Neonatal Sepsis

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Session Summary

This session provides a general overview of neonatal sepsis to help prepare for the certification exam.

Session Objectives

Upon completion of this presentation, the participant will be able to:

- identify the clinical settings of sepsis;
- discuss the pathophysiologic consequences of the systemic inflammatory response syndrome (SIRS) and its role in the development of sepsis;
- identify precipitating factors for development of sepsis;
- identify the most common microorganisms responsible for newborn infection;
- recognize signs of infection in the newborn;
- discuss a multi-disciplinary approach to screening and treating client with sepsis;
- determine the most-likely appropriate antimicrobial agent based upon history, physical examination finding, and laboratory test results.

Test Questions

1. A newborn with sepsis may exhibit worsening after they receive an initial dose of antibiotics due to:
   a. drug interaction leading to toxicity
   b. decrease in white blood cell count
   c. production of B cell antibody
   d. release of endotoxin

2. Diapedesis is a process in which:
   a. neutrophils migrate from the bloodstream to an injured tissue site
   b. neutrophils stick to capillary walls
   c. there is oxygen-dependent killing of cells
   d. bacteria are "coated" with opsonin
3. Your patient has a WBC count of 6.1 with an absolute neutrophil count (ANC) of 300. This result indicates:
   a. normal WBC with neutropenia
   b. leukopenia and neutropenia
   c. leukocytosis and neutrophilia
   d. normal WBC and neutrophilia

4. To determine whether a newborn acquired an infection in utero, antigen specific antibody to which of the following classes should be measured?
   a. IgA
   b. IgG
   c. IgM
   d. IgD
   e. IgE

5. When used in reference to the WBC differential a "shift to the left" means
   a. an increase in segmented neutrophils
   b. an increase in immature lymphocyte cells
   c. an increase in total WBC count
   d. an increase in neutrophil bands

References


Neonatal Sepsis

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Is This Scenario Familiar?

Two infants…same gestational age, same maternal history and care, both GBS positive

One alert and active…the other…the sickest baby in the NICU

Is This Scenario Familiar?

• What happened?
  ○ Was anything missed?
  ○ Could these changes have been recognized earlier?
• Need to look at how the host responds to the bacteria
  ○ Systemic reaction by the host to bacteria that gives us the signs & symptoms

“Classic” Definition of Neonatal Sepsis

• Clinical syndrome of systemic illness accompanied by bacteremia in the first month of life

Early-onset Sepsis

• Presents in first three days of life (up to 7 days of life in other literature)
• Multisystem fulminate illness
• Colonized with pathogen in perinatal period
  ○ GBS, E.Coli, Listeria, Enterococcus, Staphylococcus
• Can have rapid progression to septic shock

Late-onset Sepsis

• Presents after DOL 7
• Pathogens similar to early onset
• Increased predilection for CNS
• Less severe systemic & CV symptoms
Nosocomial Sepsis (Late/late onset)

- Pathogenesis multifactorial
- Related:
  - Underlying illness
  - Altered flora in NICU environment
    - Antibiotic and steroid use
    - Use of H₂ blockers
  - Invasive monitoring

Nosocomial Pathogens

- Staphylococci
  - Staph epi, staph aureus & MRSA
- Gram negative rods
  - Pseudomonas, Klebsiella, Proteus, Serratia
- Fungal
  - Candida albicans, Candida parapsilosis

Risk Factors for Sepsis - Maternal

- Chorioamnionitis
- PROM
- Maternal fever
- Premature labor/prolonged labor
- Bacteremia
- UTI
- Amniotic fluid problems
- Maternal substance abuse

Risk Factors for Sepsis – Neonate

Immature Host Defense Mechanisms

- Fragile skin & mucus membranes
- ↓ response to chemotaxis
- ↓ ability to perform migration
- ↓ antibody production
- ↓ phagocytosis
- ↓ killing ability

Complement

- Consists of 20 serum proteins
- No transplacental passage
- Synthesized in liver & alveolar cells
- Classic pathway
  - Antibody/antigen mediated
- Alternative pathway
  - Endotoxin release

Complement

- Initiates intrinsic clotting cascade
  - Results in bradykinin formation
  - Increases hypotension
- Decreased activity in term infants
  - ½ adult level
  - Normal values by 3-6 months (classical)
  - Normal values by 12 months (alternative)
**Phagocytosis**

