

Will COVID-19 Vaccine Genetically Modify Humans? – Facts and Myths

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ABSTRACT

The vaccines being developed to protect humans from the Coronavirus pandemics have also been developed in the past to save humans from many other pandemics. The current COVID-19 vaccine research and development involves people from all over the world, therefore raising many questions which must be addressed by all stakeholders. No doubt, it is the need of the day to provide an effective vaccine to control the pandemics that must be balanced with incorporation of the research ethics. In any event, the safety and well-being of research subjects must be protected, especially that of vulnerable subjects. The consent of the population is very important and usage must be addressed through transparent sharing of information. The current review article will try to unveil some facts and myths related to the safe use of this vaccine against SARS-CoV-2.

KEYWORDS: SARS-CoV-2, Vaccine, Human DNA, G2 technology, COVID-19, Foetal cells.

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INTRODUCTION

According to the World Health Organization (WHO), a COVID-19 DNA vaccine “involves the direct introduction into appropriate tissues of a plasmid containing the DNA sequence, encoding the antigen(s) against which an immune response is sought, and relies on the in-situ production of the

target antigen”. This kind of vaccine activates the natural immune response in the body and is easy to manufacture on large scale.¹

Vaccines have been developed in the past to save lives during epidemics and pandemics. The Spanish flu of 1918 – 1919, considered to be the “the Mother of All Pandemics” is a dark page in the human history. About 20 – 50 million people died during these two years. It is believed that about one third of the world’s population was affected by Spanish influenza. It was only after few years that the attempts to produce safe and effective vaccines became fruitful when world’s first vaccine against the flu became available in the 1930s.²⁻³

Attempts to produce effective and safe vaccination have, over a century, long history. Louis Pasteur used the live attenuated and inactivated bacteria to produce cholera and anthrax vaccine, respectively, in late 19th century. Vaccines against Plague and BCG were developed next. In 20th century, inactivated toxoids were used to produce vaccines against tetanus and diphtheria. Advent of the inactivated injectable polio vaccine and live attenuated oral polio vaccine led to the mass

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immunization worldwide. Efforts to use various methods to produce vaccines resulted in prevention, control and even eradication of many infectious disease outbreaks.³⁻⁴

In the past 20 years, new techniques have been discovered and utilized to manufacture vaccines using genetic engineering e.g., recombinant hepatitis B vaccines, pertussis vaccine, and seasonal influenza vaccine. Some of these latest techniques such as use of mRNA, DNA, and Viral vector are currently under trial for SARS-CoV-2.⁵

This world is a global village and is very intricately woven by international travel, trade, and communication media. COVID-19 has swept over 218 countries in ten months, affecting more than 80 million people and killing more than sixteen million people since the pandemic started in March 2020, and is still going strong. Health protective measures such as social distancing, sanitization, protective equipment, and lockdowns alone provide insufficient control over Pandemic. Complete and effective control of pandemic is impossible without the development, distribution and uptake of the vaccine.⁶

The SARS-CoV-2 is a new virus, so entirely new vaccines must be developed and tested to ensure they work and are safe. Dozens of companies around the world have been trying to develop a vaccine since the beginning of pandemic but only four or five companies have managed to reach the clinical trial phase so far. Among them are Moderna, Pfizer and Astra Zeneca.⁵⁻⁷

How is Viral Vector Vaccine Prepared?

Vaccination is based on the concept of introducing a weakened infectious agent or its component that is modified in a way to cause no harm or disease but is capable of activating the natural immune response in human body. The genetic engineering and molecular genetics have increased our understanding of the viral molecular biology and its genetics. This technology has enabled the use of viruses as “vaccine vehicle” to introduce bacterial plasmid in human body for activating both humoral and cell-mediated immune responses. This concept is being used in the preparation of COVID-19 vaccine.¹

The SARS-CoV-2 is a lipid enveloped, single-stranded, positive-sense RNA virus. It belongs to

