

Sepsis in Newborn: Common issues and  
case discussion  
Clinical Features and Diagnosis

Sridhar Santhanam  
Professor, Neonatology Department,  
Christian Medical College, Vellore

# Neonatal Sepsis

Defines as a clinical syndrome of **bacteremia** with **systemic signs and symptoms** of infection in the first four weeks of life

# Classification

## **Early onset sepsis (EOS)**

- Sepsis in the first 48-72 hours\*
- Source of organisms is maternal environment

## **Late onset sepsis (LOS)**

- Sepsis after 48-72 hours\*
- Source is the environment

# Causative organisms

## **Early onset sepsis (EOS)**

- Klebsiella
- E coli
- Staphylococcus aureus
- Group B Streptococcus
- Acinetobacter\*

## **Late onset sepsis (LOS)**

- Klebsiella
- E coli
- Staphylococcus aureus
- CONS
- Acinetobacter baumannii
- Pseudomonas
- Candida spp.

# Risk factors for sepsis

## **EOS**

- Maternal fever  $>38^{\circ}\text{C}$
- Chorioamnionitis
- Multiple vaginal examinations
- Prolonged ROM  $> 18$  hours
- Preterm labour
- Preterm prelabour rupture of membranes (PPROM)
- Untreated UTI

## **LOS**

- Prematurity
- Mechanical ventilation
- Central lines
- Outborn babies
- Surgical or invasive procedures
- Overcrowding/  
understaffing

# Clinical features

- Clinical features tend to be:
  - Subtle or rapidly progressive
  - Non specific
  - Involve multiple organ systems

# Clinical Features

- Not breathing well
- Not feeding well
- Not looking well

## Skin

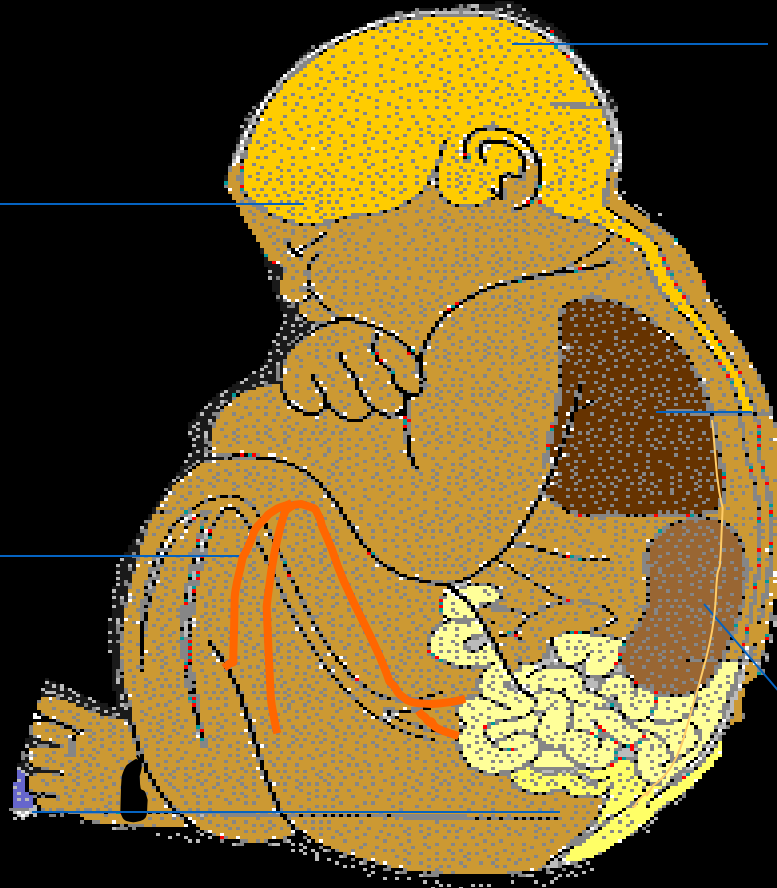
- Rashes / erythema
- Purpura
- Pustules / paronychia
- Omphalitis
- Sclerema

## Circulatory System

- Pallor / cyanosis / mottling
- Cold, clammy skin
- Tachycardia / arrhythmia
- Hypotension

## Gastrointestinal tract

- Poor feeding
- Vomiting
- Diarrhoea
- Abdominal distension



## Central Nervous System

- Lethargy
- Poor feeding
- Poor cry
- Tremors / seizures
- Comatose
- Hypotonia / increased tone

## Respiratory System

- Cyanosis
- Grunting
- Irregular respiration
- Tachypnoea / apnoea
- Retractions

## Haematopoietic System

- Jaundice
- Bleeding
- Purpura / ecchymosis
- Splenomegaly



# Respiratory symptoms

- Rule out nasal block and neck flexion
- Consider other causes:
  - TTN
  - Congenital heart disease
  - Pneumothorax
  - Malformations: Congenital diaphragmatic hernia, TEF
- In mildly symptomatic cases, monitoring for the first six hours is advisable; if the neonate improves, sepsis is unlikely.

