SEPSIS

SAVE THE NEONATE-AFRICA

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OBJECTIVES

- Prenatal and postnatal risk factors that predispose the neonate to infection
- Identify infants at risk for sepsis
- Clinical signs of neonatal sepsis
- Bacterial and viral organisms that may cause infection
- Lab work used to diagnosis sepsis
- Treatment of sepsis

INFANTS AT RISK FOR SEPSIS

- Careful maternal history
- Infections in first trimester may result in severe consequences for fetal growth and organ development
- Early gestation exposure places infant at risk for: IUGR, visual, hearing, brain, liver, cardiac damage
- Late pregnancy, intrapartum or post partum exposure
  - Maternal or family illness

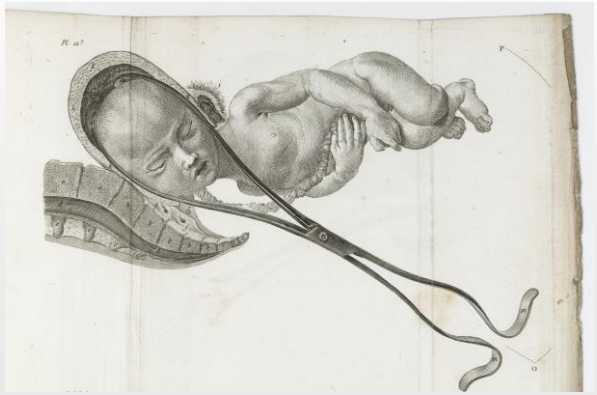
- Neonatal infection can be devastating for the immunologically immature infant
- Immature immune system places the neonatal at increased risk for acquiring and succumbing to infection
  - Impaired ability to effectively eliminate invading organisms
  - Mortality rates for preterm infants with early onset infection are high 40%

PRENATAL FACTORS

- Premature rupture of membranes
- Premature onset of labor
- Rupture of membranes > 18 hours
- Recent maternal infection or illness
- Maternal fever in the peripartum period
- Maternal genitourinary tract infection including UTI or STI
- Perinatal asphyxia especially with prolonged ROM

- Chorioamnionitis
  - Uterine tenderness
  - Maternal tachycardia
  - Fetal tachycardia
  - Maternal Temperature
  - Foul smelling amniotic fluid
  - Purulent vaginal discharge

- Poor nutritional status
- Recurrent abortion
- Substance abuse
- Inadequate prenatal care
- Low socioeconomic status



- Procedures
  - Prior to delivery
    - Amniocentesis
    - CVS
  - Instrumentation at delivery
    - Scalp electrode
    - Forceps
    - Vacuum

NEONATAL FACTORS

- Prematurity
- Low birth weight
- Difficult delivery process
- Male
- Resuscitation
- Low APGAR scores at 5 minutes
- Congenital anomalies
- Breach of skin integrity
- Multiple births
- Invasive procedures

ENVIRONMENTAL

- Hospital admission
- Length of stay
- Common use of broad-spectrum antibiotics
- Use of medication systems in the ventilator
- Incubator care
- Invasive procedures

INFECTION CAN OCCUR

- In utero
- During birth process
- Within the first 72 hours (early onset)
  - Early onset usually appears in first 24 to 48 hours
- After the first 72 hours (late onset)

VERTICAL

- Enter with intact membranes
- Maybe a direct extension of am infected uterus
- Enters after ROM
- Aspiration of infected amniotic fluid
- Incurred through passage through colonized area
- Infection through skin abrasions
- Post partum acquisition through breast milk

HORIZONTAL

- Transmission to the infant from nursery personnel, family and visitors
- Contaminated hospital equipment, invasive procedures, devices, and blood products
- Nosocomial or Hospital acquired

EARLY ONSET

- Perinatal infection
- Within 3 days of birth
- Organisms acquired in utero or during birth
- Common organisms
- *Strep* (GBS)-most common
- *E.coli*
- *Listeria*

LATE ONSET

- Beyond 3-5 days of life-presenting beyond 72 hours or greater than seven days of age
- Nosocomial
- Organisms acquired from the "environment"
- Common organisms
- *Staph*
- Enterobacteria
- *Pseudomonas*
- *Klebsiella*

SIGNS OF SEPSIS MAY RANGE FROM SUBTLE TO

- Signs of sepsis may range from subtle and nonspecific to unmistakably apparent
- Culture proven sepsis is difficult in the newborn
- Most are symptomatic without correlation of positive cultures

CLINICAL SIGNS OF SEPSIS

- Respiratory distress
  - Tachypnea
  - Nasal flaring
  - Retractions
  - Grunting
  - Apnea
  - Cyanosis
- Temperature instability
  - Hypothermia
  - Hyperthermia(less common)

