

Research explains how the measles virus destroys immune “memory”

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The measles virus is one of the most contagious and virulent diseases affecting humanity. The virus is rendered even more dangerous as it wipes out immunity previously acquired after exposure to other microbes. The effect is the equivalent of taking a very strong immune suppressant. Although scientists have known of this phenomenon, “immune amnesia,” for some time, recent research in Europe and the US is starting to elaborate the mechanism involved.

The disease is making a comeback internationally, as immunisation rates decline. Currently the tiny Pacific island state of Samoa with a population of 200,000 people faces a measles epidemic. As of December 20, there were 5,463 confirmed cases and 78 deaths. The main reason was the country’s very low vaccination rates of between 30 and 40 percent.

Data from the pre-vaccination period, prior to the 1950s, linked measles to 50 percent of all childhood deaths. Scientists estimate that between 1855 and 2005 the virus killed 20 million people worldwide. An effective vaccine was developed in the 1950s, which today is part of the MMR vaccine (measles, mumps and rubella) commonly delivered in early childhood.

The measles virus acts to suppress the body’s immune system, leaving it susceptible to secondary infections. Exposure to the virus also wipes out immunity to other diseases, but renders children immune to further infection by the measles virus itself.

The immune system is extremely complex and has evolved to protect the human body from attacks by bacteria, viruses or other invaders, such as parasites. The immune system is able to detect their presence then act to destroy them. The system can distinguish between the body’s own cells and any invaders.

B lymphocytes, a type of white blood cell, detect foreign proteins on the invading body known as antigens, and then secrete antibodies that lock on to specific

antigens. Antibodies come in various types and are part of a group of chemicals called immunoglobulins. T lymphocytes, another type of white blood cell, are involved in coordinating the immune response and killing viruses.

Once the body has developed an antibody to a microbe it acts to give the person immunity to the disease throughout his or her lifetime.

The two recent studies were published simultaneously in *Science Immunology* and *Science* on 31 August led by immunologist Velislava N. Petrova from the Wellcome Sanger Institute and Cambridge University in the UK and Assistant Professor of Epidemiology and Immunology Michael J. Mina from Harvard medical school in the US respectively.

The studies examined children in an orthodox Protestant community in the Netherlands who had not received the measles vaccination. The children were looked at before and after a measles outbreak in 2013. Scientists conducted tests to determine the degree of B cell [B lymphocyte] impairment after measles infection.

The ability of the immune system to fight off infections depends on the range of immune system cells with different receptors. “The more diverse range of them (receptors) we have, the better,” Petrova told the *Guardian*.

The Petrova study showed that after the measles infection, the immune cells had a reduced range of receptors and thus a lower capacity to deal with infections. “We show that measles directly causes the loss of protection to other infectious diseases,” Petrova said.

The measles virus works by inserting itself into B cells to reproduce itself. The B cells acquire the ability to detect and destroy infections due to earlier encounters with microbes. B cells have receptors remain “naïve,” ready to react to new infections. The Petrova study found that the measles destroys both types of B cells.

Petrova only examined children after six weeks of being infected, so it is not clear how long the “immune amnesia” lasts.

In a related study, Colin A. Russell from the University of Amsterdam, a co-author on the Petrova study, used a virus akin to measles, the morbillivirus, to infect ferrets. The ferrets had been given an influenza vaccine. Scientists found that after being infected with the morbillivirus the animals became susceptible to the influenza virus again. The vaccinated ferrets who had not been infected with measles still remained immune to the flu.

“For the first time we see that measles resets the immune system and it becomes more baby-like, limiting how well it can respond to new infections... In some children the effect is so strong it is similar to being given powerful immunosuppressive drugs,” Russell stated.

Michael Mina in the US used the same cohort of students as Petrova to examine their antibody recognition to common viruses and found a much-reduced range of antibodies in subjects who had suffered measles. Mina showed that damage from the measles virus was due to the loss of long-lived plasma cells that secreted antibodies. Plasma cells are white blood cells that produce a single type of antibody.

Mina and his team showed the Dutch students, before they were infected with measles, were able to produce antibodies to a range of viruses and bacteria. They found that after the measles infection the children lost between 11 and 73 percent of their antibodies.

Mina surmises that in order for the immune system to go back to its original state children would have to be re-exposed to the viruses and bacteria once more. “This work highlights the importance of MeV (measles virus) vaccination not only for the control of measles but also for the maintenance of herd immunity to other pathogens, which can be compromised after MeV infection,” the Mina study stated.

The two studies highlight the importance of maintaining the MMR vaccinations in the population, under conditions where the number of measles cases is multiplying rapidly across the world.

Scientists estimate that 95 percent of the population has to be vaccinated in order to cover people who are unable to take the vaccine for various medical reasons. This level of vaccinations is sufficient to make a society free of measles.

Although the US was given measles-free status in 2000, in April 2019, 695 cases of measles from 22 states

occurred.

In Europe in the first six months of 2019, the World Health Organisation (WHO) reported 90,000 cases across 48 of the 53 countries in the WHO European region resulting in 37 deaths.

Ukraine was the worst affected, with more than 54,000 cases and 18 deaths. Britain lost its measles-free status in the first half of 2019, with 489 cases reported. Albania, Czech Republic and Greece also lost their measles-free status in this period.

The main reason for the decline in vaccination rates in countries such as the UK is because of government cuts to health services. Britain’s Health and Social Care Act of 2012 led to lower vaccination rates because of the loss of key staff such as immunisation coordinators. Public health programs were shifted from the National Institute of Health (NIH) to local authorities that systematically cut their budgets.

Anti-vaccination campaigns have also had an impact on declining rates. Most of these focus on the promotion of bogus claims that vaccinations cause diseases such as autism. Several studies involving 1.5 million children found no link between vaccinations and autism.

In poor countries in Africa and Asia, vaccination rates are very low resulting in high numbers of deaths. In Madagascar, off the coast of Mozambique, there have been 150,000 cases resulting in more than 1,000 deaths. In the Democratic Republic of Congo, according to Doctors without Borders, 2,700 deaths were reported from January.

One important outcome of the two recent studies is that it places renewed emphasis on the boosting of public vaccination to reach the 95 percent rate required to give herd immunity. It is entirely possible to eliminate the deadly measles virus. A vaccine has existed for decades, but poverty and cuts in public vaccination programs are eroding the gains made in an earlier period.



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