Coronaviridae family and β -Coronavirus genus. There are 4 structural proteins; spike protein (S), envelope protein (E), matrix protein (M) and nucleocapsid protein (N). S protein has two components: S-1 and S-2. The S-1 attaches with angiotensin-converting enzyme-2 (ACE-2) receptor through their receptor-binding-domain (RBD) while helping in membrane fusion, and enables the virus to enter and infect human cells. The vaccine is based on signaling S proteins preparations in the body. Neutralizing antibodies (nABs), that target RBD, may block viral binding to host cells, whereas those targeting the S2 subunit may inhibit membrane fusion and viral entry.⁷⁻¹⁰

In attempts to produce vaccine (ChAdOx1 Covid-19), the adenovirus was taken from the Chimpanzee. The viral genes responsible for infection were removed to eliminate the pathogenicity. The virus is now a cell that can no longer replicate or be infective. Once inside a cell, viral vectors hack into the same molecular system as SARS-CoV-2 and produce the spike protein in its three dimensions. This resembles a natural infection, which provokes a robust innate immune response, triggering inflammation and mustering B and T cells.⁹⁻¹³

Adenovirus as a Vector for COVID-19 Vaccine?

Adenovirus walls are made up of lipids that are stable and can hold recombinant DNA. Adenoviruses are also capable of entering human cells easily by producing lipid nano particles which are required to produce innate immune response in the body after vaccine inoculation.¹⁰

Scientists have carefully studied the response of human cells after the introduction of this recombinant adenovirus DNA. They have proved that the adenovirus, once inside the human cells, activates the production of specific proteins but does not replicate or produce disease.¹¹⁻¹²

Recombinant DNA is prepared by combining bacterial plasmid DNA and the viral DNA that signals S-protein production. Plasmid is obtained from bacteria and is used in preparation of recombinant DNA because of its ability to replicate independently. This plasmid is cleaved to remove a part of it so that the S-protein coding DNA, obtained from virus, can be inserted into it. This process is called *Annealing*. It is then harvested in the host

bacteria. This recombinant viral DNA plus S protein DNA is harvested in different cell lines. Once inside human body, this recombinant DNA will signal and synthesize S protein of the SARS-CoV-2 without having any replicative or infective potential. Innate and humoral immune system of human body will identify this S-protein as “foreign” and will produce immunity against it. When human body will confront the actual Coronavirus, it will be ready to identify, respond and pin the virus down without it having any opportunity to cause disease. In short, this vaccine activates the immune response and will not modify humans genetically.¹²⁻¹³

Use of Foetal Cells for Development of Vaccine

Scientist developing vaccines are required to rigorously check for the safety and effectiveness of the vaccine. It is achieved by exposing human cells to these vaccines under trial, in laboratory. Three different human cell lines are used for this purpose.

Medical Research Council Cell Line strain 5 (MRC-5) is an approved cell line which is used as a substrate for vaccine testing. These cells were obtained from 14 week old aborted Caucasian male foetus, in 1966. Another cell line used was A549 cells which was developed through the removal and culturing of cancerous lung tissue of a 58-year-old Caucasian male, in 1972. The third cell line used was Human embryonic kidney 293 cells (HEK 293) which was obtained from an aborted male foetus, donated by a mother for research in 1973. These foetal cells have been cultured and replicated over decades, creating what’s known as “Cell Strains” and do not have any original foetal component left in them. Therefore, these cells cannot be considered to be taken directly from a foetus.¹²⁻¹⁴

Vaccine safety protocols are taken very seriously at each step of vaccine manufacturing. When scientists exposed MRC-5 and A594 cell lines to recombinant Adenovirus vaccine, it was proved that the virus could not grow in these experimental cells lines, but was capable of signaling S protein synthesis. Adenovirus vector transcripts were next to zero in MRC-5 cells, however A549 cells showed a wider repertoire of adenoviral gene expression, at very low levels. Multiple adenovirus proteins were detected in A 549 cells compared to just one in MRC-5 cells. It is important to mention here that these

experimental cells are destroyed after use and the original transcriptional RNA is used in vaccines. The cells cultured from human cell lines, used to manufacture the vaccine, are filtered out of the final product.¹²⁻¹⁵

