Vaccines

Chapter 28

Objectives

- Describe the importance of vaccines.
- Explain how vaccines are produced.
- List the most common vaccines.
- Explain how the body builds up immunity against diseases.

Objectives (cont'd)

- Describe where immune cells are produced and what their function is.
- Differentiate between active and passive immunity.
- List the schedule for administering vaccines.

Objectives (cont'd)

- Explain why some vaccines need boosters, whereas others do not.
- Explain under which circumstances adults should receive vaccines.

Introduction

- Vaccines:
  - Prevent infection.
  - Have contributed to longevity in humans.
  - Developing countries still face higher risk of contracting bacterial and viral infections.

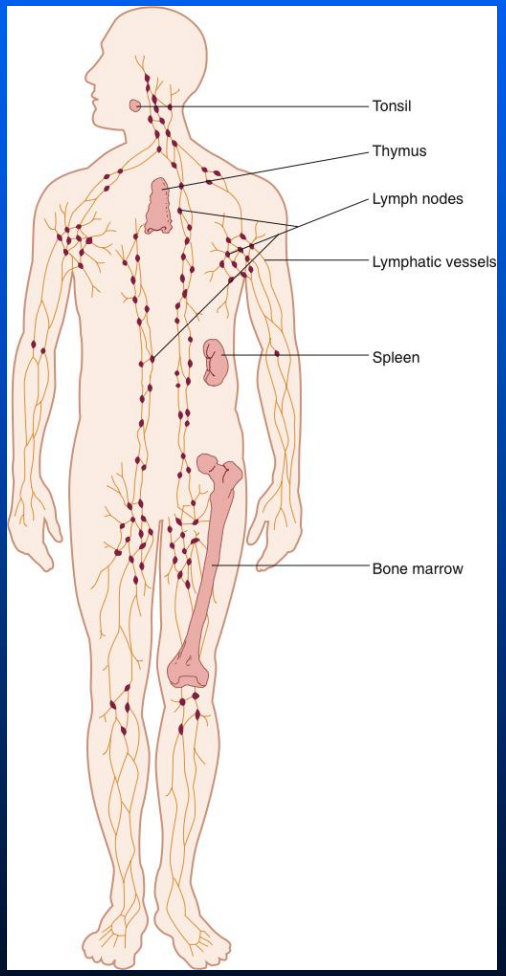
The Lymphatic System

- Body's built-in defense mechanism
- Helps protect from invading organisms
- Primary source of immune cell production
- Referred to as immune system
- Lymph nodes produce arsenal of weapons
- Organs: thymus, tonsils, spleen

Thymus

- Located in upper chest and middle of neck region
- Primary function—produce lymphocytes
- Production begins before birth
- Organ larger in childhood than adulthood

Overview of the Major Lymphatic Organs



Tonsils

- Lymphoid tissue
- Tonsils and adenoids
- Located in throat, nose
- Help fight off infection; filter bacteria, other infective material

Spleen

- Located in left side of upper abdomen
- Largest lymphatic organ in body
- Function: filter large amount of blood cells at end of their life cycle
- Macrophages in spleen remove cellular debris

Types of Immune Cells

- On first contact with foreign body (antigen)—antibodies form
- Lymphocytes:
  - Major fighting cells of body; patrol body circulating through bloodstream
  - Reside in lymph nodes and tissues waiting to attack foreign bodies

Types of Immune Cells (cont'd)

- Two types:
  - B cells—have antibodies
  - T cells—perform cell mediated immune response (direct killing of attached cell)

Major Immune Response Cells

Major Cell Types	Origin of Production	Location in Body	Function
T lymphocytes	Lymph nodes	Lymph nodes	Produces more T lymphocytes that are sensitized to specific antigens
B lymphocytes	Bone marrow (prenatal, produced in liver)	Lymph nodes	Produces specific antibodies
Plasma cells	Lymph from B cells	Bloodstream	Antibodies

Major Immune Response Cells (cont'd)

Major Cell Types	Origin of Production	Location in Body	Function
Memory cells	Lymph from B cells	Lymph nodes	Creates a memory antibody
T cells	Thymus gland	Bloodstream, lymph nodes	Binds to a specific antigen

Immunizations

- Immunizations are given to stimulate antibodies to protect body from disease (whooping cough, tetanus, polio).
- Centers for Disease Control and Prevention—recommends course of vaccinations for children.

