Which statement[s] is/are true?
- At birth the immune system is non-functional (it is partially functional at birth)
- For the first 2 months of life infants are completely protected by Antibodies from the mother. (partially protected)
- **The immune system of a child is not fully functional until 6-8 years of age.**

Immunity: Review
- Innate/Natural Immunity
  - Intact Skin (very important in the immune response!)
  - Mucous membranes
  - Body pH (not as acidic as it will eventually become)
- Passive
  - Placental transmission
  - Breast feeding (IgG)
- Adaptive/Active (these develop over time)
  - Inflammatory and phagocytic properties; born with phagocytic intact, takes a while for inflammatory response to kick in
  - Humoral-antibody mediated
  - Cell mediated

Humoral Immunity
- Largely responsible for fighting bacterial infections; first time someone is exposed to a specific antigen, the body stimulates a response to produce an antigen for that; specific antibody; the first time this happens, it takes about 72 hours to get an ample anti-body response
- B-lymphocytes
- Produced in bone marrow
- Antigen-Antibody response
- Primary immune response – 1st exposure time frame 3 days
- Subsequent <24 hours due to memory cells "remembering" the antigen
- At birth – IgG from mother – others increase through exposure during early childhood; this usually diminishes at around 6 months of age, then slowly increases up through age 6 or 7.

Cellular Immunity
- Largely functional at birth
- T-lymphocytes
- Produced/mature in the thymus; if a baby is born without a thymus or thymus is disrupted d/t surgeries then we really worry about an alteration in T-lymphocytes
- Responsibility in fighting viruses, fungi, slowly-developing bacterial invasions
- Beyond neonatal period they are mostly functional

Complement Activation (don't worry if you don't understand this!)
- Cascade that is responsible for the inflammatory response
- Inflammatory response brings stuff to the site of infection...shows us nurses indicators of infection (redness, swelling, warmth)
- Important in inflammatory reaction; kills foreign cells
- Complement system is decreased in newborn period (1st 2 months) ; it develops after birth at different times for different babies...baby may not be able to give us signs of WHERE the infection is, can't wall-off the infection either
- Delays and hampers inflammatory response

Key Points!
- At birth and during the newborn period, the inflammatory response is not reliably present
- Under 6 years of age children do not have a full compliment of immunoglobulins
- **Response to initial exposure to bacterial antigens takes 3 days**, increasing the risk for sepsis due to difficulty localizing and fighting bacterial infections

Chain of Infection
- Agent to reservoir to exit to transmission to entry to host to agent…
  - Agent
  - Reservoir is where it lives
  - Exit is how it gets out
  - Transmission: airborne, contact, droplet
  - Entry is how it gets into another person
  - Host must be susceptible (children are MORE susceptible)
  - Host becomes the agent

Measles
- Airborne (few things are truly airborne…..measles and chicken pox are); this is VERY contagious...MORE SO than droplet! Will be on respiratory isolation; most contagious BEFORE the rash develops up to 4 days after rash shows
- Child is quite ill...symptoms are three Cs (choriza/runny nose, cough, conjunctivitis)
- Symptoms: cough, very high fever around 104-105, red eyes, rash hairline to feet, Koplik's spots (these spots are diagnostic for measles...bluish white spots in mouth)
- Complications: pneumonia (fairly common, can lead to ARDS), encephalitis, death
- Treat supportively
  - Pain: tylenol
  - Rash: keep clean and dry to reduce itchiness, Benadryl
  - Eyes: warm compresses

Mumps (a happier situation than measles)
- Droplet transmission; contagious 7 days prior to swelling and stays contagious until 9 days after
- Symptoms: earache, swollen cheeks/jaw, fever, HA
- Complications: encephalitis (most common one, so need to teach parents signs of meningeal irritation), deafness (child needs a follow-up hearing exam), testicular swelling
- No airway problems even though it looks like
- Problems with eating/drinking b/c it hurts to move jaw
- Kids are managed at home via comfort measures and fluids.
  - Warm or cold compresses help
  - Tylenol for pain
  - Soft foods
  - Hydration

Diphtheria
- A bacteria that produces an endotoxin that produces the symptoms
- Direct contact/ droplet transmission; can also get via unpasteurized milk
- Symptoms (wide-ranging): asymptomatic all the way up to "can't breathe", sore throat, fever, difficulty swallowing
- Complications: suffocation, paralysis (Guillian Barre), death, endocarditis (from endotoxin attacking heart), neuropathy (from endotoxin)
- Treatment: antitoxin and abx + supportive care.
- Diphtheria has a high mortality rate in places where there is not a pediatric ICU...child needs to have airway maintained via careful intubation.

