IMMUNIZATIONS: THE RISKS AND BENEFITS

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DISCLOSURES

- NOTHING TO DISCLOSE
OBJECTIVES

- To know what is a vaccine
- To learn how vaccines work
- To know the differences between live and killed vaccines
- To know if a vaccine worked after administration
- To learn why vaccinations are important during the diagnosis process of primary immunodeficiency
- To know if giving a vaccine will be helpful or harmful
HISTORY OF VACCINES

• **INOCULATION**
  • Person would undergo **VARIOLATION** against **SMALLPOX** (**Variola**) to cause immunity
    • Material taken from a patient or a recently variolated person to hopefully cause a mild, but protective infection
    • Origins in China and the Middle East then introduced in England and North America in the 1700s

• **VACCINATION**
  • In 1798, **Edward Jenner** introduced the smallpox vaccine derived from cowpox
    • Based off his observation that those infected with cowpox were immune from smallpox
    • **Variolae vaccinae** = smallpox of the cow
Sarah Nelmes, a milkmaid infected with cowpox.

James Phipps is inoculated with cowpox pus from Nelmes.

Phipps falls ill with a mild case of cowpox.

Scabs are collected from a smallpox patient.

Phipps is inoculated with the scabs of smallpox.

Phipps is unaffected. Protection is complete.
HISTORY OF VACCINES

• LATE 1800S TO EARLY 1900S
  • LOUIS PASTEUR
    • WORK LEAD TO THE DEVELOPMENT OF LIVE ATTENUATED CHOLERA VACCINE AND INACTIVATED ANTHRAX VACCINE IN HUMANS
  • PLAGUE VACCINE WAS ALSO DEVELOPED AROUND THIS TIME

• 1900-1950, SEVERAL BACTERIAL VACCINES WERE CREATED INCLUDING THE BACILLIS-CALMETTE-GUERIN (BCG) VACCINATION
  • STILL USED IN MANY COUNTRIES OUTSIDE OF THE US

• ALEXANDER GLENNY
  • DEVELOPED METHOD UTILIZING ANTITOXIN THAT LEAD TO PROTECTION AGAINST DIPHTHERIA AND TETANUS

• 1950 AND 1961
  • POLIO VACCINES (INACTIVATED AND LIVE) DEVELOPED
TERMINOLOGY

- **Vaccine**
  - A substance that is usually injected into a person or animal to protect against a particular disease.

- **Vaccination**
  - The action of making a person or animal immune to infection, typically by a vaccine.

- **Immunization**
  - The use of all vaccines and antitoxin (diphtheria and tetanus) to develop immunity.
IMMUNITY

• **When disease germs (virus, bacteria) enter your body, they start to reproduce.**

• **Your immune system recognizes these germs as foreign invaders and responds by making proteins called antibodies.**
  
  • **First job = destroy the germs**
  
  • **Second job = protect you from future infections**

  • **Immunity**
HOW DO VACCINES WORK?

• **Without having to get sick first from a germ, vaccines help you become create immunity**

• **Vaccines are made from the same germs (or parts of them) that cause disease**
  
  • **Polio vaccine is made from polio virus**
  
  • **Vaccines containing these weakened or killed germs are introduced into your body.**

• **Your immune system reacts to the vaccine in a similar way that it would if it were being invaded by the disease — by making antibodies.**

• **The antibodies destroy the vaccine germs just as they would the disease germs and then the antibodies are now trained to fight that germ (immunity).**
  
  • **The antibodies stay in your body protect you (memory).**
TYPES OF VACCINES

- Live Attenuated Vaccines (LAVs)
- Inactivated/Killed Vaccine
- Toxoid Vaccine
- Subunit (Purified Antigen) Vaccine
- Conjugated (Subunit) Vaccine
- Nucleic Acid (DNA) Vaccine
LIVE ATTENUATED VACCINES (LAVS)

- A vaccine where the germ is weakened but still viable or "alive"
  - **Bacterial:**
    - Tuberculosis (BCG)
  - **Viral:**
    - Oral Polio Vaccine
    - Measles, Mumps, Rubella (MMR)
    - Varicella (Chicken Pox)
    - Rotavirus
    - Yellow Fever
    - Influenza (Nasal Spray)
INACTIVATED/KILLED VACCINE

• A VACCINE WHERE THE GERM HAS BEEN DESTROYED WITH CHEMICALS, HEAT, OR RADIATION.
  • INACTIVATED POLIO
  • HEPATITIS A
  • RABIES
  • INFLUENZA (INJECTED)
TOXOID VACCINE

