

Podcast: Vaccines in pregnancy and further childhood vaccinations

As of May 2022

In our last podcast, we talked about childhood immunizations and ended with an answer to the question: Do we really have to immunize against so many diseases in new-borns?

The answer is yes, as neonates have an immature immune system that has still to grow and learn until it functions well. Until it reaches that ability it needs the nest protection of the mother: IgG antibodies passed via the placenta and later by colostrum and breastmilk.

In this podcast we will look at three diseases where it is very important that that nest protection is given by the pregnant woman: tetanus, pertussis and diphtheria. A combined vaccine, which is called DTP, can prevent these three diseases – it is used in most countries for immunization.

However, let us start with some basics in pregnancy. XXX, can you tell us what happens to a woman's immune system in pregnancy?

Yes, sure. In pregnancy the body reduces the activity of its defences to prevent attacking the baby's cells which are genetically half of the father and therefore foreign to the woman's body. Thus, the maternal immune system develops an immunological tolerance against the foetus and suppresses its rejection. The adaptation is based on an interaction of pregnancy hormones and immune cells and contributes to a complication-free course of pregnancy until the birth of the child.

So let me get this right: Pregnant women have a weakened immune system in order to tolerate the baby. However, what does this mean in case of infections?

The result is an increased susceptibility to infections. Therefore, in order to prevent these infections for the mothers, vaccination plays an important role. If all pregnant women are fully vaccinated, this results in a significant reduction of maternal, neonatal, and young infant morbidity and mortality. Firstly, it can prevent maternal infections, secondly it has a cocooning effect that can potentially protect the foetus, and thirdly it can also provide further direct foetal/infant protection against an infection via the transport of specific antibodies from the mother to the foetus before and after birth.

An example from Europe is the influenza virus, where we know that pregnant women are infected much easier, and an infection during pregnancy can be very dangerous for the mother and the unborn or new-born child. Therefore, we give a dead flu vaccine to pregnant women during flu season.

[I have heard the weirdest stories about vaccination in pregnancy. Can you tell me something about the safety of vaccination in pregnant women?](#)

Unfortunately, there are many misunderstandings about vaccine safety in pregnancy and during breastfeeding. And this leads in some cases to missing out on a lifesaving tool and to deaths that are easily preventable.

For example, the flu vaccine can be given at any time in pregnancy, if it is a dead vaccine. As with flu, pregnant women can get severely sick with SARS-CoV 2. As the baby grows, you may be unable to breathe deeply enough, thus increasing the risk of complications such as pneumonia. We know that pregnant women benefit from the flu and COVID-19 immunization during pregnancy. An inactivated or mRNA vaccine does not contain a live version of the virus it is protecting against, so it is safe in pregnancy.

Some other vaccines, such as the diphtheria, tetanus and the pertussis vaccine (DTP), are perfectly safe to have during pregnancy if necessary. It is normally given in the third trimester and also protects babies during early infancy when especially pertussis and tetanus can be life-threatening, as we will see later.

Other vaccines we can give in pregnancy are HPV, pneumococcus or hepatitis B and it then depends on a risk assessment if you need to give these vaccinations urgently. For example, you start working in a hospital and are half way through your hepatitis B vaccines. Even if you get pregnant, there is no need to interrupt your immunization schedule.

Generally, we can say as a rule of thumb that dead vaccines are ok to be given in pregnancy and living vaccines not, as there is a theoretical risk of infection for the foetus with a live virus or bacteria although there is no evidence that any live vaccine causes birth defects. An unintentional vaccination of pregnant women with e.g. MMR-containing vaccines is not considered an indication for pregnancy termination.¹

So, to be prepared for pregnancy it is best to check the immune status of girls who enter the childbearing age: Did they have measles, rubella and varicella as a child or did they get two live vaccines in childhood? Do they need vaccinations to complete their status? Some countries check this systematically on school visits and outreaches.

[What happens in breastfeeding women? Can we immunize with live vaccines after pregnancy?](#)

Yes, if it was detected during pregnancy that you will need rubella, measles or chickenpox vaccination it can be done after giving birth in the breastfeeding time.^{2,3}

[Okay, let us start with the diseases we want to take a closer look at.](#)

[Tetanus](#)

Tetanus is caused by the bacterium *Clostridium tetani*. It is transmitted via injured skin or sores. *C. tetani* is widespread in spore form in soil, as well as in the faeces of animals. *C. tetani* spores are extremely robust. They can survive temperatures of nearly 120 °C for 10-15 minutes, and are resistant to antiseptics.