- Most important function of neutrophil
- Can phagocytize 5-20 bacteria
- Killing occurs via “respiratory burst”

**Adult Neutrophil**

**Neonatal Neutrophil**

- Widespread inflammatory response
  - Formation of mediators
- Initiated by variety of insults
- Encompasses several stages of infection
  - Sepsis
  - Septic cascade

**Systemic Inflammatory Response (SIRS)**

- Widespread inflammatory response
  - Formation of mediators
- Initiated by variety of insults
- Encompasses several stages of infection
  - Sepsis
  - Septic cascade

**Normal Inflammatory Response**

- Discrete reaction
  - ↑ nutrient delivery to tissues
  - ↑ WBCs to area
  - ↑ phagocytosis
  - Wall off injury
  - Promote host defense healing

**Septic cascade**

- Uncontrolled vasodilation
  - Hypotension
  - Third spacing
  - Microthrombi
  - Further mediator release
  - DIC

**Overstimulation of coagulation**
DIC

Inflammatory Mediators

- Mediator
  - Bioactive substance that exerts a physiologic or pathophysiologic change in body cells or tissues
- Septic Triad
  - Endotoxin
  - Tumor necrosis factor (TNF)
  - Interleukin-1 (IL-1)

- Endotoxin
  - Component of bacterial cell wall
  - Liberated when bacteria die or multiply
  - Can be present in absence of positive blood culture
    - Gut translocation

- TNF (Tumor Necrosis Factor)
  - Levels rise immediately after endotoxin release
  - Cytotoxic to endothelium
  - Activates the clotting cascade
  - Stimulates production of PAF
  - Promotes release of IL-1
  - Stimulates arachidonic acid metabolism
    - Leukotrienes
    - Prostaglandins
    - Free oxygen radicals

- Interleukin-1 (IL-1)
  - Released in response to TNF
  - Synergistic effect with TNF
  - Potentiates hypotension
  - Initiates complement cascade & coagulation
  - Promotes leukocytosis, fever, metabolic changes

Inflammatory Mediators

- Clinical consequences
  - Hypotension, GI ischemia
  - Alveolar thickening, acute tubular necrosis

Septic Shock

- Gram negative
  - E.coli
  - Klebsiella
  - Enterobacter
  - Pseudomonas
  - Proteus

- Gram positive
  - GBS
  - Staph species
  - Enterococcus
  - Group A strep
  - Listeria

Clinical Signs of Sepsis

- Respiratory
  - Early-onset predominantly pneumonia
  - Presents similar to RDS
  - CXR show infiltrates, bilateral consolidation or pleural effusions
  - Apnea (in first 24 hrs) usually associated with sepsis

- Cardiac
  - Pulmonary hypertension
  - Decreased cardiac output
  - Bradycardia
  - Systemic hypotension

- Metabolic
  - Glucose instability
  - Metabolic acidosis

Clinical Signs of Sepsis

- Neuro
  - “Not acting right”
  - Meningitis
    - GBS, E.Coli most common
    - Ventriculitis -> arachnoiditis -> vasculitis -> cerebral edema
    - Infarction

Increased morbidity and mortality
Clinical Signs of Sepsis

- Temperature instability
  - Response to pyrogens
  - Sympathetic nervous system instability
- Hematologic
  - Thrombocytopenia
  - DIC
  - Neutropenia/neutrophilia

Gastrointestinal

- Feeding intolerance
- Jaundice
- Ileus
- NEC

Skin Lesions

- Pustules, abscesses
- Cellulitis
- Necrotic skin lesions

Osteomyelitis

- Inflammation of the long bones caused by a microorganism
- Etiology
  - Sepsis
  - Direct inoculation – scalp electrodes, IV, blood draws, heelsticks
  - Extension from ear or sinus infections

Clinical presentation

- Pain on motion, redness, swelling, paralysis, continuous positive blood cultures

Diagnosis

- Full sepsis workup, x-ray, needle aspiration of involved bone and 4 weeks of antibiotics

Prognosis

- Can lead to permanent disability and increased mortality. Early diagnosis and treatment is imperative

Diagnostic Work-up

- CBC with differential
  - May need to follow serial CBCs
  - Immature to total neutrophil count (I/T)
    - Bone marrow releasing more immature cells
    - Left shift – elevated I/T ratio > 0.2
  - Absolute neutrophil count (ANC)
    - ANC of 500-1000 intermediate risk
    - ANC <500 increased risk