Tetanus
- A spore that lives in dirt, gets into the body through some opening in the skin and causes production of an endotoxin that attacks the CNS.
- Direct contact with non-intact skin; a huge cause world-wide is cutting the umbilical cord with something dirty
- Symptoms: muscle rigidity
- Complications: Respiratory, broken bones (because the muscles in young kids are stronger than the bones), death
- Treatment: antispasmodics (boat-load of Valium), so need to be careful for respiratory so be prepared for that, IV abx, Immunoglobulin asap, Tetanus toxoid at a different site than the Immunoglobulin)
- Tetanus has a 30% mortality (even with ICU care)

- Prevention: Tetanus immunization...need booster q 10 years of q 5 if they have a contaminated wound.

Pertussis
- Droplet/ direct contact
  - Bacteria invade cilia then paralyzes cilia leading to an inflammatory response and an inability to clear thick secretions (child is going to cough and cough and cough)
  - Contagious 1 week after exposure to when????
- 3 stages of pertussis
  - Catarrhal Stage (1-2 weeks): looks like a cold with a cough that gets progressively worse; tends to cough at night
  - Paroxysmal Stage: "whooping" cough; coughing in spasms; the problem with this is that the child has periods of hypoxia and child is also at risk for aspiration; child doesn't have the energy to continue and crashes
  - Convalescent Stage: cough gradually goes away; takes a long time; at risk for episodes of coughing for a period of a couple years, indicating some degree of temporary lung damage
- Diagnostics: physical exam, Hx, listen for "Whoop", + culture means pertussis (but negative culture doesn't mean it's not there), elevated WBC > 20,000
- Treatment
  - Erythromycin
  - Supportive for airway, rest, NG fed if can't eat safely, may need vent
  - Treat the whole house

Polio
- Fecal-oral transmission
- Symptoms (wide-ranging): fever, HA, muscle spasm, varying-degrees of muscle weakness/paralysis
- Treatment is supportive and working to prevent complications of immobility
- 5-10% of kids who end up with polio have respiratory depression
- Complications: respiratory, long-term paralysis

Chickenpox
- Airborne transmission (very easy to catch)
- Absolutely deadly for immuno-suppressed patients
- Symptoms: "dew drop" rash (red base with a clear vesicle on top), fever, sore throat, super itchy (prone to secondary infection)
- Complications: skin infections, pneumonia, encephalitis (neuro symptoms), death
- The deal with chicken pox: it is HIGHLY contagious, has a long incubation period (10-21 days post exposure), it is most contagious right before the rash breaks out and until pox have crusted over

Things to look for with kids
- fever that lasts more than a week, or fever that goes away and then spikes
- trouble breathing
- neuro signs
- look at skin b/c many of these illnesses have rashes

Global Considerations
- What is the #1 cause of death in children > 1 year of age – worldwide? Diarrhea...it causes dehydration and they are not able to be rehydrated
- What strategies do you believe would be useful?

Rotavirus
- By 5 years of age nearly 100% children +
- Pandemic every year! Each year > 500,000 children die
- Incidence: Industrialized countries = Developing countries (vast majority of death is in developing countries b/c can't rehydrate them)
  - oral rehydration is preferred, but if child can't keep anything down then have to go with IV fluids

- Transmitted person to person; has nothing to do with drinking bad water
- Causes 3-8 days fever, vomiting, diarrhea
- Self-limiting, partial immunity after infection...so 2nd case will not be as severe as the first
- Rota-Shield (the first immunization for Rotavirus) NOT ON TEST. The problem with this, is they had a too-high incidence of intesusception; they have a new immunization (RotoTrix?)

Infectious/communicable diseases: general management
- Specific treatment
- Prevent spread
- Prevent complications
- Manage fever (Tylenol, NOT aspirin)
- Comfort (Tylenol)

Why Immunize? Risk vs Benefit
- '98 British Medical Journal reported link between immunization & autism
  - this report went out over popular press and was interpreted to mean that the cause of autism was found
  - the researchers looked at kids with autism and then looked back to see what was the same about all of them...they had all gotten the MMR vaccine.
  - many people got concerned with MMR vaccine
  - since then there have been 5 very strong studies looking at MMR and autism
  - there are complications of vaccines, just a there are complications of diseases...have to choose one or the other and nothing is 100% safe.
- 2000 U of W Study: increased risk of febrile seizure but no evidence of risk of neurodevelopmental effects
- World wide 1 million measles related deaths per year

Disease risks
- Measles
  - Pneumonia: 1:20
  - Encephalitis: 1:2000
  - Death: 1:3000
- Mumps
  - Encephalitis: 1:300
- Rubella
  - Congenital Rubella Syndrome: 1:4
- Vaccine Risk
  - Link between MMR and encephalitis or severe allergic reaction (1:1,000,000)
- Allergy risks
  - Egg allergy, gelatin, neomycin
- Diptheria
  - Death: 1:20
- Tetanus
  - Death: 3:100
- Pertussis
  - Pneumonia: 1:8
  - Encephalitis: 1:20
  - Death: 1:200
- Vaccine Risks of DTaP
  - seizures or shock then full recovery 1:17,500
  - acute encephalopathy o