Symptoms of tetanus are headache, fever and sweating, followed by lockjaw, which means patients cannot open their mouth, due to spasms lasting seconds to minutes. Further progressing to muscle spasms often in the back, abdomen and extremities, stiffness, and swallowing difficulties. A diagnostic hint for the doctor is that sudden painful muscle spasms are often triggered by noises. Later symptoms include severe muscle spasms and seizure-like activity. The spasms are caused by a toxin produced by the bacteria: tetanospasmin.⁴

Spasms of the vocal cords or the muscles used for respiration can cause breathing problems. The disease's effects on the nervous system can lead to high blood pressure and abnormal heart rhythms. Spasms can continue for 3-4 weeks; recovery may take months. The spasms can only be treated supportively and tetanus immunoglobulin, or antitoxin, will only remove toxin that has not yet been bound to nerve endings. Even with intensive care possibilities, with immunoglobulin available, muscle relaxants and mechanical ventilation, mortality is between 10% and 20%.⁴ In low-income countries it is usually higher, e.g. in neonatal tetanus it can be up to 72%.⁵

Tetanus is diagnosed on the basis of clinical features. People who recover from tetanus do not have natural immunity and can be infected again and therefore need to be immunized.

I see, so it is important for everybody to be immune against tetanus toxin. Can you explain why it is so immensely important for pregnant women?

Yes, like everybody, pregnant women can also get tetanus; we call this maternal tetanus. This is almost a death sentence for the mother and the baby. Luckily, it does not occur frequently. The incubation period in tetanus is usually about ten days but can also be up to several months. In neonatal tetanus symptoms usually appear from 4 to 14 days after birth, averaging about 7 days. It usually occurs through infection of the unhealed umbilical stump, especially when cut with non-sterile instruments. In neonatal tetanus the new-born starts often with an inability to breastfeed and excessive crying, progressing to twitching of muscles and typically develops opisthotonus, spasm of the back muscles where the spine is curved backwards.⁴

The main reason why we want the woman to be immune is neonatal tetanus of the new-born. Because when the mother is properly vaccinated against tetanus, she gives the antibodies via placenta to the baby and the baby is protected from neonatal tetanus.

Okay, do I get it right: With tetanus vaccination not only the mother is safe but also the child? That is a very good thing to hear. So, do let us vaccinate against tetanus!

Yes, let's do that. Since 2000, we have reached a reduction of 88% in deaths from neonatal tetanus.⁶ But still 25,000 died from it in 2018. Nearly all cases of tetanus occur in people who have never been vaccinated or in adults who have not kept up to date on their booster shots. The disease remains an important public health problem in many parts of the world, but especially in low-income countries or districts, where immunization coverage is low and unclean birth practices are common.

Okay, I get it: improving mother and child health, delivery with skilled birth attendants and clean services are also important to improve the situation. Because this is important to stop the spread of many infectious diseases. But for tetanus we additionally have the vaccine as very effective tool. Can you tell me a bit more about it?

The vaccine consists of the tetanus toxoid, or inactivated tetanus toxin. It is given alone or in combination with other vaccines, e.g. diphtheria and pertussis. To be protected throughout life, WHO recommends that an individual receives 6 doses, 3 primary doses at 6 weeks, 10 weeks and 14 weeks of age plus 3 booster doses until adulthood. In adults a booster should be given every ten years. It has then an efficacy of nearly 100%.⁶

Neonatal tetanus can be prevented by immunizing women of reproductive age with the tetanus toxoid, either during pregnancy or without pregnancy. Additionally, robust medical practices can also prevent tetanus disease including clean delivery and cord care during childbirth.⁷

Let us move to another vaccine that is usually given with the tetanus and diphtheria vaccines:

Pertussis

Pertussis is also called whooping cough, caused by a bacterium *Bordetella pertussis*. Its toxins cause inflammation in the respiratory tract. It's a highly contagious infection, spread by droplets. Beginning flu-like with a running nose, fever and mild cough, the cough becomes more severe over weeks. It lasts then typically several minutes, with coughing fits and making the typical whooping sound on inhalation. During the coughing fit children and infants may turn blue.⁴ Whooping cough sounds like the audio sample from YouTube to which I will link you in the written podcast, it also gives you examples for other coughing types like croup.⁸

