the vaccine, are usually reported more commonly among the younger population and more often after the second dose of the vaccine. [20]

CHANGES SEEN IN HEART POST VACCINATION

Symptoms:

1 chest pain-92.5%
2 Dyspnea- 27.50%
3 Associated fevers- 25%
4 myalgia- 7.50% [20]



FUTURE DIRECTIONS AND RESEARCH PRIORITIES

More studies are needed to find more about the vaccine use, risk factors including genetic predisposition, prognosis,potential mechanisms, reasons for sex differences incidence of myocarditis, clinical course of vaccine, treatment strategies and long term impact of myocarditis post COVID-19 vaccination. [20]

STATISTICAL ANALYSIS

In this article patient demographic characteristics, disease manifestations and causes are summarized. Experimental and clinical data provide evidence that lipid in the mRNA vaccine is one of the causes of heart dysfunction or any cardiac abnormality, by lipid accumulation, also the elevation of cholesterol level in the mRNA Vaccine causes efflux of cholesterol in Cardiac tissue and lead to progression of myocarditis in young adults. Other causes of incidence of myocarditis post Vaccination are due to the ingredients present in the mRNA Vaccine. [21]

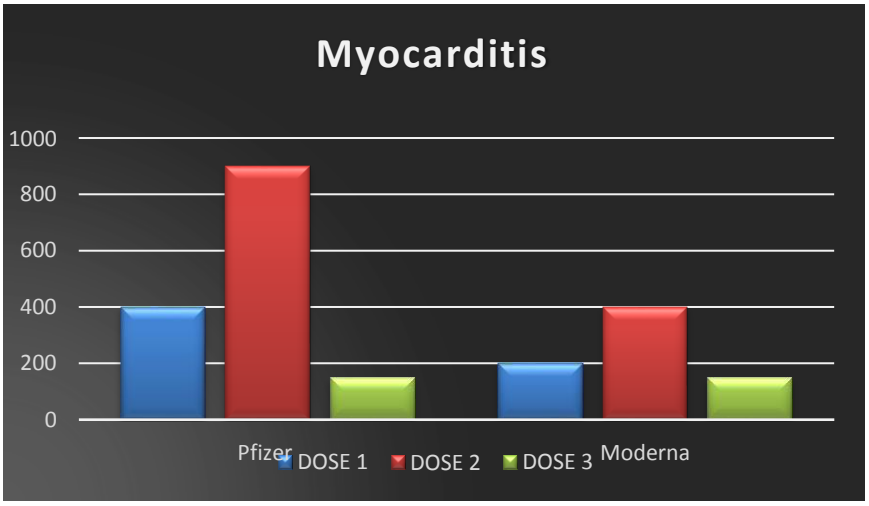
STEPS TO CONTROL MYOCARDITIS POST mRNA VACCINATION

Management Strategies:

For initial evaluation, ECG and cardiac troponin levels should be obtained, and inflammatory markers such as C- reactive protein and erythrocyte sedimentation \rate can be helpful. Cardiology consultation and evaluation with echocardiography and cardiac MRI should be considered. Evaluation and management may vary depending on the patient's age, clinical presentation, potential other causes and comorbidities, hemodynamic and rhythmic stability, and clinical course. Patients with chest pain, evidence of myocardial injury, ECG changes cardiac imaging abnormality, arrhythmias, hemodynamic instability after COVID-19 vaccination likely will require hospitalization andclose follow up of the patient. [22] In addition to supportive care nonsteroidal anti- inflammatory drugs, steroids, and colchicine were used for management of some patients with myocarditis after COVID-19 Vaccination. A few patients were treated with intravenous immunoglobulin and aspirin, and some were initiated on beta blocker and angiotensin converting enzyme inhibitor therapy because of left ventricular systolic dysfunction. Among patients with rapid resolution of symptoms, with preserved cardiac function and normal biomarkers or resolving cardiac biomarker abnormality, therapy may be deferred. [23] In patients with persistent mild symptoms without hemodynamic instability, arrythmia, significant left ventricular dysfunction or heart failure, colchicine non-steroidal anti-inflammatory drugs and steroids may be considered or given. In patients with left ventricular dysfunction, heart failure, new onset arrythmia or hemodynamic instability intravenous steroids and intravenous immunoglobin along with other cardiac or circulatory supportive measures can be considered. Also, in some patient's guideline directed therapy including beta blockers and angiotensin is given. [26]