Diagnostic Work-up

- C-reactive protein (CRP)
  - Acute phase protein
  - Elevated in 50-90% of infants with systemic bacterial infections
  - Rises within 24 hours & peaks within 2-3 days
  - Serial values used to determine response to antibiotics, duration of therapy, and/or relapse of infection

- Blood cultures
  - Positive cultures confirm diagnosis
  - Factors affecting results
    - Maternal antibiotics
    - Organisms difficult to grow & isolate
    - Sampling errors with small volumes

Diagnostic Work-up

- CSF culture
  - When to obtain?
    - Those with clinical signs or positive blood culture for EOS, should be done for all LOS work-ups
    - Low yield in asymptomatic infants being treated for maternal/OB risk factor (EOS)
  - Findings: pleocytosis, elevated protein, low glucose
    - WBC: 0-32 in first month; no higher than 10 after 1 month
    - Protein: term 20 to 170; preterm 65 to 150
    - Traumatic taps: one leukocyte for every 700 RBCs

- Urine culture
  - Part of late onset sepsis evaluation
  - Suprapubic is gold standard

Management

- Fluid resuscitation
  - Increased requirements
  - Peripheral vasodilation & capillary leakage
  - Early & effective therapy may prevent progression to shock
  - ? use of colloids vs. crystalloids

- Inotropic support
  - Dopamine & Dobutamine

- Oxygenation
  - Correct metabolic abnormalities
    - Acidosis, hypoglycemia, hypocalcemia

- Antimicrobials
  - Initial administration
  - ? amplifies inflammatory response
Management

- **Antimicrobials**
  - Initial therapy
    - Combination of a penicillin & aminoglycoside
  - Ampicillin
    - Effective coverage for gram positive
    - H. flu, E. coli, Proteus & Listeria
  - Gentamicin
    - Coverage against gram neg (+ Pseudomonas)
    - Synergistic effect with ampicillin against GBS, E.coli, listeria & enterococcus
  - Claforan
    - Coverage against gram negative
    - Better tissue penetration (CSF)

Management

- **Continuation of treatment**
  - Initial cultures negative & infant asymptomatic
    - 2-3 days
  - Clinical or lab evidence of infection but negative cultures
    - 7 days
  - Blood cultures positive → 7-10 days
  - UTI → 10 days
  - Pneumonia → 10 days
  - Meningitis → gm + (14 days); gm – (21 days)

Management

- **Adjunct strategies to strengthen the immunocompetence of the infant**
  - Granulocyte transfusions
  - Immunoglobulin transfusions
  - Monoclonal antibodies
  - Cytokine therapy

Cytokine Therapy

- Promote differentiation of stem cells into different types of myeloid cells
- rhG-CSF
  - Induces dose-dependent neutrophilia
  - Increases bone marrow storage & proliferative pools
  - Improves NB host defense
    - Chemotaxis, adhesion, & killing

Common Neonatal Infections

- **Antimicrobials**
  - Nosocomial therapy
    - Need to consider organisms acquired from NICU environment
  - Addition of a penicillinase-resistant drug
    - Nafcillin, oxacillin or vancomycin
  - Consider anti-fungal therapy

Didn’t you hear? There’s a virus sweeping the hospital.
**Group B Strep**

- Gram + cocci in pairs or chains
- Leading cause of neonatal sepsis
- Incidence is decreasing with intrapartum antibiotic prophylaxis (IAP)

![GBS Transmission Diagram](http://www.cdc.gov/groupbstreptococcal/disease/transmission.html)

**Enterococcus**

- Enterococcus faecalis, enterococcus faecium
- Gram positive cocci in chains
- Nosocomial
- Increasing resistance, watch sensitivities
- Vancomycin-resistant enterococcus (VRE)
- Present as bacteremia, meningitis, and urinary tract infection

**Staphylococcus**

- Gram positive cocci in clusters
  - Staph coag positive = staph aureus
    - Sepsis, osteomyelitis, pneumonia, septic arthritis
    - Scalded Skin Syndrome
    - Methicillin Resistant Staph Aureus (MRSA)
  - Staph coag negative = staph epi
    - Usually causes a mild disease but in an immunocompromised patient can cause severe disease
Escherichia coli (E. Coli)

