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Lecture outline: Neonatal infections

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The term "**neonatal**" includes infants from birth (day 0) up to and including 28 postnatal days. The term "**neonatal infection**" was chosen to include different **infection** syndromes during the **neonatal** period (proven blood stream **infections**, probable blood stream **infections**, meningitis and respiratory tract **infections**).

Objectives:

Student must be able to

- understand the importance of neonatal infection
- recognize risk factor which predispose new born infant to infection
- diagnose neonatal infection
- implement infection control to prevent infection

Definitions:

congenital : contracted *in utero*

perinatal: from completion of 28 weeks gestation until 1-4 weeks after birth

postnatal: From external sources after birth (postpartum/post natal)

neonatal: from birth (day 0) up to and including 28 postnatal days

Susceptibility of the neonate to infection

I. **Endogenous factors**

1. Low levels of IgG, IgM & Ig A
2. Premature infant fail to receive IgG from mother
3. Phagocytic action is less effective
4. Humoral activity is impaired (complement are low)
5. IUGR infant also appear to be more susceptible

II. **Exogenous Factors:**

1. Baby is bacteriologically sterile → little competition existing bacterial flora
2. Breaches of the skin barrier → entry of bacteria to the baby
3. Drugs may impair immune function (corticosteroids)
4. Fat emulsion (intralipids impair the phagocytic function of white cells)
5. Hyperbilirubinemia reduces immune function in several different ways

Neonatal infection can be acquired (Origins of neonatal infections

- In utero transplacentally (congenitally) or through ruptured membranes
- In the birth canal during delivery (intrapartum)
- From external sources after birth (postpartum/post natal)

Congenitally (intrauterine)

I. Transplacentally

- **First trimester:** TORCH (infection)
  - Toxoplasmosis
  - Others e.g coxsaches B virus, varicella, HIV
  - Rubella
  - CMV
  - Herpes simplex type 2
- **Second trimester:** syphilis
- **Third trimester:**

1. **Viral** : Varicella, Hepatitis B, coxsachoe B, HIV, echovirus.
2. **Bacterial**: - group B β-haemolytic streptococcus
   - *Listeria monocytogenes*, *Haemophilus influenzae*
   - pneumococcus
3. **Protozoa** : malaria

II. **Ascending infections** : after rupture of membranes

Pathogens : *Eschericia coli, Klebsiella pneumonae,* Proteus, *Enterococcus fecalis*,

group B beta haemolytic streptococcus

group A streptococcus,

staphylococcus.

Intrapartum infection

Pathogens : - Herpes simplex virus,

Neiserria gonorrhoeae,

Hepatitis B,

Group B streptococcus

Chlamydia trachomatis

Candida albicans, HIV

Risk Factor Intrapartum Infection

Maternal factor:

1. Maternal factors of sepsis (fever, WBC high, tender uterus, purulent liquor)
2. Prolonged rupture of membrane
3. Duration of labour (>12 hours)
4. Frequent vaginal examinations
5. The presence of fetal distress or birth asphyxia

Postnatal/Acquired infection

Nosocomial:

1. Bacteria: coagulase negative staphylococcus,

Staphylococcus aureus, group B streptococcus

coliform, salmonella, shigella, anaerobic bacteria, pseudomonas.

2. Viruses: Coxsachie, rotavirus, RSV, adenovirus, echovirus

3. Fungal: *Candida albicans*

Neonatal Sepsis

Learning Objectives

Define neonatal sepsis

Recognize the importance of neonatal sepsis as a major cause of infant mortality and morbidity.

Recognize infants who are at increased risk of developing sepsis

Obtain a neonate's history in order to identify risk factors and symptoms of sepsis

Perform a physical examination of a neonate to recognize signs of sepsis.

Suspect the bacterial pathogens responsible for causing sepsis

Use laboratory tests appropriately to diagnose sepsis, including the use of cultures to identify the suspected organism

Decide on the appropriate specific and supportive treatment.

Definition of Neonatal Sepsis

Disease of infants who are younger than

1 month of age

are clinically ill and

have positive blood cultures (or positive cultures from other normally sterile sites)

Incidence of Neonatal Sepsis

Asia: 7.1 to 38 per 1000 live births

Sri Lanka? → Refer

Africa: 6.5 - 23 per 1000 live births

South America: 3.5 to 8.9 per 1000 live births

United States: 6 - 9 per 1000 live births

Direct Causes of Neonatal Deaths
World Health Organization.
State of the World's Newborns 2001

* **Infections 32%**
* Asphyxia 29%
* Complications of prematurity 24%
* Congenital anomalies 10%
* Other 5%

Neonatal sepsis- morbidity in survivors

Brain damage due to meningitis, septic shock, or hypoxemia

Other organ damage - lung, liver, limbs, joints

Neonatal Sepsis

Early Onset

< 72 hours of age

Acquired around birth

Vertical transmission from mother to baby

Late Onset

> 72 hours of age

Acquired from the environment

Nosocomial or hospital acquired

Distinction between Early onset sepsis and Late onset sepsis

not clear in developing countries:

baby born at home and brought to the hospital at 3 days of age

baby referred from another hospital

Early Onset Sepsis - risk factors

Prolonged rupture of membranes >18 h

Maternal chorioamnionitis

Foul smelling amniotic fluid

Handling by untrained midwife

Maternal urinary tract infection

Premature labor

Chorioamnionitis

Maternal fever during labor ≥ 38ºC

± uterine tenderness

± leucocytosis

± fetal tachycardia

High risk of neonatal sepsis

Late Onset Sepsis -risk factors

Prematurity/ LBW

In hospital

Invasive procedures- ventilator, IV lines, central lines, urine catheter, chest tube