• A VACCINE MADE FROM INACTIVATED TOXIC COMPOUNDS MADE BY THE GERM THAT CAUSES DISEASE
  • Tetanus
  • Diphtheria
SUBUNIT (PURIFIED ANTIGEN) VACCINE

- Similar to an inactivated vaccine but contain only the disease causing part of the germ
  - Protein-based subunit vaccine
    - Hepatitis B vaccine
    - The pertussis (whooping cough) component of the DTaP vaccine
CONJUGATED (SUBUNIT) VACCINE

- POLYSACCHARIDE VACCINE
  - BACTERIA HAVE A SUGAR COATING TO HIDE GERM
  - HARD FOR IMMUNE SYSTEM TO RECOGNIZE

- CONJUGATE SUBUNIT VACCINE
  - HELP SUGAR ATTACH TO A PARTNER GERM THAT CAN BE RECOGNIZED BY IMMUNE SYSTEM

- HEMOPHILUS INFLUENZA TYPE B (Hib)
- PNEUMOCOCCAL CONJUGATE (PCV-7, PCV-10, PCV-13)
THE FUTURE

• DNA VACCINES
  • Injection with genetically engineered DNA so cells directly produce a foreign substance causing an immune response

• RECOMBINANT VECTOR VACCINES (PLATFORM-BASED VACCINES)
  • Act like a natural infection, so they are great at teaching the immune system how to fight germs
DID IT WORK?
TITER TESTING

• Blood test that measure memory antibodies
  • Immunoglobulin G (IGG) levels
• If levels are low a booster vaccine may be administered, and IGG levels checked 4-6 weeks later
ROLE OF VACCINES DURING A PRIMARY IMMUNE DEFICIENCY DIAGNOSIS
Immune System

- Innate
- Adaptive
  - Lymphocytes
    - B cells
    - T cells
    - NK cells
B cell

Plasma cell

Immunoglobulins

IgG
IgM
IgA
IgE
IgD
ROLE OF VACCINES DURING A PRIMARY IMMUNE DEFICIENCY DIAGNOSIS

• They may help make the diagnosis
  • Low titers to vaccines previously administered may indicate an issue with the immune system
  • Lack of titers to certain vaccines despite re-vaccination confirm certain diagnosis
    • Specific antibody deficiency
  • Avoidance of vaccination, especially of those vaccines containing live viral or bacterial components would, be strongly recommended for certain immunodeficiencies
WILL IT HURT?
Recommendations for live viral and bacterial vaccines in immunodeficient patients and their close contacts

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PRIMARY B-CELL IMMUNODEFICIENCY

- Patients with severe deficiencies should avoid oral polio, yellow fever, smallpox, live attenuated influenza, and live bacterial (typhoid and BCG) vaccines.

- Vaccine effectiveness is uncertain in patients receiving immune globulin replacement therapy.

- Consider measles and varicella vaccines.

- All vaccines are considered safe for patients with less severe B-cell antibody deficiencies.
PRIMARY T-CELL DEFICIENCY

• Severe deficiencies
  • Avoid all live viral and bacterial vaccines (oral polio; yellow fever; measles, mumps, rubella (MMR); herpes zoster; smallpox; rotavirus; herpes zoster; live attenuated influenza; typhoid; BCG vaccines).
  • Pneumococcal and Haemophilus influenzae type B (Hib) are recommended.

• Partial T-cell deficiencies
  • All live viral vaccines should initially be avoided.
  • When T cell counts are above a certain number MMR and Varicella are usually safe
  • Pneumococcal, Hib, meningococcal, and killed seasonal influenza vaccines are recommended.
OTHER IMMUNODEFICIENCIES

• Complement deficiencies
  • Patients can receive all vaccines. Pneumococcal, Hib, and meningococcal vaccines are strongly encouraged using both conjugated and unconjugated vaccines.

• White blood cell disorders
  • Patient can receive all routine vaccines but should avoid live bacterial vaccines (BCG and salmonella).
OTHER IMMUNODEFICIENCIES — CONT’D

• Close contacts
  • Family members of immunodeficient patients can receive all vaccines except oral polio and small pox.

• Pregnancy
  • Pregnant women should routinely receive only Tdap and inactivated influenza.
  • Mothers whose immunizations are not up to date and who are at risk for a child with immunodeficiency should also receive pneumococcal, Hib, and meningococcal vaccines.
TAKE AWAY POINTS

• Personal vaccination and herd immunity are very important for patients with primary immunodeficiency.

• Individuals with primary immune deficiency should be immunized as recommended safe for them.

• Family members should be encouraged to receive all vaccines except oral polio.
  • Rarely given in the U.S.
REFERENCES

- Vaccine.org
- Immunze.org
- Primaryimmune.org
THANK YOU!