- Gram negative rod
- Most common second only to GBS
- Associated with chorioamnionitis
- Nonspecific signs of sepsis
- Progresses rapidly
- Need double coverage for SPACE: Serratia, pseudomonas, acinetobacter, citrobacter, E Coli

Klebsiella

- Second most common Gram negative rod
- Frequent cause of pneumonia especially in neonate on ventilator
- Can produce extended-spectrum beta-lactamases

Pseudomonas Aeruginosa

- Opportunistic
- Immunocompromised patients
- Nosocomial
- Can cause sepsis, pneumonia, conjunctivitis
- Treatment: Aminoglycosides, meropenum, imipenum, cefepime, ceftazidime
  - Watch sensitivities, often resistant
  - Double coverage

Candidiasis

- Normal flora of the mucus membranes of the respiratory, GI and female genital tract
- An opportunistic infection – 3rd most common
- Risk factors (warm, moist, sugar)
  - Broad spectrum antibiotics – destroys the competing bacteria
  - Treatment with a 3rd generation cephalosporin
  - Invasive lines/procedures
  - Prolonged TPN
  - VLBW
  - Disrupted skin barrier
  - Colonization

Candida

- Types
  - Candida albicans (a) – 80%
  - Tropicalis (t) – 6%
  - Stellatoidea
  - Guilliermondii
  - Parapsilosis (p) – 14%
  - Malassezia furfur

Cutaneous Candidiasis

- Oral candida
  - Treat with nystatin/gentian violet
- Cutaneous
  - Found in moist area including skin folds
  - Appears as a papular or vesicular rash with an erythematous base
Congenital Candidiasis Sepsis

- Related to ascending infection in utero
- Presents shortly after birth
- Full term
  - Generalized rash
- Preterm
  - Rash, pustules, vesicles
  - Invasive pulmonary disease

Systemic Candidiasis

- *Insidious* and individually variable
- Signs of sepsis and worsening status with negative cultures and no response to treatment
- Respiratory deterioration (100%)
- Apnea and bradycardia (90%)
- Usually appears around DOL 30
- Infiltrates on chest x-ray
- **Thrombocytopenia**
- **Hyperglycemia (70%)**

Systemic Candidiasis and Organ Involvement

- Meningitis – 15%
- Osteoarthritis
- Eyes (endophthalmitis) – fluffy white lesions on retina or vitreous – 3%
- Renal – common involvement. May be the primary site – 5%
  - HTN
  - Oligo/anuria
  - Pyuria/hematuria/proteinuria
  - Enlarged kidney
- Cardiac -5%
- Brain abscess – 3%
- Liver/spleen

TORCH Infections

- T = Toxoplasmosis
- O = Other (Syphilis, HIV)
- R = Rubella
- C = Cytomegalovirus
- H = Herpesviruses (HSV, Varicella-Zoster)

Common Manifestations of Congenital TORCH Infection

<table>
<thead>
<tr>
<th>Findings</th>
<th>Toxo</th>
<th>Treponema</th>
<th>Rubella</th>
<th>CMV</th>
<th>HSV</th>
<th>VZV</th>
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<tbody>
<tr>
<td>Bony Abnormal</td>
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<tr>
<td>Cardiac Abnormal</td>
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<tr>
<td>Cataracts</td>
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<td>Hearing deficit</td>
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<tr>
<td>HSIM</td>
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<tr>
<td>Hydrocephalus</td>
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</table>

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Common Manifestations of Congenital TORCH Infections

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<tbody>
<tr>
<td>Intracranial Calcifications</td>
<td>X</td>
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<tr>
<td>Microcephaly</td>
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<tr>
<td>Hydrops</td>
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<tr>
<td>IUGR</td>
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<td>Rash</td>
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<td>Thrombocytopenia</td>
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Diagnostic Tests for Congenital TORCH Infections

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Dx test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxoplasma</td>
<td>Detection IgM or IgA antibody, blood or urine cx, DNA PCR</td>
</tr>
<tr>
<td>Treponema</td>
<td>Quantitative serum and CSF treponemal test, VDRL, direct fluorescent antibx test of lesions</td>
</tr>
<tr>
<td>Rubella</td>
<td>Nasal cx, specific IgM antibody</td>
</tr>
<tr>
<td>CMV</td>
<td>Culture of urine, DNA PCR, shell virus assay, detection of CMV IgM</td>
</tr>
<tr>
<td>HSV</td>
<td>DNA PCR of CSF, cell cx of skin lesions, mouth, NP, eyes, biopsy/culture</td>
</tr>
<tr>
<td>VZV</td>
<td>DNA PCR, viral culture, specific IgM antibody</td>
</tr>
</tbody>
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Toxoplasmosis