- Cardiac
  - Normal heart rate
  - Bradycardia-with poor perfusion HR < 100 bpm
  - Tachycardia-Heart rate > 180 bpm

BLOOD PRESSURE

- Adequate size
- Will be higher when infant is awake and active
- Measure the arm circumference
- Too big will underestimate the reading
- Too small will overestimate

- Blood pressure
  - Normal or low
- Pulses
  - Weak peripheral pulses

- Peripheral perfusion
  - Poor perfusion
  - Prolonged capillary refill time
  - Cool skin
  - Mottled
  - Gray
  - Cyanosis

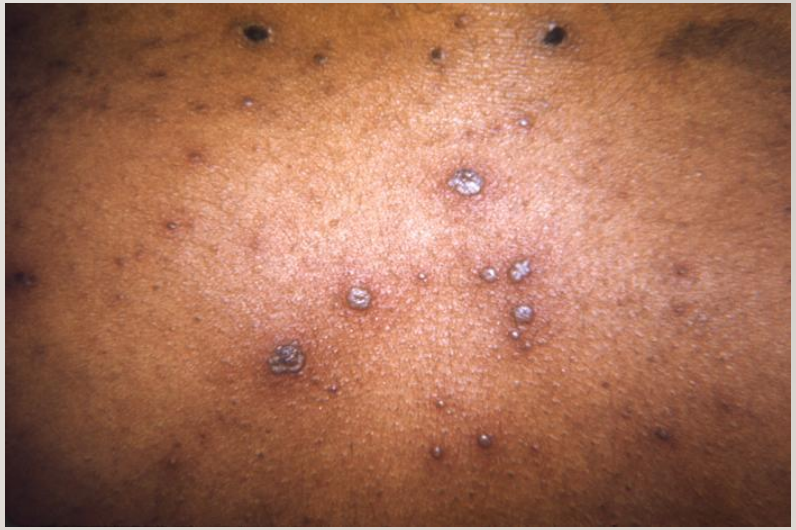
- Loss of vascular integrity allows fluid to leak out of tissues spaces
- Poor myocardial contractility allows leads to poor tissue perfusion and oxygenation

- Urine out put
  - Low < 1ml/kg/hr.

- Neurological
  - Irritability
  - Increased sleepiness
    - Lethargy
      - Hypotonia
        - Seizures

- Feeding intolerance
  - Increased gastric pre-feeding residuals
  - Poor feeding pattern
  - Vomiting
  - Abdominal distension

- Abnormal skin findings
  - Omphalitis
  - Blisters on skin
  - Soft tissue swelling and redness
  - Cellulitis
  - Necrotic skin lesions



MENINGITIS

- Usually acquired in the first 2-6 days after birth due to vertical transmission
- Acquisition:
- Direct invasion
- Clinical contamination between CSF space and integumental surfaces
- Bacterial dissemination from infected structures

CLINICAL PRESENTATION MENINGITIS

- General symptoms of sepsis
- Specific CNS symptoms
  - increased irritability
  - alteration in consciousness
  - poor tone
  - tremors
  - seizures

COMPLICATIONS OF MENINGITIS

- Hydrocephalus
- White matter atrophy
- Developmental delay
- Late onset seizures
- Cerebral palsy
- Cortical blindness

ORGANISMS THAT CAUSE SEPSIS

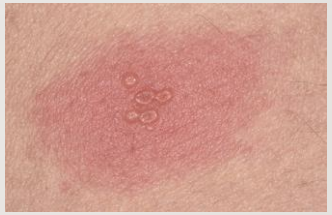
BACTERIAL ORGANISMS

- Gram positive
  - Coagulase negative staphylococcus
  - Staphylococcus aureus
  - Listeria Monocytogenes
  - Streptococcus pneumoniae
  - Group A Streptococcus

- Gram-negative
  - Neisseria meningitides
  - Haemophiles influenza
  - Klebsiella pneumoniae
  - Pseudomonas aeruginosa
  - Acinetobacter
  - Citrobacter
  - Enterobacter
  - Serratia marcescens
  - Proteus Species

VIRAL ORGANISM

- HSV
- CMV
- Rubella
- Parvovirus
- HIV
- Hepatitis



FUNGAL

- Candida albicans
  - Amphotericin B
  - Fluconazole

SPIROCHETES

- Syphilis

PARASITIC

- Malaria
- Toxoplasmosis

FUNGAL INFECTIONS

- Pathogen: C. Albicans, significant neonatal pathogen
- Mucocutaneous candidiasis
- Most common form of candidiasis
- Acquired during passage thru birth canal or from mother during breast feeding
- Clinical presentation:
- Pearly, white material on buccal mucosa, dorsum and lateral areas of tongue, gingiva and pharynx
- Treatment
- Oral nystatin oral suspension (100,000units/cc) each side of mouth every 6 hours for 3 days after symptoms have subsided