# Meningitis

- Specific manifestations are often lacking
- Subtle and non-specific signs- Fever or hypothermia, lethargy, drowsiness, irritability, apnea, bradycardia, poor perfusion, hypotonia, hypo- or hyperglycemia
- Abnormal cry, bulging fontanelle, convulsions, and nuchal rigidity: late
- Differentiate Jitteriness from convulsion
  - Stimulus sensitive, absence of autonomic changes
  - Stops on holding the involved part

# Omphalitis

- Tenderness, erythema, and induration of umbilicus and surrounding tissues
- Localized superficial cellulitis can rarely progress to involve the entire abdominal wall
- If erythema progresses rapidly or gas accumulates in surrounding tissues, necrotizing fasciitis should be considered

# Osteomyelitis and Septic Arthritis

- Preterm infants: part of sepsis syndrome of minimal or no symptoms
- Many neonates afebrile
- Mild and nonspecific, including temperature instability, feeding intolerance, irritability, or reduced movement.
- Later, more specific signs like local swelling or erythema, restricted limb movement, and focal tenderness over long bones become apparent.
- Asymmetrical limb movement or a neonate not allowing to change diapers

# Diagnosis

# Blood culture

- Blood culture is the gold standard to diagnose sepsis
- Ideally, it should be taken prior to starting antibiotics for ALL babies
- Ideal to take 1ml of blood atleast for culture
- Sensitivity of blood cultures in detecting sepsis is variable
- Both false positives and false negatives may be seen

# When do you NOT treat a positive blood culture report? (Contaminants)

- Skin and other commensals- Diphtheroids, Micrococci, Aerobic Spore Formers (ASF), Aerococci, CONS\*, Burkholderia cepaciae\*
- Organisms which grow >72 hours\*
- Polymicrobial growth\*
  - Treat if Enterobacteriaceae, GBS or candida
  - Treat if GI pathology
- Non human pathogen/Environmental contaminant- Pseudomonas stutzeri, Acinetobacter Iwoffii etc.

# Sepsis screen

- Symptomatic infants with sepsis may have a blood culture being negative- Culture negative sepsis
- Sepsis screen:
  - White blood cell counts
  - Differential counts
  - Micro ESR
  - CRP



# Sepsis screen

## Sepsis Screen

- Leukopenia (TLC  $<5000/\text{cu mm}$ )
  - Neutropenia (ANC  $<1800/\text{cu mm}$ )
  - Immature to total neutrophil ratio (I/T)  $>0.2$
  - CRP +ve  $>10 \text{ mcg/ml}$  after 24 hrs
  - Micro-ESR  $>15 \text{ mm}$  in 1st hour
- \*If two or more screening tests are positive, treat infant as neonatal sepsis***

# How to calculate the IT ratio?

Reported on: 08/02/2024 09:03

/2024 08:29 WBC TOTAL 5800 / ct  
Reported on: 08/02/2024 09:03

/2024 08:29 WBC DIFFERENTIAL  
Shift left, monocytosis, reactive lymphocytes and nRBCs present. Mr.Rajkumar.P/Dr Anannya

BLASTS		%
PROMYELOCYTES		%
MYELOCYTES	5	%
METAMYELOCYTES	3	%
BANDFORMS	1	%
NEUTROPHILS	39	%
EOSINOPHILS	1	%
BASOPHILS	1	%
LYMPHOCYTES	18	%
MONOCYTES	32	%
PLATELETS	130.2	/10

- Immature cell count=  
 $5 + 3 + 1 = 9$
- Mature neutrophils=  
39
- Total neutrophils=  
mature + immature  
neutrophils=  
 $39 + 9 = 48$
- IT ratio=  $9/48 = 0.19$