When to Immunize?
- Opportunity vs schedule (do not memorize the schedule)
- Contraindications to immunization
  - Severe febrile illness b/c if child has a bad reaction then it's hard to separate out the illness vs. the reaction

- Recent administration of immune globulin: usually < 6 months; body will not be stimulated to produce immune response
- Altered immunity: whether or not they get the immunization depends on their type of altered immunity and the doc's management
- Severe pertussis reaction: do not give pertussis if they've reacted badly to it before
- hypersensitivity

Giving Immunizations

- Key points
  - Safe to give several at same visit
  - 2 injections/different site but same limb OK
  - Minor illness/low grade T OK
  - Recent exposure infectious disease OK
  - Hx local reaction or family member reaction OK
- Legal Considerations
  - date/time
  - site/route
  - write down vaccine, manufacturer, lot #, expiration date
  - name, title, address of administrator
- Need consent
- Need to teach parents the common side effects to expect (fever, local irritation, irritability) and which side effects you are concerned about (neuro symptoms, extreme irritability, seizure, high fever)

Alterations in Immune Function

- Autoimmune: General Principles
  - "self" recognized as "non-self"
  - Tissue injury caused by immune cell attack
  - Systemic: SLE & JRA (read about these in the book as well)
  - Organ specific: IDDM & Thyroiditis (not on test)

Juvenile Rheumatoid Arthritis

- Most common pediatric connective tissue disease
- 80-90% recover without functional limitations...yay! The 10-20% are the ones you see in the hospital setting.
- Peak onset: 2-4 y/o (girls>) and also 10-12 y/o (boys>)
- Etiology?: multifactorial, not really sure, may be genetic + triggering factor
- Pathophysiology of JRA
- T-cell activation that recognizes the connective tissue as foreign, causing AG-AB complexes to set up in tje joints and Release inflammatory substances leading to Inflammation: joint effusion/swelling and long-term causes Chronic Inflammation anderosion of cartilage. Main problems for these kids are PAIN and mobility.
- Symptoms of JRA (swelling, inflammation and pain in the joints)
  - Pauciarticular onset (a few joints involved)
    - Arthritis in <4 joints
    - 50% cases
  - Polyarticular onset (many joints involved)
    - > 4 joints
    - 40% cases
- Systemic (not in all kids, maybe 10% of kids)
  - High fevers w/ late evening spikes
  - Maculopapular rash (red, raised rash)
  - Hepatosplenomegaly (signs that the immune system has been stimulated)
  - Pericarditis (immune system is attacking connective tissue)
  - Pluritis (immune system is attacking connective tissue)
  - Lymphadenopathy (sign that immune system has been stimulated)

Treatment for JRA
- Diagnosis: history, assessment
  - Arthritis onset < 16 y/o
  - Persisting 6 weeks or more
  - No other causes can be found
- Relieve pain
  - Salicylates; NSAIDs to take care of inflammation and pain
  - Methotrexate will depress the immune system
  - Steroids to depress the immune system
- Prevent contractures
  - PT/OT
- Social/emotional
  - Steroids make teens gain weight, grow hair in places they don't want to, irritability/mood swings
- Prevent obesity if possible
- Skin d/t steroids and immobility
- 30% of kids are at risk for eye involvement, so need to watch for that.

SLE (Systemic Lupus Erythmatomus)
- Epidemiology:
  - Females > Males; see more of this in the hospital than JRA
  - AA, Hispanics, Asian > Caucasians
  - Presents at puberty
- Etiology:
  - AG-AB complexes
  - Vascular system is attacked by antibodies
  - Widespread inflammation & damage, different systems involved
  - Highly variable presentation (
  - The most common systems to be affected are skin (butterfly rash), kidneys….less common are spleen and heart.
- Treatment
  - Create remission of symptoms: decreasing the immune response
    - corticosteroids
    - cytoxin
    - Paquanil (an anti-malarial)
  - Prevent complications (target measures to organs involved)
  - Teach kids what their triggers are; common ones are:
    - stress (teach stress management)
    - UV light (sunlight)

Immunodeficiency disorders
- May be congenital or acquired
- May involve failure of humoral antibodies [B-cell]
- May involve failure of cellular [T-cell]
- May involve both T and B cells...not good news at all

B-cell disorders
- Symptoms generally present at 3 months (we don't expect them to have B-cell fxn until around then anyway)
- Recurrent bacterial infections
- Failure to thrive d/t chronic GI infection leading to diarrhea
- Prognosis depends on degree of dysfunction
  - some kids get Immunoglobulin for rest of life
  - others just watch and prevent disease?