- Acute disseminated(systemic) candidiasis
- Serious infection occurring in VLBW infants
- Common sites of infection: lungs, liver, spleen, brain

- Risk factors
- Prematurity
- Total parenteral nutrition and fat emulsions
- Prolonged use of broad spectrum antibiotics
- Indwelling catheters
- Steroid use
- LOS > 7 days
- Exposure to multiple antibiotics

VIRAL INFECTIONS

HSV

- Type 1 or 2
- Type 2 may be present in maternal genital tract without mother knowing she has the infection
- Exposed infants may not have symptoms for 3-7 days or as late as 10-14 days
- Maternal genital tract, mother may not know she has it
- Severe neonatal infection may occur
- Ask about sexual partner

- Types:
- HSV-1 Nongenital type
- HSV-II-Genital type
- Causes 75 % of neonatal disease
- Transmission
  - Transmission may be ascending through ruptured membranes, but is more common during birth through an infected genital tract
- 85-90% acquired at time of delivery
- >75% of neonates who acquire neonatal HSV have been born to women who had no history of clinical findings suggestive of active HSV infection during pregnancy
- Greatest risk to neonate is with a mother who has a primary infection at birth

- C-section
  - Clinically apparent HSV
  - Some recommend whenever birth canal infected
  - Immediate C-section with ROM and active lesions
- Active HSV lesions postpartum
  - Contact isolation
  - Careful hand washing
  - Breast feeding OK if no lesion on breast

SIGNS

- Skin vesicles
- Poor feeding
- Lethargy shock
- If the CNS has been affected-seizures

TREATMENT

- Acyclovir
- PCR testing
- Stop if cultures are negative
- If the mother has active genital herpes on the genital area or buttocks acyclovir should be administered

RUBELLA

- Found in nasopharynx secretions
- Can result in :
  - Miscarriage
  - Fetal death
  - Up to 85% will have anomalies if infection occurs in the first trimester

- Presentation
  - Cataracts
  - Glaucoma
  - Micropthalmia
  - Hearing impairment
  - Hepatosplenomegaly
  - Thrombocytopenia
  - Pulmonary artery stenosis
  - “Blueberry Muffin “ rash

HEPATITIS B

- Transmission: vertical
- Virus found in any bodily secretion, including breast milk
- If mother is Hepatitis B surface antigen (HBsAg) positive there is no added risk to baby of acquiring HBV infection
- Breast feeding not contraindicated if monoprophylaxis recommendations are followed
- Presentation
- Infected in utero: asymptomatic at birth
- Infected at delivery or after birth-will not have HBsAg present for 2-5 months

- Routine screening for all pregnant women
- Routine neonatal immunization
- Hepatitis B vaccine
- Energex-B 10mcg
- Recomb Ivax HB 5 mcg
- Term infant immunized at discharge,
  2 months and 6 months
- Preterm immunized at discharge if weight >2kg or at 2 months of age

- Treatment
- If born to a HBsAg positive mother, treatment is 85-95% effective in preventing the development if hepatitis B carrier state
- Initial bath to remove blood/secretions that may be contaminated
- Administration of hepatitis B immunoglobulin (HBIG) 0.5 ml IM as soon as possible with in 12 hours of birth, in addition to a hepatitis vaccine
- Isolation: Standard Precautions

SYPHILIS

- Treponema pallidum
- Preventable with prenatal care (VDRL, RPR testing)
- Infant may not develop symptoms until 2 years
- Symptoms: hepatosplenomegaly, jaundice, osteochondritis, petechiae, purpura, lymphadenopathy, ascites, cutaneous lesions, sniffles
- Treat with Penicillin G

HIV

- Transmission is through blood or blood products
- Vertical transmission is thought to be the most common method of transfer
- Transplacental transmission
- Intrapartum transmission during exposure to infected maternal blood or genital tract secretions
- May be transmitted through breast milk
- Risk of infection to unborn infant whose mother did not receive antiviral therapy is 13-39%

- Failure to thrive
- Lymphedema, hepatomegaly, splenomegaly
- Recurrent mucosal infections
- Systemic bacterial infections
- Recurrent candidiasis
- Parotitis, hepatitis, nephropathy, cardiomegaly
- Opportunistic infections
- Neurodevelopmental delay
- Malignancies