# How to calculate absolute neutrophil count?

04/02/2024 10:38	WBC TOTAL	3700	/cumm
	Reported on: 04/02/2024 12:45		
04/02/2024 10:38	WBC DIFFERENTIAL		
	BLASTS		%
	PROMYELOCYTES		%
	MYELOCYTES		%
	METAMYELOCYTES		%
	BANDFORMS		%
	NEUTROPHILS	28	%
	EOSINOPHILS	1	%
	BASOPHILS	0	%
	LYMPHOCYTES	53	%
	MONOCYTES	18	%
	NUCL RED CELLS		/100 WB
	Reported on: 04/02/2024 12:45		

- Absolute neutrophil count (ANC)= (Neutrophil percentage/ 100) X Total leucocyte count

- $28/100 \times 3700 = 1036$

# CSF Examination

- Perform lumbar puncture (LP) in late-onset sepsis or symptomatic/specific early-onset cases.
- CSF indicators:
  - WBC  $>20/\mu\text{L}$
  - Glucose  $<20 \text{ mg/dL}$
  - Protein  $>150 \text{ mg/dL}$



© 2018 CMC Vellore

Thank

Sepsis in Newborn: Common issues and  
case discussion  
Case Discussion

Sridhar Santhanam  
Professor, Neonatology Department,  
Christian Medical College, Vellore

# Case discussion I- Inborn baby with symptoms

- Baby A., born at 38 weeks of gestation with weight of 3200g by normal vaginal delivery
- Is found to have respiratory distress at 30 minutes of life
- RR: 80/min; Mild subcostal recessions; maintaining saturation with ½ L/ min nasal cannula oxygen
- Would you evaluate for sepsis?

# Maternal history

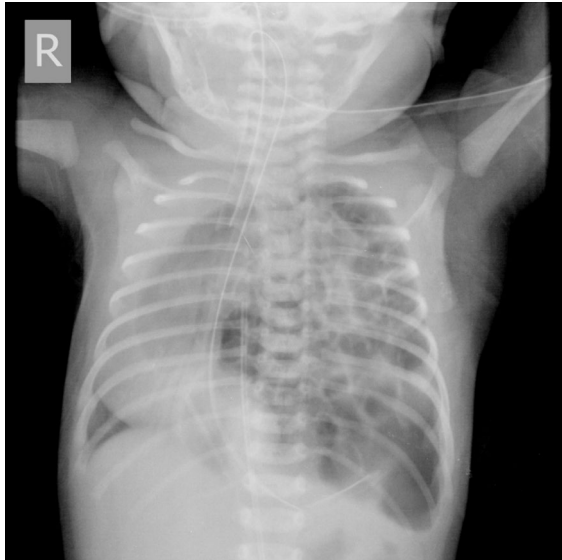
- Mother was a primigravida who came with labour pains of 7 hours duration and ROM of 5 hours
- Delivered vaginally
- No risk factors for sepsis
- Reassuring
- Mother was a primigravida who started labour 28 hours prior and had ROM of 24 hours
- Mother also had fever of 38.5<sup>0</sup> C at admission
- She received one dose of Inj Ampicillin and Gentamicin 6 hours prior to delivery
- Two risk factors for EOS



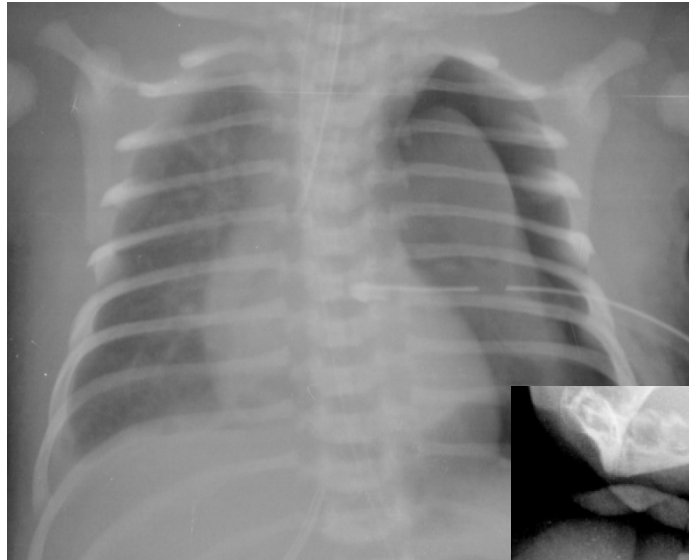
# Assess clinically..