Immunizations (cont'd)

- Children at risk for contracting:
  - Measles
  - Chicken pox
  - Mumps
  - Whooping cough
  - Rubella
  - Polio
- Children and adults better protected against diseases
- Higher risk—persons with weakened immune systems, transplants, AIDS

Immunizations (cont'd)

- High risk—people from countries where immunizations not given
- Disease transmitted through blood, body fluids by sharing needles, unprotected sex with infected persons

Types of Immunity

- Active natural immunity:
  - Occurs when body is exposed to a disease and actively produces antibodies to respond to the disease
  - Occurs when vaccines administered
- Two types of vaccine:
  - Live, attenuated (weakened)
  - Disadvantage: Need booster shots
- Passive immunity

How Vaccines Are Prepared

- Viral vaccines:
  - Live vaccines must be attenuated (weakened) before given to patients.
  - Virions—weakened or diffused so as not to cause full-blown disease.
- Antigen: virus or any known foreign substance.

How Vaccines Are Prepared (cont'd)

- Boosters—vaccines given in a series—outer shell of virus used
- Bacterial antigens—cholera, typhoid—require boosters

Common Viral Vaccines, Diseases Treated, Route of Administration

Vaccine Agents	Disease Treated	Route of Administration
Havrix	Hepatitis A	Intramuscular (IM)
Engerix, Recombivax HB	Hepatitis B	IM
Fluzone	Influenza	IM
MMR II	Measles, mumps, and rubella	Subcutaneous (SC)
Attenuvax	Measles	SC
Mumpsvax	Mumps	SC
Meruvax II	Rubella	SC
IPOL	Polio	SC or IM
Varivax	Chicken pox	SC
YF-Vax	Yellow fever	SC

How Vaccines Are Prepared (cont'd)

- Toxoids:
  - Inactivated bacterial toxins
  - Can induce an antibody response in body
- Adult vaccines—tetanus (every 10 years) throughout life

Common Toxoids and Route of Administration

Toxoid Agents	Disease Treated	Route of Administration
Tetanus toxoid	Tetanus	SC IM
Diphtheria and tetanus	Diphtheria, tetanus	IM
DPT	Diphtheria, tetanus, pertussis	IM

DPT, diphtheria, pertussis, and tetanus; *IM*, intramuscular; *SC*, subcutaneous.

Development of Vaccines

- To develop a vaccine, large number of contagious cells must be collected
- Comes through use of lab animals
- Culture cells from humans
- Research being done on HIV
- Danger present with vaccine administration

Development of Vaccines (cont'd)

- Less common vaccines include:
  - Subunit, Antiidiotypic, Acellular and conjugated
- Only two types of vaccines available:
  - Bacterial
  - Viral
- No vaccine available for parasitic, fungal infections

Childhood Immunization

- United States recommends a series of vaccinations for children.
- No school registration without immunizations.
- Childhood immunization schedule.
- See Table 28-5.

National Childhood Vaccine Injury Act of 1986

- Act passed 1986 by congress.
- Act is compensation program for those injured after receiving routine vaccines.

Autism and Vaccines

- Many studies have looked to see if there is a direct relationship between childhood autism and vaccines.
- To date, all scientifically sound studies have failed to find an association between vaccines and the occurrence of autism.

Diphtheria, Pertussis, and Tetanus (DPT) Vaccine

- Diphtheria causes breathing problems from thick mucus covering back of throat.
- Pertussis: whooping cough (traumatic coughing spasms), can lead to pneumonia, death.
- Tetanus: lockjaw, painful muscle spasms.

Diphtheria, Pertussis, and Tetanus (DPT) Vaccine (cont'd)

- DPT vaccines given in 5 doses.
- Doses spread out over several years.
- Pertussis only given to children younger than 7 years.
- Tetanus boosters must be given every 10 years.

Polio Vaccine

- Main polio symptom is paralysis of muscles of legs, respiratory system.
- Mid-1950s polio vaccine developed.
- Oral dose no longer used (can cause infection).
- Injectable form used currently—four immunizations.

Measles, Mumps, and Rubella (MMR) Vaccine

- Measles: serious with flulike symptoms.
- Can progress to major infection—pneumonia, brain damage, death.
- Mumps—affects parotid glands of body—visibly enlarged, fever.
- Can cause meningitis and deafness.

Measles, Mumps, and Rubella (MMR) Vaccine (cont'd)

- Rubella—also called German measles
- Pregnant women—contagious to fetus; vaccine given 3 months before pregnancy
- Symptoms: rash, fever
- MMR—two shots

Chickenpox Vaccine

- Varicella (chickenpox) vaccine
- Very contagious disease; rarely causes death
- Symptoms: skin blisters, fever, itchy rash
- Severe effects: brain damage, infection, death (rarely)

Chickenpox Vaccine (cont'd)

- Shingles is disease caused by chicken pox virus (herpes zoster) in adulthood.
- Symptomsinclude: painful lesions along nerves.
- Treatments: valacyclovir (Valtrex); acyclovir (Zovirax)—7-day period to reduce pain.
- 2006: Single dose for adults older than 60 yrs.