II. Conclusion

Myocarditis is reported post COVID-19 vaccination. The cases are seen in adolescent and young adult males, withinseveral days after mRNA COVID-19 Vaccination (Pfizer-BioNTech or Moderna). A total of 411 myocarditis or pericarditis, or both, events were observed among 15,148,369 people aged 18–64 years who received 16,912,716 doses of BNT162b2 and 10 631 554 doses of mRNA-1273. [24] Among men aged 18–25 years, the pooled incidence rate was highest after the second dose. Most cases of myocarditis are reported within 7 days after receiving second dose of mRNA COVID-19 Vaccine (Pfizer-BioNTech and Moderna). The overall rate of myocarditis was 0.97 per 1,00,000 mRNA vaccine doses and the risk window of the development of myocarditis is reported within 1-7 days after an mRNA vaccination. In some cases, myocarditis post vaccination has also been observed after dose 1 and booster doses. [25] With this article review we come to the conclusion that the mRNA vaccine is one of the causes of heart dysfunction or any cardiac abnormality, by lipid accumulation, Also the elevation of cholesterol level in the mRNA Vaccine causes efflux of cholesterol in Cardiac tissue and lead to progression of myocarditis in young adults. Other causes of incidence of myocarditis post Vaccination are due to the ingredients present in the mRNA Vaccine, so still More studies are needed to find more about the vaccine use, risk factors including genetic predisposition, prognosis, potential mechanisms, reasons for sex differences incidence of myocarditis, clinical course of vaccine, treatment strategies, long term impact of myocarditis post COVID-19 vaccination and association of further other factor associated with the usage of this vaccine. Common treatment adopted for myocarditis post vaccination was nonsteroidal anti-inflammatory drugs and other treatments like corticosteroids. Antiviral drugs are also in use. [26]



References

[1]. Myocarditis | Johns Hopkins Medicine (no date). Available at: https://www.hopkinsmedicine.org/health/conditions-and-diseases/myocarditis (Accessed: 13 April 2023).

[2]. Myocarditis - Symptoms and causes - Mayo Clinic (no date). Available at: https://www.mayoclinic.org/diseases-conditions/myocarditis/symptoms-causes/syc-20352539 (Accessed: 13 April 2023).

[3]. Yonkers, L.M. et al. (2023) 'Circulating Spike Protein Detected in Post-COVID-19 mRNA Vaccine Myocarditis', Circulation, 147(11), pp. 867–876. Available at: https://doi.org/10.1161/CIRCULATIONAHA.122.061025.

[4]. Risk of myocarditis and pericarditis after the COVID-19 mRNA vaccination in the USA: a cohort study in claims databases - PubMed (nodate). Available at: https://pubmed.ncbi.nlm.nih.gov/35691322/ (Accessed: 10 April 2023).

[5]. Schoenmaker, L. et al. (2021) 'mRNA-lipid nanoparticle COVID-19 vaccines: Structure and stability', International Journal of Pharmaceutics, 601, p. 120586. Available at: https://doi.org/10.1016/j.ijpharm.2021.120586.

[6]. Fox, A. and Preiss, T. (2021) What do I need to know about the Moderna vaccine? And how does it compare with Pfizer, The Conversation. Available at: http://theconversation.com/what-do-i-need-to-know-about-the-moderna-vaccine-and-how-does-it-compare-with-pfizer- 165537 (Accessed: 13 April 2023)

[7]. What are mRNA vaccines and how do they work? Medline Plus Genetics(nodate). Available at: https://medlineplus.gov/genetics/understanding/therapy/mrnavaccines/ (Accessed: 10 April 2023).

[8]. How do vaccines work? (nodate). Available at: https://www.who.int/news-room/feature-stories/detail/how-do-vaccines-work (Accessed:13 April 2023).

[9]. mRNA Vaccines | U.S. Pharmacopeia Blog (no date). Available at: https://qualitymatters.usp.org/what-is-mrna-and-how-does-it-work(Accessed: 13 April 2023).

[10]. The clinical progress of mRNA vaccines and immunotherapies | Nature Biotechnology (no date). Available at: https://www.nature.com/articles/s41587-022-01294-2 (Accessed: 13 April 2023).