- If stable and distress settles within 6 hours..
- No evaluation
- If baby still requires oxygen by 6 hours (OR)
- Baby worsens clinically/  
respiratory scores worsen
- Sepsis screen, blood culture and antibiotics

# Always rule out other causes of Respiratory distress



CDH



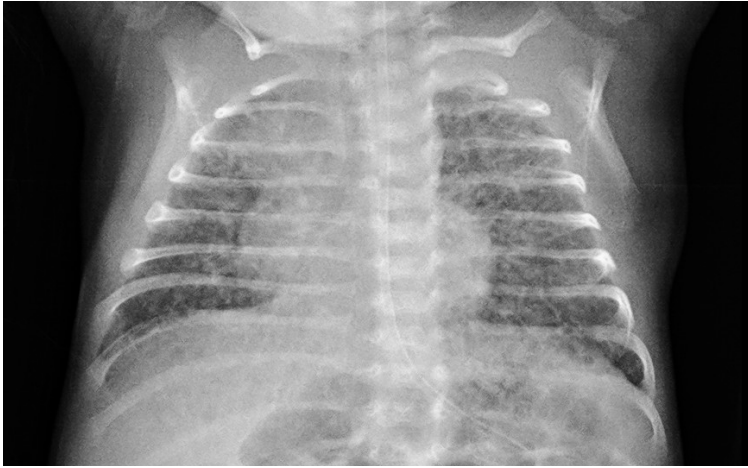
pneumothorax



Bilateral pleural effusion



TEF with dextrocardia with aspiration



Pneumonia

17/12/2024 09:28 CULTURE BLOOD

Reported on: 19/12/2024 08:48

No growth so far

16/12/2024 23:51 HAEMOGLOBIN

14.5

GM%

Reported on: 16/12/2024 23:51

16/12/2024 23:51 WBC DIFFERENTIAL

Test done on 16/12/2024

BLASTS

%

PROMYELOCYTES

%

MYELOCYTES

%

METAMYELOCYTES

%

BANDFORMS

%

NEUTROPHILS

33

%

EOSINOPHILS

04

%

BASOPHILS

01

%

LYMPHOCYTES

29

%

MONOCYTES

33

%

NUCL RED CELLS

/100 WBC

Reported on: 18/12/2024 17:08

16/12/2024 23:51 PLATELET COUNT

211000

/cumm

Reported on: 16/12/2024 23:51

16/12/2024 23:51 WBC TOTAL

12900

/cumm

Reported on: 16/12/2024 23:51

17/12/2024 06:32 WBC DIFFERENTIAL

Dc done on 50 cells , 5nrbc/50wbc prt , MRS.SLatha

BLASTS

%

PROMYELOCYTES

%

MYELOCYTES

%

METAMYELOCYTES

%

BANDFORMS

%

NEUTROPHILS

11

%

EOSINOPHILS

2

%

BASOPHILS

11

%

LYMPHOCYTES

22

%

MONOCYTES

4

%

NUCL RED CELLS

5NRBCS/50WBCS

/100 WBC

Reported on: 17/12/2024 19:26

17/12/2024 06:32 WBC TOTAL

1500

/cumm

Reported on: 17/12/2024 19:26

Leucopenia and neutropenia

19/12/2024 08:38 CRP

59.4

mg/L

Reported on: 19/12/2024 10:07

Treat as possible sepsis even if culture negative

# Culture report

29/10/2024 20:40	SENS ROUT COMMON	002
TIME OF DETECTION : 7.44 HOURS SMEAR: GNB		
Klebsiella pneumoniae		
Amikacin	Susceptible	
Cefotaxime	Susceptible	
Cefoper + sulbact	Susceptible	
Ceftazidime	Susceptible	
Ertapenem	Susceptible	
Meropenem	Susceptible	
Gentamicin	Susceptible	
Netilmicin	Susceptible	
Tigecycline	--	
Piperacillin/Tazo	Susceptible	
Colistin	--	
Imipenem	--	
Ciprofloxacin	Susceptible	
Reported on: 04/11/2024 12:39		

Continue empiric antibiotics if organism is sensitive

20/07/2024 19:55	SENSITIVITY ROUTINE & SPL. BLOOD	002
"ESBL POSITIVE" . NOTE - AVOID ALL PENICILLI NS, 1st TO 4th GENERATION CEPHALOSPORINS & AZ TREONAM		
TIME OF DETECTION : 15.6 HOURS SMEAR: GNB ** CIPROFLOX - RESISTANT		
E.coli		
Cefoper + sulbact	Susceptible	
Amikacin	Resistant	
Ceftazidime	Resistant	
Meropenem	Susceptible	
Gentamicin	Resistant	
Netilmicin	Susceptible	
Co-Trimoxazole	--	
Minocycline	Susceptible	
Tigecycline	Susceptible	
Colistin	--	
Piperacillin/Tazo	Intermediate	
Tobramycin	--	
Imipenem	--	
Cefepime	Resistant	
Reported on: 24/07/2024 15:17		
Validated by : DR.BALAJI V		