- Infants with positive HIV peripheral blood test within the first 48 hours of life are considered to be infected in utero and tend to have early onset symptoms
- Infants are asymptomatic at birth and are classified as exposed
  - Disease progression is more rapid in infants, and they may become seriously ill within 2-4 weeks of life
- DNA PCR may detect provirus DNA before 48 hours of life
  - Preferred test

- Prompt treatment of infections
- Antiretroviral therapy at birth
- Perinatal prophylaxis
- Intrapartum loading dose of Zidovudine
- Neonatal treatment with ZDV beginning at 8-12 hours of life

LABORATORY EVALUATION

- Blood count
- Blood culture
- Blood glucose
  - In response to stress the infant may initially be hyperglycemic because of catecholamine release
  - Glucose utilization may be increased leading to risks for hypoglycemia
- Blood gas-Metabolic acidosis
- CRP
- CSF
- Electrolytes
- Renal function
- Calcium

CBC

- May have a completely normal; in early stages of sepsis
- Time from onset of infection to change in CBC may be 4-6 hours
- Never withhold antibiotics in an ill neonate on sole basis of the CBC

- Bone marrow responds to infection by releasing WBCs into circulation.
- There is an increased number of immature forms in the presence of infection

- Neonates who deplete their neutrophil reserves are at an increased risk of dying from sepsis
- Know the maternal history
- Infant born to mothers with PPHN may have a low count that is not due to infection

I/T RATIO

- Immature-to-total ratio
- Reveals the proportion of circulating neutrophils released from the bone marrow.
- Most sensitive for estimating the risk that infection may be present
- Majority of neutrophils that are in the blood stream should be mature neutrophils or segmented
- When more than 20-25% are immature suspicion should be increased of infection

- Identify the immature neutrophil forms: Bands, Metamyelocytes
- Add them together
- Add the mature and immature together
- Divide the two numbers

- WBC-15,000
- Segmented neutrophils-----35%
- Bands 15%
- Metamyelocytes 3%
- Lymphocytes 42%
- Basophils 4%
- Eosinophils 1%

- 1) 15 Bands + 3 Metas = 18 % of the neutrophils are immature
- 2) 15 Bands + 3 Metas + 35 segs = 53 % of the WBCs
- 3) 18 divided by 53 = 0.34

  18/53= .34
- 4) The I/T ratio is .34

- # % of the neutrophils are immature
- This should raise concern for infection

- I/T ratio >0.20 raises index of suspicion
- I/T ration >0.8 is correlated with a higher risk of death from sepsis

PLATELET COUNT

- Infectious etiology
  - Bacterial
  - Fungal
  - Viral
- Maternal medical conditions
  - PIH
- Maternal auto immune or isoimmunization
- Genetic etiology
- Others

THROMBOCYTOPENIA

- Platelet count less than 150,000 per microliter
- Mild-100,000-149,000
- Moderate-50,000-100,00
- Severe <50,000

- IF < 100,000 re-evaluate, especially if there is a downward trend
- Examine infant for signs of bleeding(oozing)
- Petechia

- Less than 50,000
- Risk of bleeding is increased
- Evaluate for signs of bleeding
- Be sure it is accurate

LUMBAR PUNCTURE

- Culture
- Glucose, protein
  - Protein — Term >100mg/dl; Preterm >290 mg/dl
  - Glucose — <70-80% of serum level
- Cell count
  - WBC > 20,000
- PCR

- Reserved for those with CNS signs or proven bacteremia
- Up to 15% of infants with sepsis develop meningitis
- Interpreting CSF findings very widely in the first few weeks of life
- Positive blood culture: repeat CSF tap every 24-36 hours until sterile
- Gram stain smear of CSF can detect organisms
- If positive culture from CSF repeat every 24-48 hours until negative

URINE

- Obtain sample by sterile catherization or supra-pubic needle aspiration
- Follow-up
- To document sterilization when a positive culture has been obtained

TREATMENT

- Supportive care
- Combination of therapies
  - Administer volume
  - Hypotension that responds poorly to fluid resuscitation
- Ionotropic medications
  - May need pressor support
  - Dopamine
- Optimize ventilation

ANTIBIOTIC THERAPY

- First draw culture
- Antibiotics of choice vary from region to region
- Ampicillin and Gentamicin
  - Broad spectrum coverage against Gram negative and Gram-positive organisms

- Severe sepsis or gram-negative meningitis consider a third-generation cephalosporin
- Begin antifungals if concerned for sepsis

- QUESTIONS????

CONTACT

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THE END