Hepatitis Vaccines

- Hepatitis A: rare, but does have a vaccine
- Hepatitis B—has many side effects:
  - Diarrhea, vomiting, jaundice, lack of energy
- Can lead to liver damage, death.
- Virus contagious via blood and body fluids.
- Contracted through unprotected sex, sharing syringes, infected needles.

Hepatitis Vaccines (cont'd)

- Series of four doses:
  - First dose—newborns immunized right after birth
  - Second dose—1 month after first
  - Third dose—4 months later
  - Last dose—child is 6 months old

Hepatitis Vaccines (cont'd)

- Hepatitis C
  - May not show any symptoms
  - No vaccine
- Treatment: peginterferon (Pegasys) and ribavirin
- Hepatitis D: prevent by vaccine for hepatitis B

HPV Vaccine

- Human papillovirus (HPV) common around world, affects both genders.
- Are 100 types HPV.
- Most vulnerable age: teens through 20s
- Virus causes cervical cancer, genital warts.

HPV Vaccine (cont'd)

- Vaccine: persons 9 to 26 yrs
- Best time: before sexual activity occurs
- Three injections: 6 months
- Side effect: soreness at injection site
- Not safe for pregnant women

Pneumonia Vaccine

- Pneumococcal conjugate vaccine—given for *Streptococcus pneumoniae* (causes pneumonia)
- Serious disease—causes pneumonia, brain damage, death
- Vaccine—three doses
- Pneumococcal polysaccharide—adult vaccine (meningitis, pneumonia)

Haemophilus Influenza Type B (HiB Vaccine)

- HiB—to prevent bacterial infection *Haemophilus influenzae* type B
- Symptoms mild if infection remains in nose and throat
- Spreads to lungs—pneumonia, meningitis, brain damage, systemic infection
- Series of four shots

Influenza Vaccines

- Protect against persons at high risk for influenza.
- FDA (2003) approved new intranasal spray vaccine: FluMist.
- Side effects include: runny nose, nasal congestion, headache, sore throat, chills, cough.

Influenza Vaccines (cont'd)

- Use only on healthy children older than 5 yrs and adults up to 49 yrs.
- Fluvin, Fluzone vaccine given IM.
- Side effects include: soreness, fever, myalgia, malaise.
- Fluzone: children 6 to 23 months; 2-50+ yrs.

Influenza Vaccines (cont'd)

- Do not give to children younger than 6 months, or persons with egg allergy.
- CDC&P: only vaccine for persons over 50 yrs is killed trivalent influenza vaccine (TIV).

Influenza Vaccines (cont'd)

- Swine flu (H1N1)is very different from previous human seasonal influenza viruses (2009).
  - Caused severe illness and deaths especially in high-risk groups.
- Vaccine recommended for high-risk groups.

Passive Immunity

- Passive immunity:
  - Does not require any work on part of body
  - Receives protection from other sources (immune globulins)

Travel Medicine and Immunizations

- Adults receive immunizations for travel outside of United States.
- U.S. military—vaccinates against 12 top contagions.
- Adults needing vaccines include: scientists, researchers, lab animal caretakers.

Example of Vaccines

Vaccine	Disease or Organism	Recommendation
Cholera	*Vibrio cholerae*	Persons living or traveling to endemic areas where the disease occurs; military
Plague	*Yersinia pestis*	Persons protecting against wild rodents in endemic areas; military
Yellow fever	Endemic areas	Persons living in or traveling to endemic areas; military
Anthrax	Anthrax	Military only at this time

Antitoxins and Antivenins

- Antitoxins, antivenins:
  - Passive immunity system for short-term protection from serious symptoms
  - Contain antibodies to neutralize dangerous toxins
- Stepping on rusty nail—*Clostridium tetani*
  - Tetanus antitoxin given

Antitoxins and Antivenins (cont'd)

- Antivenins counteract poison from snakes, spiders, and so forth
- Common antitoxins:
  - Diphtheria
  - Rabies
  - Botulism
- Common antivenins:
  - Black widow spider
  - Rattlesnake

Storage of Vaccines

- CDC&P – guidelines on storage for vaccines; preserve effectiveness
- Most vaccine stored between 2°-8°
- FluMist – frozen in specially made freeze box

Immune Therapies

- Biological therapy or biotherapy
- Biological response modifiers (BRMs): suppress or stimulate the immune system
- Body produces small amount
- Scientists produce large amounts in lab
- Cancer, rheumatoid arthritis, Crohn's disease

Immune Therapies (cont'd)

- Side effects: if severe, patient admitted to hospital
- Table 28-7

Special Situations for Vaccination—Pregnancy

- Pregnant women—contracting hepatitis poses high risk to fetus.
- High-risk women—given DT, hepatitis B, influenza vaccines.