Change antibiotics to targeted antibiotics according to sensitivity



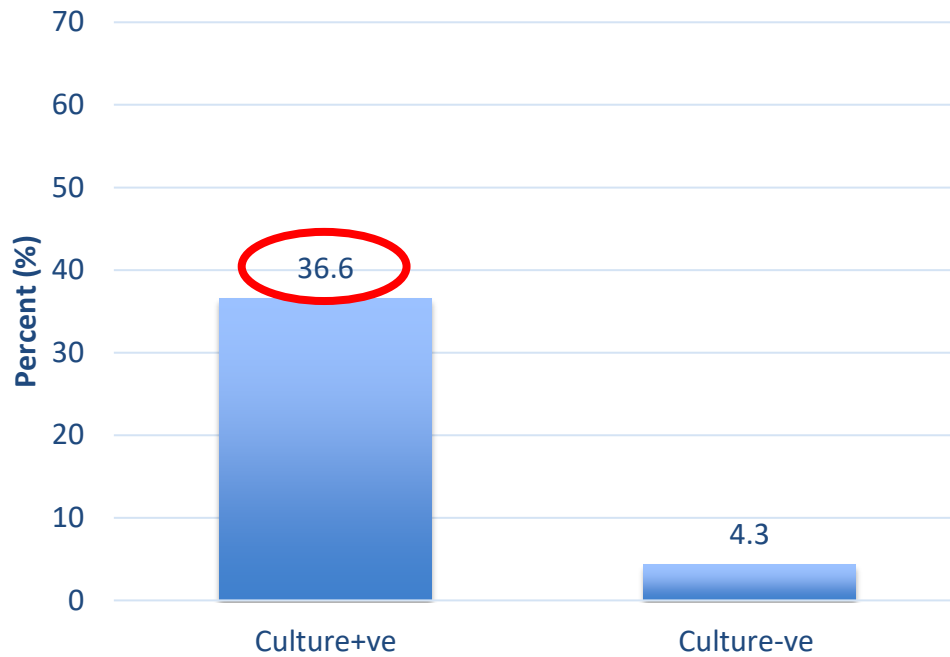
© 2018 CMC Vellore

Thank

# Sepsis in neonates

## Management and prevention

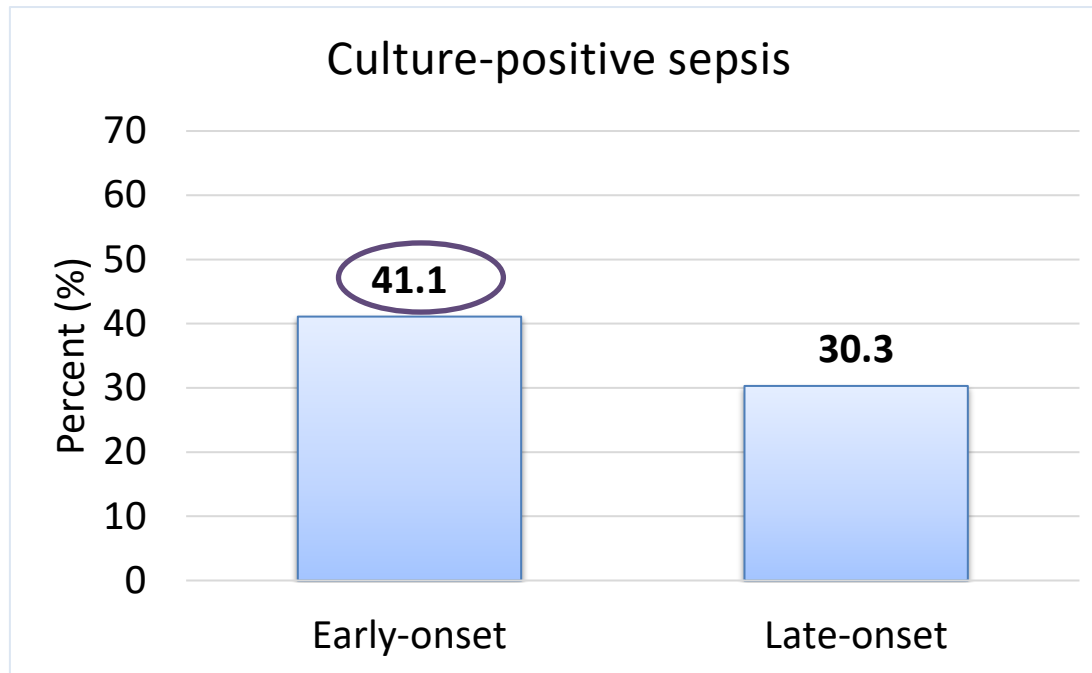
# Case-fatality



**~1/3<sup>rd</sup> in culture-positive sepsis**



# Case-fatality: Onset



**Higher in early-onset sepsis**

# Principles

- Early diagnosis
- Prompt treatment

# To admit or not

## **Ideally, all babies.**

- Significant respiratory distress
  - Not able to feed, lethargy
  - Hemodynamic instability
  - Abdominal distension
  - Abnormal movements
  - Bleeding
- (A sick baby)

## **Postnatal ward/home**

- Fast breathing ONLY
- No chest retraction
- Feeding well

```
graph LR; Management[Management] --- Supportive[Supportive]; Management --- Antibiotics[Antibiotics];
```

**Management**

Supportive

Antibiotics

# Maintain TABC

## Temperature

- 36.5-37.5°C
- KMC, radiant warmer/incubator
- Hyperthermia may need a cooler place in hot weathers

## Airway and breathing support (Saturations-91-95%)

- Free flow oxygen
- HFNC
- CPAP
- Ventilation

## Circulation

- Fluid bolus
- Dopamine, epinephrine

## Maintain glucose

- Check blood sugar
- Glucose-electrolyte infusion
- Maintain BSL: 60-120 mg/dL

## Hematological

- Transfusion
- Bleeding

# Antibiotics

- First line

Sepsis: Ampicillin + Gentamicin

Meningitis: Cefotaxime + Amikacin

- Second line

Sepsis: Piperacillin-Tazobactam + Amikacin

Meningitis: Cefotaxime + Amikacin

# Septicemia or Pneumonia

## First line antibiotics

### B wt <2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 14 days age	>14 days age		
Inj Ampicillin	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

### B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Ampicillin or	50 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj cloxacillin	50 mg/kg/ dose	12 hrly	8 hrly	IV	7-10 days
AND					
Inj Gentamicin	5 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