Contact with infectious disease - doctors, nurses, babies with infections,

Not fed maternal breast milk

POOR HYGIENE in NICU

Bacterial Pathogens Responsible for Sepsis in Developing Countries

Early onset sepsis

Gram negative bacilli

E.coli

Klebsiella

Enterococcus

Group B streptococcus

Late onset sepsis

Gram negative bacilli

Pseudomonas

Klebsiella

Staph aureus

Coagulase negative staphylococci

Neonatal Meningitis

Organisms: Gram negative in 1st week, *Strep pneumoniae* > 1 week

Diagnosis of Neonatal Sepsis

Clinical signs and symptoms

Laboratory tests

culture of bacterial pathogen

other laboratory indicators

Diagnosis of Neonatal Sepsis -
(i). Clinical signs and symptoms

Clinical Signs: <u>early signs non- specific, may be subtle</u>

Respiratory distress- **90%**

Apnea

Temperature instability- ↓ temp more common

Decreased activity

Irritability

Poor feeding

Abdominal distension

Hypotension, shock, purpura, seizures- late signs

Clinical Criteria for Severe Bacterial Infection
WHO Handbook Integrated Management of Childhood Illnesses, 2000

Respiratory rate > 60 breaths per minute

Severe chest in drawing

Nasal flaring

Grunting

Bulging fontanelle

Convulsions

Pus draining from ear

Redness around umbilicus extending to the skin

Temperature > 37.7 C (or feels hot) or < 35.5C (or feels cold)

Lethargic or unconscious

Reduced movements

Not able to feed

Not attaching to the breast

No sucking at all

Laboratory Tests

Cultures to identify bacterial pathogen

blood, CSF, urine, other

Haematological tests

WBC count

Platelet count

Erythrocyte Sedimentation Rate (ESR)

Other tests

C- reactive protein

Blood Culture

Gold standard for diagnosis of bacteremia

Add at least 0.5 -1.0 ml blood obtained by sterile venipuncture to culture bottle

Most bacteria grow within 24 to 48 hours

Talk to your microbiology lab every day- do not wait for the written report.

Baby has risk factors and clinical signs of sepsis but
blood culture is negative

Blood cultures are positive in only 2 to 25% of babies with clinically suspected sepsis.

Mother may have received antibiotics in labour

Baby may have received antibiotics before blood culture

Volume of blood taken for blood culture too small

Lumbar Puncture

Possibility of meningitis 1-10%

Babies with meningitis may not have specific symptoms

15% of babies with meningitis will have negative blood cultures

Normal CSF values in newborn

WBC count: 0 - 32 wbc / mm^3

Glucose concentration : 24 - 119 mg / dl

Protein concentration: 20 - 170 mg / dl

Urine culture

Useful in neonates with late onset sepsis.

Sterile specimen obtained by sterile catheterization or by suprapubic bladder aspiration.

Other cultures

Surface cultures

Endotracheal cultures

Gastric aspirate cultures

Poor Sensitivity and Specificity

Prevention of Nosocomial Infection

Hand washing

Early feeding

Maternal breast milk

Decrease use of broad spectrum antibiotics

Decreased use of invasive procedures

Proper sterilization procedures

Localized Infections

- **An infections in a certain part of the baby's body (cord, skin, eye, mouth)**
- Can spread quickly through the newborn's small body and causes sepsis
- Quick & correct treatment of localized infections may prevent sepsis and possible death

I. Umbilical cord infections

- infection around the umbilical cord in the umbilicus
- can easily pass through the cord → sepsis and death if treatment is delayed or not given (Refer)

II. **Skin Infection**

- Skin pustules
- Localized or serious skin infection
- Th/ : Localized : - wash the skin and remove all dirty and pus
  - apply gentian violet 0,5 %
  - Serious infections : - Cloxacillin 50mg/kg IM

III. **Eye infection**

- Etiology : - Chemical : $AgNO_3$ (no treatment)
  - Bacteria : - *Chlamydia trachomatis*
  - *Neissieria gonorrhoeae*
- Treatment : - Refer

IV. Oral Trush

- White patches on the mucous membrane or tongue (*Candida albican*)

- Treatment : Refer

Infectious causes of ophthalmia neonatorum;

Chlamydia trachomatis

- **strains D-K** (i.e. the same strains responsible for genital infection)
- onset 5-14 days after birth
- cause follicular keratoconjunctivitis.

Neisseria gonorrhoeae

- onset on first or second day of life
- severe purulent conjunctivitis

Staphylococcus aureus

- onset 5-10 days after birth
- known as 'sticky eye'

Other causes include

- *Streptococcus pneumoniae. Haemophilus*
- *influenzae.* herpes simplex virus (HSV)

What investigations should be Performed?

- **(i). A conjunctival** smear should be **Grain stained**
- **(ii). One smear- stained for chlamydial** basophilic **intracytopiasinic inclusion** bodies **using Giemsa.**
- (iii). Swabs **for** culture of *C. trachomatis. N. gonorrhoeae.* other **bacteria** and HSV.
- (chlamydial and viral transport medium for *C. trachomatis* and HSV)

What is the treatment of choice? Refer