In 2018, there were more than 151 000 cases of pertussis recorded globally. But there are estimations that the real burden is around 25 million cases.⁹ Infants younger than 6 months are at particular risk for complications and death and they might not show the typical coughing attack but have phases of apnoea. Pneumonia is a relatively common complication, otitis media, and seizures and brain disease occur rarely. Sometimes conjunctival bleedings are visible and vomiting after coughing in infants occurs. In adults the cough can lead to inguinal hernia, rib fractures and pneumothorax.¹⁰

Many children who contract the infection have coughing spells that last 4 to 8 weeks. Once the cough is established treatment for pertussis is generally limited to supportive measures. In 2013, according to WHO estimates, pertussis was still causing around 63 000 deaths in children. Antibiotics, e.g. macrolides, are used but are primarily given so that the bacteria are not spread to others.⁴ Antibiotics may be given to individuals in contact with the patient to prevent infection.

The best way to prevent pertussis is through immunization. The three-dose primary series diphtheria-tetanus-pertussis vaccines decrease the risk of severe pertussis in infancy. WHO recommends the first dose be administered as early as 6 weeks of age; with subsequent doses given at least 4 weeks apart, at age 10 and 14-18. This includes also HIV positive children. Further boosters depend on the endemic background situation.¹¹

Vaccination during pregnancy, in order to prevent early infant mortality is particularly important, if the mother has not been immunized or boosted every 10 years. National programmes may

consider vaccination of pregnant women in the second or third trimester with pertussis-containing vaccine as a strategy additional to routine primary infant pertussis vaccination in countries or settings with high or increasing infant morbidity/mortality from pertussis. It is a highly cost-effective strategy.¹¹ Efficacy of immunization is 80-90%, immunity wanes over time, immune individuals might spread the disease as well. That is why eradication is a difficult task.

Diphtheria

Diphtheria once was a major killer among children under five. At the beginning of the 20th century, it had a fatality rate of 20% even in industrialized countries¹²It is caused by a bacteria called *Corynebacterium diphtheriae* and is transmitted by droplets. Early symptoms are flu-like and include sore throat, loss of appetite, croup-like cough and fever. When the disease progresses, a thick grey substance called pseudo membrane may spread over the nasopharynx. It is formed by waste products related to a powerful toxin that causes damage to body tissues. If pseudo membranes are touched, e.g. with a spatula, they start bleeding. Pseudo membranes can obstruct breathing, thus be life threatening. Additionally, the toxin may damage heart, kidneys, nerves and liver permanently.

Diphtheria can be treated with antibiotics and antitoxin. Active vaccination for diphtheria is accomplished with a toxoid, a modified version of the diphtheria toxin. Since the introduction of effective immunization in the 1920s, diphtheria rates have dropped dramatically. And during the period 1980–2000, the total number of reported diphtheria cases was reduced by >90%, showing the success of childhood vaccination campaigns. But outbreaks still occur.¹³

In part two of this podcast, we will look at two diseases that can have devastating consequences for the foetus and the baby when infected by the mother: these are rubella and hepatitis B.

You are welcome to join and stay blessed.

Internet and other sources as of May 29, 2022

- 1 www.who.int/groups/global-advisory-committee-on-vaccine-safety/topics/pregnancy-and-lactation/vaccines
- 2 www.health.harvard.edu/blog/vaccines-for-women-before-conception-during-pregnancy-and-after-a-birth-2020011018649
- 3 www.nhs.uk/pregnancy/keeping-well/vaccinations/
- 4 <https://historyofvaccines.org/>
- 5 www.researchgate.net/publication/350542061_Tetanus_in_a_rural_low-income_intensive_care_unit_setting
- 6 www.who.int/health-topics/tetanus#tab=tab_1

- 7 www.who.int/health-topics/tetanus#tab=tab_3
- 8 www.youtube.com/watch?v=UDG6z5AiU-A&t=149s Pertussis from 2:05 on; Croup from 0:20
- 9 www.cdc.gov/pertussis/fast-facts.html
- 10 Gerd Herold und Mitarbeiter: Innere Medizin 2022, ISBN 978-3-9821166-1-7
- 11 www.who.int/health-topics/pertussis#tab=tab_1
- 12 <https://historyofvaccines.org/>
- 13 https://cdn.who.int/media/docs/default-source/immunization/position_paper_documents/diphtheria/diphtheria-references.pdf?sfvrsn=240b42b5_2