• Protozoan
• Sources
  o Domestic cats – only definitive host. It is a reservoir for the oocytes, which are passed in the feces and may remain viable in the soil up to 1 yr.
  o Undercooked meat (esp pork)
• Transmission
  o Congenital infection result of transplacental transmission during primary maternal infection

Transmission and Fetal Impact

• Directly related to gestational age when maternal infection occurs and if mother is being treated

<table>
<thead>
<tr>
<th></th>
<th>Without maternal treatment</th>
<th>With maternal treatment</th>
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<tbody>
<tr>
<td>First trimester</td>
<td>10-15%</td>
<td>5%</td>
</tr>
<tr>
<td>Second trimester</td>
<td>30%</td>
<td>17%</td>
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<tr>
<td>Third trimester</td>
<td>60%</td>
<td>29%</td>
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</tbody>
</table>

• Inverse relationship between timing of infection and fetal sequlae

Clinical Manifestations

• Usually asymptomatic at birth (70-90%)
  o If untreated, a large number will develop visual impairment, learning disabilities, or cognitive deficiency several months to years later
• Chorioretinitis **
• CNS defects
  o The central focus of the infection.
  o Leads to necrosis and calcifications in the brain (intracranial)
    o Hydrocephaly **
    o Intracranial calcifications **
  o Seizures
• IUGR, microcephaly
• Blueberry muffin rash
Treatment

- Postnatal therapy – need ID consult
  - Treatable but not curative
  - Sulfadiazine and Pyrimethamine
    - Take both orally for 12-14 months
  - Folinic acid
  - Corticosteroids if elevated CSF protein or active chorioretinitis

Syphilis

- Gram-negative spirochete
- One of the few bacteria that can readily cross the placenta causing fetal infection

Syphilis

- Transmission
  - Crosses the placenta throughout gestation
    - Nearly 100% transmission if untreated primary syphilis
  - Possibly at birth from contact with maternal lesions

Syphilis

- Congenital infection
  - Prematurity
  - Stillborn/SAB/ or perinatal death (30-40%) – if untreated
  - Hydrops (1/6 of infants with congenital syphilis)
  - Intrauterine growth restriction (IUGR)
  - Only 1/3 will be symptomatic at birth

Early Congenital Syphilis

- Sx before 2 yr of age
- HSM (50-90%) with abnl liver enzymes/jaundice
- Lymphadenopathy (20-50%)
- Lesions on palms and soles
- Anemia/thrombocytopenia
- Osteochondritis
- Pneumonitis
- Rhinitis (snuffles) (10-50%) – early sign
- Fever/irritability/FTT
- Rhagedes – cracks in lips which scar
- CNS involvement (60%)
  - If untreated may progress to communicating hydrocephalus, optic atrophy and cerebral infarctions

Late Congenital Syphilis

- After 2 yr, if congenital infection not treated
- Hutchison’s triad: blunted upper incisors, keratitis and 8th nerve deafness
- Other findings: saddle nose, hard palate defect
Syphilis

- Non-treponemal antibody tests
  - Does not test for the specific antibody to the disease; detects the presence of reagin, an antibody to cardiolipin
  - Considered screening tests – if positive, confirm with a treponemal antibody test
  - VDRL (Venereal disease research lab)
  - RPR (Rapid plasma reagin)
- Tests serial dilutions of serum
- Titers correlate with disease activity
- 10–20% false positive tests

Syphilis

- Specific treponemal antibody test
  - TA-PA/FTA-ABS/TP-EIA
  - Detects a specific antibody (IgG or IgM) to Treponema pallidum
  - Remains positive
  - Does not correlate with disease activity

Syphilis - Treatment

- Seropositive mother who was inadequately treated
  - No treatment
  - Mother's PCN dose was unknown
  - Mother received erythromycin or other non-PCN antibiotic
  - The treatment was 4 weeks or less before delivery
  - Maternal evidence of reinfection/relapse (fourfold or greater increase in maternal titers)
- Infants titers are more than 4-fold that of mothers
- Reactive CSF VDRL and/or abnl CSF
- Symptomatic neonate
- HIV in mom