[11]. The mRNA vaccine technology transfer hub (no date). Available at: https://www.who.int/initiatives/the-mrna-vaccine-technology-transfer-hub (Accessed: 13 April 2023).

[12]. Messenger RNA vaccines (no date). Available at: https://www.who.int/teams/health-product-policy-and-standards/standards-and-specifications/vaccine-standardization/mrna-vaccines (Accessed: 13 April 2023).

[13]. The Moderna COVID-19 (mRNA-1273) vaccine: what you need to know (no date). Available at: https://www.who.int/news-room/feature-stories/detail/the-moderna-covid-19-mrna-1273-vaccine-what-you-need-to-know (Accessed: 10 April 2023).

[14]. Anastassopoulou, C. et al. (2022) 'Temporal relationship of myocarditis and pericarditis following COVID-19 vaccination: A pragmatic approach', International Journal of Cardiology, 358, pp. 136–139. Available at: https://doi.org/10.1016/j.ijcard.2022.04.024.

[15]. Case report: acute myocarditis following the second dose of mRNA-1273 SARS-CoV-2 vaccine - PubMed (no date). Available at: https://pubmed.ncbi.nlm.nih.gov/34514306/ (Accessed: 10 April 2023).

[16]. Clinical Considerations: Myocarditis after COVID-19 Vaccines | CDC (2023). Available at: https://www.cdc.gov/vaccines/covid-19/clinical-considerations/myocarditis.html (Accessed: 10 April 2023).

[17]. CDC (2020) COVID-19 Vaccination, Centre's for Disease Control and Prevention. Available at: https://www.cdc.gov/coronavirus/2019- ncov/vaccines/safety/myocarditis.html (Accessed: 10 April 2023).

[18]. Ammirati, E. et al. (2020) 'Management of Acute Myocarditis and Chronic Inflammatory Cardiomyopathy', Circulation. Heart Failure, 13(11), p. e007405. Available at: https://doi.org/10.1161/CIRCHEARTFAILURE.120.007405.

[19]. Myocarditis With COVID-19 mRNA Vaccines | Circulation (no date). Available at: https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.121.056135 (Accessed: 10 April 2023).

[20]. Touracos, I.P. et al. (2022) 'Adverse effects of COVID-19 mRNA vaccines: the spike hypothesis', Trends in Molecular Medicine, 28(7),pp. 542–554. Available at: https://doi.org/10.1016/j.molmed.2022.04.007.

[21]. Oster, M.E. et al. (2022) 'Myocarditis Cases Reported After mRNA-Based COVID-19 Vaccination in the US From December 2020 toAugust 2021', JAMA, 327(4), pp. 331–340. Available at: https://doi.org/10.1001/jama.2021.24110.

[22]. COVID Vaccine and Myocarditis (no date). Available at: https://www.webmd.com/vaccines/covid-19-vaccine/covid-19-vaccine-myocarditis (Accessed: 13 April 2023).

[23]. Myocarditis after COVID-19 vaccine treatable; AHA urges continued vaccination (no date). Available at: https://www.healio.com/news/cardiology/20210621/myocarditis-after-covid19-vaccine-treatable-aha-urges-continued-vaccination (Accessed: 13 April 2023).

[24]. Hei decker, B. et al. (2022) 'Myocarditis following COVID-19 vaccine: incidence, presentation, diagnosis, pathophysiology, therapy, and outcomes put into perspective. A clinical consensus document supported by the Heart Failure Association of the European

Society of Cardiology (ESC) and the ESC Working Group on Myocardial and Pericardial Diseases', European Journal of Heart Failure, 24(11), pp. 2000–2018. Available at: https://doi.org/10.1002/ejhf.2669.

[25]. Acute myocarditis caused by COVID-19 disease and following COVID-19 vaccination | Open Heart (no date). Available at: https://openheart.bmj.com/content/9/1/e001957 (Accessed: 13 April 2023).

[26]. Incidence, Clinical Presentation, and Management of Myocarditis following mRNA-Based Covid-19 Vaccines: A Brief Report - Full Text - Cardiology 2022, Vol. 147, No. 4 - Karger Publishers (no date). Available at: https://www.karger.com/Article/FullText/522216 (Accessed: 13 April 2023).

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