# Septicemia or Pneumonia

## Second line antibiotics

### B wt <2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 14 days age	>14 days age		
Inj Piperacillin+ Tazobactam	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days

### B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Piperacillin+ Tazobactam	100 mg/kg/dose	12 hrly	8 hrly	IV	7-10 days
Inj Amikacin	15 mg/kg/ dose	24 hrly	24 hrly	IV	7-10 days



# Meningitis

## First line antibiotics

### B wt <2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime	50 mg/kg/dose	12 hrly	8 hrly	IV	3 weeks
Inj Amikacin	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

### B wt ≥ 2 kg

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Cefotaxime*	50 mg/kg/dose	12 hrly	6 hrly	IV	3 weeks
Inj Amikacin**	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks

# Meningitis

## Second line antibiotics

Antibiotic	Each dose	Frequency		Route	Duration
		0 – 7 days age	>7 days age		
Inj Meropenem	40 mg/kg/dose	8 hrly	8 hrly	IV	3 weeks
Inj Amikacin	15 mg/kg/ dose	24 hrly	24 hrly	IV	3 weeks



# Antibiotics

- Cloxacillin if pustules/umbilical sepsis
  - IV infusion using a syringe infusion pump over 30 minutes or longer
  - Dilute appropriately
    - Ampicillin 100 mg/mL
    - Gentamicin 10 mg/mL
    - Cefotaxime 100 mg/mL
    - Amikacin 5 mg/mL
    - Piperacillin 50 mg/mL
    - Meropenem 10 mg/mL
-



# Duration

- Culture negative 5-7 days
- Positive culture 10-14 days
- Meningitis 21 days

Review antibiotics every day (5<sup>th</sup> of 10 days)

---



# When to change

- No improvement in 48-72 hours
  - Exclude alternative diagnoses (hypoglycemia, HIE, airway problems, MAS)
  - Avoid using serial CRP as the sole guide
-



# Refer

Depends on local capabilities: when you cannot manage

- Worsens or no improvement after 48 hours
  - Respiratory failure requiring ventilation, unresponsive shock, or refractory seizures.
  - Ensure initial stabilization before referral
-