Syphilis - Treatment

- Aqueous PCN G
  - 50,000 units/kg IV every 12 hours (1 wk chronologic age or younger); if older than one week, dosing interval should be changed to every 8 hr for 10 days total treatment
- Procaine PCN G
  - 50,000 units/kg single dose IM for 10 days
- Benzathine PCN G
  - 50,000 units/kg single-dose IM (not for active syphilis)

Congenital Syphilis Evaluation

- Physical exam
- CBC with diff
- Serum nontreponemal and treponemal testing
- CSF examination – quantitative VDRL, CSF protein and cell count
- Other tests as clinically indicated
  - CXR, X-ray long bones, Liver function tests, eye examination, neuroimaging and ABR
Syphilis – Follow up

- Follow All infants who have reactive VDRL/FTA or who were born to seropositive mothers at delivery at 2, 4, 6, and 12 months of age
- Follow VDRL/RPR every 2-3 months until nonreactive or titers decreased at least 4-fold
  - Titors should decline by 3-4 months of age and should be nonreactive by 6 months
  - If titers are persistent even if they are low – retreat

Neurosyphilis
- CSF examination at 6 month intervals until CSF is normal
- Reactive CSF VDRL at 6 months - retreat

Cytomegalovirus (CMV)

- DNA virus, member Herpesviridae family
- Most common congenital infection
  - 0.2 – 2.2% occurrence in U.S.
- Transmission
  - Transplacental and intrapartum
    - Maternal infection first half of pregnancy associated with greater risk of neonatal infection and greater severity of infection
  - Breast milk
    - Passively transferred maternal antibodies thought to be protective so preterm infants may be at higher risk

Clinical presentation of congenital infection
- 85-90% are asymptomatic
  - 90% develop sequelae
- 10-15% are symptomatic at birth
  - IUGR, jaundice, HSM, purpura, dermal hematopoiesis (blueberry muffin rash), microcephaly, periventricular calcifications and chorioretinitis
  - 5-15% develop sequelae

Diagnosis
- Can be difficult
- Viral culture of CMV in the urine in the 1st wk of life

Management
- Get ID consult
- Ganciclovir – limited data regarding efficacy

Sequelaes
- Mortality
  - 10-20% major neurodevelopmental sequelae
  - Deafness, visual impairment, mental retardation, spastic quadriplegia
  - Other findings: increased risk of dental caries
Algorithm for Long-term Follow-Up

Herpes Simplex
- Mode of transmission
  - Congenital (4%)
    - Triad: Brain, eye, skin
  - Perinatal (86%)
  - Postnatal (10%)

Herpes Simplex
- Primary versus secondary infection
  - 50% risk of transmission with primary infection
  - Risk 10-20 times that of recurrent infection
    - Prolonged shedding of virus (3 weeks versus 2-5 days)
    - Increased viral number
    - Less passive immunity

Disseminated HSV
- Most lethal
- Earliest presentation
- Organ involvement
  - Pneumonitis
  - Hepatitis
  - DIC
- 10-50% have NO lesions

SEM HSV
- All other tests are normal
- Most common
- If untreated will progress to disseminated or CNS disease (can reduce from 70% to 5-20% with early treatment)
CNS HSV

- May also have disseminated
- Typically presents latest (DOL 10-18)
- Initially may have subtle, non-specific findings
- Seizures
- Abnormal LP

Algorithm for evaluation of asymptomatic neonate following vaginal or c-section delivery to women with active genital herpes lesions.
Red Book, 2015

Varicella – Zoster Virus (VZV)

- Incubation period is 10-21 days after exposure; neonates 9-15 days
- Congenital infection
  - Rare
  - Exposure during the 1st 20 weeks of gestation
  - Mild to severe neonatal disease that presents before DOL 10
    - CNS abnormalities, limb abnormalities, and skin lesions

Varicella – Zoster Virus (VZV)

- Perinatal infection
  - Infant is exposed and born before the mom can transfer immunity via the placenta
- Possible transmission situation
  - Maternal onset between 5 days prior to delivery until 2 days after delivery

Varicella – Zoster Virus (VZV)

- Clinical manifestations
  - Usually a very severe infection
  - Skin lesions
  - Severe respiratory distress/pneumonia
  - Necrotic visceral lesions – fatal
  - Untreated mortality = 30%
**Varicella –Zoster Virus (VZV)**