T-cell disorders
- Absence of parathyroid/thymus gland
  - DiGeorge Syndrome is most common of these
- Cardiac and ear defects
- Viral and fungal infections in neonatal period

General Nursing Care with Immunodeficiency
- Prevent/treat systemic infection
- Skin integrity
- Symptomatic support
  - Nutrition; there is good data that good nutrition supports immune function; micronutrient deficiencies are associated with poor immune function.
- Medication therapy (will depend on individual patients)
  - Antibiotics, may be prophylactic
  - IVIG (passive immunity)
    - According to manufacturer
    - Slow start; monitor VS & RXN (as though you are giving blood)
  - Immunizations will be specific to the child
- Emotional/social support
  - stressful events are associated with depressed T-cell counts
  - help family develop positive coping mechanisms

Acquired Immunodeficiency Syndrome in Children
- Exposure source children under 15 y/o
  - Hemophilia/coagulation disorder: 2.6%
  - Vertical Transmission: 91.2% (mom to baby)
    - Once a baby starts to present with S&S of AIDS, that it progresses much more rapidly than it does in adults. If this happens in infancy, most will be dead by 2 years.
  - Receipt of blood or tissue: 4.2 %
  - Risk not identified: 1.9%
- Treatment of Prenatally exposed
  - Testing (ELISA test looks for the antibodies...if it's + then the baby has been exposed)
    - PCR test shows the DNA of the virus
    - Baby is not NEGATIVE until they've had two separate PCR (one month apart) when child is over 6 months of age.
  - All babies get abx prophylaxis against PCP (begin 4- 6 weeks); if asymptomatic, then we consider ART therapy; if symptomatic then we start ART right away; the regime for ART is complicated and compliance is an issue.
  - ART to mothers after first trimester
  - Close monitoring for s/s infection or drug side effects

Treatment Considerations in Pedi HIV
- Goal: Slow progression and Increase quality of life
- ARV TX: (antiretroviral therapy)
  - Increase compliance by teaching, talking to parents, <u>support group</u>
  - Limited choices?
  - <12mo tx vs not in asymptomatic patient controversial
- Goals ARV therapy
  - Maximal suppression of viral replication
  - Preservation & restoration of immune function
  - Prevention of complications: opportunistic infections, nutrition, pain
- Nutrition for HIV kids
  - Malnutrition impairs immune function
  - HIV-related nutrient malabsorption compromises nutritional status (d/t diarrhea)

    - Nutritional deficiencies begin early
    - Wasting syndrome occurs in 18% children (CDC study 2000)
- Nutrition Assessment
    - Monitor growth of the child
    - Clinical status:
        - Symptoms that impair nutrition; mouth sores, diarrhea, anorexia, lethargy
        - Physical activity
        - Food intake/availability
        - Look for S/S vitamin/micronutrient deficiency
- AIDS Wasting
    - CDC Definition:
        - Persistent weight loss > 10% of baseline
        - Downward shift of 2 percentile line on growth chart
        - <5th percentile on weight chart + chronic diarrhea or fever
        - **Intervene BEFORE child has wasting syndrome!!!**
- HIV: Nutrition
    - Diet education
    - Tx underlying conditions
    - Oral supplementation
        - Initiate early
        - Increase frequency feeds
        - High calorie formulas (pediasure, nutren Jr)
        - Semi-elemental: (peptamen Jr)
    - Vitamin/mineral supplementation
    - Tube feedings
        - indicated with failure of oral management
        - NG vs GT (less infection with GT once past the surgical healing)
    - Parenteral feedings
        - Severe nutritional disturbances
        - Continue enteral nutrition while on TPN
        - Need a deep line, high risk of infection
- Pain with HIV
    - Multifactorial and biologically complex
    - Associated with quality of life, increased mortality
    - Reported more often in younger kids vs older kids, girls more than boys
    - Sources: nerve or muscle inflammation, cardiomyopathy, drug toxicities, invasive secondary infections
    - Stressors amplify pain
- Treatment for HIV related pain
    - Non-pharmacologic; visualization, distraction, etc...
    - Pharmacologic
        - Some pain meds interact with ART's
        - Alter levels ART's &/or analgesic
    - Escalating needs of narcotics = increased complications
    - Opioid/benzodiazepine require weaning if on for more than 3 days

A few last words about skin….

- At birth the skin is thin
    - Increased heat loss
    - Increased absorption
- Increase % water and loose connections
    - Increased vulnerability
- Sebaceous glands immature
- SacCT Module focus study of key skin disorders
    - exzema, lice, scabies, etc...

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