# Antibiotic Stewardship

- Rational use prevents multidrug resistance (MDR)
  - Optimize choice, dose, route, and duration
  - No prophylactic antibiotics: MAS, TTNB, Exchange transfusions, procedure, lines, IV fluids
  - Stop antibiotics appropriately
-



# Preventing Infections

- Focus on birthing areas: cleanliness, hand sanitation, asepsis
  - Clean equipment
  - Safe delivery and resuscitation practices
  - Bedding in, early breastfeeding, clean cord care
-



# SNCU

- Maintain cleanliness
- Adequate ventilation, temperature (26-27°C)
- Good housekeeping, asepsis routines, disinfection of equipment
- Ensure 24/7 water supply and avoid overcrowding
- Hand sanitation
- Asepsis during procedures

# SNCU

- Minimize investigations, skin breach
- Minimize IV fluid usage
- Promote enteral feeding: early initiation, rapid advancement
  - Many babies can be on full enteral feeds on day 1
  - Stop IV fluids when the baby is on ~2/3 of fluids as oral feeding
  - Mother's own milk; get her in, KMC



# Hand Hygiene

- Most effective method
  - Before and after touching the baby and her surroundings
  - HH dispenser at each cot
-

# Learning resources

- <https://www.youtube.com/playlist?list=PLInCfzj-EjrUfitUT6XSCWo2u93ho-Vn>

The screenshot shows a web browser displaying a YouTube playlist page. The browser's address bar shows the URL: <https://www.youtube.com/playlist?list=PLInCfzj-EjrUfitUT6XSCWo2u93ho-Vn>. The page features a dark theme with a left-hand navigation menu. The main content area displays the playlist title "Less Systemic Infection" by "Preterm Baby Package", which has 27 videos and 14,998 views. A "Play all" button is visible. Below the title, a list of video thumbnails is shown, each with a title, view count, and upload date. The first video is "How to clean floors, walls and other surfaces of NICU?" (5.5K views, 6 years ago). The second is "How to clean and disinfect a radiant warmer?" (18K views, 6 years ago). The third is "How to clean pulse oximeter?" (13K views, 6 years ago). The fourth is "How to clean a phototherapy unit?" (3.5K views, 6 years ago). The fifth is "How to clean a suction machine" (8.3K views, 6 years ago). The sixth video is "Less Systemic Infections" (2:03). The seventh is "How to disinfect CPAP machine?".

Less Systemic Infection  
by Preterm Baby Package  
Playlist • 27 videos • 14,998 views

Play all

1 How to clean floors, walls and other surfaces of NICU?  
Preterm Baby Package • 5.5K views • 6 years ago

2 How to clean and disinfect a radiant warmer?  
Preterm Baby Package • 18K views • 6 years ago

3 How to clean pulse oximeter?  
Preterm Baby Package • 13K views • 6 years ago

4 How to clean a phototherapy unit?  
Preterm Baby Package • 3.5K views • 6 years ago

5 How to clean a suction machine  
Preterm Baby Package • 8.3K views • 6 years ago

6 Less Systemic Infections  
2:03

7 How to disinfect CPAP machine?  
Preterm Baby Package • 2.6K views • 6 years ago

# A few simple things can do miracles in our SNCUs


---

Sepsis kills nearly one-third of our babies

Eminently preventable by simple methods

Can achieve excellent outcomes (at reduced cost)

- Asepsis
- Feeding
- Involvement of mother
- Reducing IV fluids, investigations



Care for **mothers** and their  
**babies** with your **heart!**

The background features two large, overlapping, curved lines. One line is light blue and the other is light green, both with a soft gradient and a slight shadow effect, creating a sense of depth. They are positioned in the top right and bottom left corners of the slide.

# Case presentation

# Demography

- DOB/TOB- 31.10.2024, 7:35 pm.
- Gestation- 33 weeks
- Birth weight- 1.9 kg
- Date of admission- 4/11/2024  
Date of discharge- 21/11/2024
- Age at discharge - 22 days



# Antenatal

- 28 years old mother, G2A1
- A1: 2 years back/ spontaneous abortion at 2.5 months followed by Dilation and curettage.
- **G2: Current Pregnancy**
  - Spontaneous conception
  - Uneventful pregnancy
  - Antenatal steroids receipt– not known

# Delivery details and outside course

- LSCS at a private hospital
- Cried immediately after birth
- Required CPAP for respiratory distress at birth