- Vaccine
- VZIG (Varicella Zoster Immune Globulin)
  - 125 U IM Xi ASAP
  - Decreases intensity of illness if given shortly after exposure; does not prevent infection
- Nursery screenings are also usually necessary
  - If ≥ 28 weeks with negative maternal serology, treat
  - If < 28 weeks, treat regardless of mom’s serology
- Droplet/contact Isolation

**Enteroviruses**

- Single stranded RNA virus
  - Coxsackie A and B viruses, echoviruses, enteroviruses (HEV A, B, C and D), poliovirus
- Worldwide distribution, seasonal variation except in tropical climates
- Higher risk and severity of infection in neonates
  - Especially low birth weight, infants intubated, receiving NG feeds, receiving antibx therapy
- Transmission
  - Transplacentally, fecal/oral and oral/oral routes, contaminated hands, detected in breast milk

**Hepatitis B Virus**

- Risk factors
  - Multiple transfusions
  - IV drug user
  - Multiple sex partners
  - Immigrants from hyperendemic areas
  - 30-40% have no real risk factors
- Incubation period is 50-180 days
- Newborn disease
  - Acute infection – most are asymptomatic
  - 70-90% becomes chronic carriers (MOB HBsAg and HBeAg +), 5-20% risk (HBsAg + but HBeAg neg)
    - versus 6-10% of adults become chronic carriers
  - 25% of carriers die of cancer/cirrhosis usually in adult life
- Clinical presentation
  - Mild to severe presentation similar to sepsis
  - Apnea, coryza, low-grade fever, vomiting, diarrhea, poor feeding, maculopapular rash
  - May develop myocarditis, meningitis, encephalitis, hepatitis
- Diagnosis
  - Rectal, stool, NP, blood, CSF and urine viral culture, PCR-CSF
- Management
  - Supportive care, close observation for organ-specific disease, IVIG (controversial)
Hepatitis B Virus

- Elevated transaminases and bilirubin
  - Not specific
- Serologic markers
  - HBsAg, HBeAg, IgM anti-HBc, anti-HBsAg
- Hybridization assay/gene amplification
  - Polymerase chain reaction (PCR) & branched-chain DNA

Hepatitis B Virus Treatment

- Infants born to HBsAg positive mom
  - Hepatitis immune globulin (HBIG) and HepB vaccine within 12 hours
  - HepB vaccine at 1-2 and 6 months
  - Follow anti-HBsAg and HBsAg 1-3 months after vaccination series complete to identify chronic carriers or vaccination failure

- Infants born to HBsAg unknown moms
  - HepB vaccine within 12 hours
  - HBIG when you find the mom is positive or within 1 week in term infant if results not available; preferable to give to preterm LBW within 12hr

  - HepB vaccine at 1-2 and 6 months
- Follow-up
  - 9 month - Give a 4th dose if titers are low

Clinical Sequelae HBV Infection

- Acute Hepatitis
- Fulminant Hepatitis

- Persistent Infection
- Death/OLT

- Carrier
- Chronic Hepatitis

- Develop Immunity
- Cirrhosis/HCC

Chlamydia Trachomatis

- Bacterial infection
- Extremely common STD
- 50% acquire the infection during delivery

HCC = hepatocellular carcinoma; OLT = organ liver transplant
**Chlamydia Trachomatis**

- Conjunctivitis (25-50% of those exposed)
  - Occurs at DOL 5-12 (can be earlier if PROM)
  - Initially watery than purulent drainage
  - Swollen eyelids
  - Red, thickened conjunctivae

- Pneumonia
  - An extremely common cause of pneumonia in the first three months
    - ½ have h/o chlamydia conjunctivitis
  - Occurs at 4-12 weeks of life
  - Tachypnea/staccato cough
  - Rarely severe but can linger or return if untreated
  - Can be severe in high risk infants

**Gonorrhea**

- Neisseria gonorrhoeae
- Small gram negative bacteria
- Transmission – during delivery

**Diagnosis – culture**

**Treatment**

- Prenatal screening
- Labor and delivery prophylactic treatment
- Ceftriaxone 125 mg IM x 1 prophylactic if mom positive
- Ceftriaxone 25-50 mg/kg/d IV or IM QD X 7 days for disseminated disease
Additional Areas to Review

- Respiratory syncytial virus (RSV)
- HIV/AIDS
- Infection control and universal precautions