Human cells are divided into three basic kinds: Stable cells, Permanent cells, and Labile cells. Stable cells, as the name indicate, are stable, have low potential for replication and regenerate only when signaled, such as hepatocytes/liver cells. Permanent cells are differentiated cells and are unable to proliferate further such as neurons. Labile cells are the cells that continue to multiply throughout life. These Labile cells are alive for only a short period of time and because of that, they replace functional cells. Examples include skin and gastrointestinal tract cells. Scientists use foetal cells for their amazing capability to proliferate quickly. Moreover, these foetal cells do not get aged unlike adult cells. After each use, these foetal cells are made to go through a complete system of purification. These are lysed and purified carefully.

Viruses such as adenovirus and chickenpox (varicella), are used as a vector for testing of vaccines and drugs because of their fast and predictable replication potential. After harvesting, these viruses are purified several times to remove the cell culture material. Therefore the possibility of any foetal material being a part of the final vaccine or drugs, is highly unlikely.¹⁵

Vaccines Prepared by Moderna and Pfizer

These companies have already obtained transcriptional RNA by engineering the recombinant viral DNA/Plasmid DNA, in the laboratory. These RNA are then incorporated into lipid nanoparticles, which are further stabilized by specialized charging i.e., positively charged lipids and negatively charged mRNA.¹⁴⁻¹⁶

Once inoculated in human body, this RNA enters human cells to activate the ribosome and signal S-proteins production inside human ribosomes, without entering human cells nucleus. These proteins, being foreign to human body, activate the humoral and innate immune response and make antibodies against S2 and produces cytotoxic T cells (Th-1 & Th2). After an initial immune response, these cells become memory cells and whenever the actual infections occur, these

memory cells reactivate and form neutralizing antibodies (nABs). The antibodies kill the infective cells before they are able to cause disease. This is how vaccine confers protection against COVID-19.^{11-17,18}

Is Vaccine a Microchip That Can Be Stored in Human DNA and Controlled by G2 Technology?

This is just a misconception. Genetic modification of human DNA would require the deliberate insertion of foreign DNA inside the nucleus of a human cell. Vaccines, on the other hand, work by activating human B cells and T cells to fight a pathogen when it comes in contact with it. Another misconception is that the vaccine DNA/RNA or foetal elements get attached to human DNA and bring genetic changes. There is a system in the human body to identify, and check the foreign substances. In human cells there is DNA repair system. If this system fails, human DNA either dies by cell death (apoptosis) or becomes cancerous and eats up itself. So, there is no chance that vaccine can modify the human DNA or insert a microchip in human DNA.^{11,19,20}

CONCLUSION/RECOMMENDATIONS

Human foetal tissue is used for various research purposes such as preparation of vaccines, and to study the pathophysiology and potential treatment options for various illnesses. This practice may raise a number of ethical issues including, but not limited to, financial incentives associated with selling components of aborted embryos. It may lead to a potential conflict of interest for those involved in the retrieval, storage, testing, preparation, and delivery of fetal tissues. In order to protect the integrity of science as well as to secure the fate of human race, it is imperative that physicians and scientists who are involved in research that uses human fetal tissues adopt the following recommendations:

1. Necessary steps should be taken to prevent the industrialization of human foetal tissue market and it should include the development and implementation of strict rules for scientist working with human foetal tissue, at international level.

2. Mandatory, complete, voluntary and informed consent should be obtained from women donating their foetal/embryonic tissue. This consent should include a disclosure of the nature of the research and the purpose of use of human foetal tissue.
3. Use of foetal cells in research and experimentation should be discouraged. Instead, adult human cells must be prepared through stem cell technology.
4. In order to make it fair and ethical for all parties involved, the donor should be kept blind to recipient and should not be allowed to designate the recipient of the tissue. Both parties should sign the confidentiality agreement.

LIMITATIONS OF THE STUDY

This is a narrative review. Systematic review with inclusion of latest studies in future shall be more enlightening.

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CONFLICT OF INTEREST

None to declare.

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Author's Contribution

ALL AUTHORS: Contributed equally and approved the final version of the manuscript to be published.