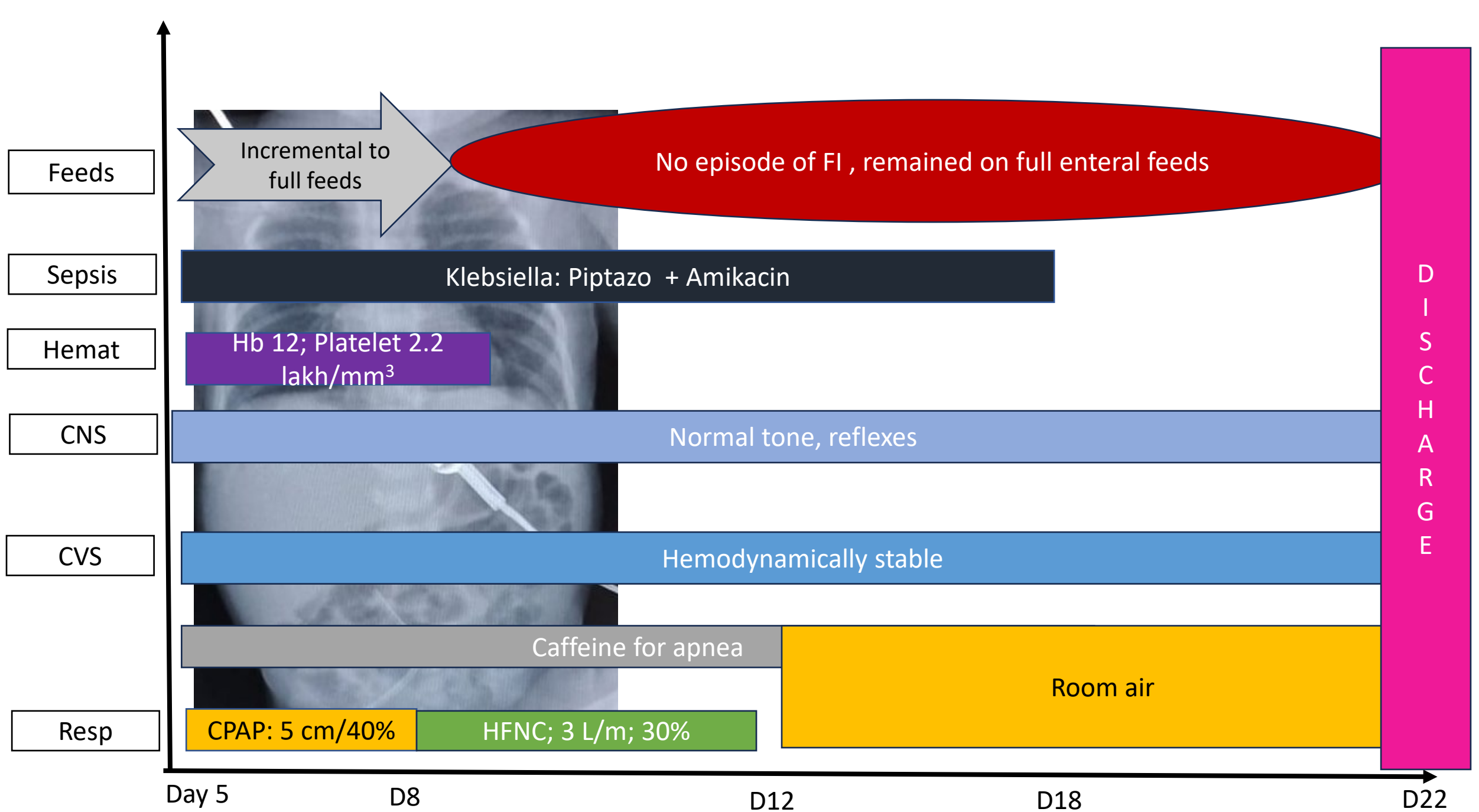
# Outside course

## Day 4

- Presence of feed intolerance and bleeding diathesis
- In view of suspected sepsis- started on meropenem and colistin
- Referred on day 5
  - Persistence of respiratory support requirement
  - Feeding intolerance

## At admission

- Lethargy
- Vitals: RR 56/min, retractions 4/10; hemodynamically stable
- Skin, umbilicus normal
- Abdomen: no distension
- Bilateral breath sounds normal
- Reflexes normal



# Final diagnosis

Singleton/ Late preterm/ low birth weight/ AGA/  
Respiratory Distress Syndrome

Late onset Klebsiella sepsis

# Follow up

- Birth dose of immunization
- Hearing screening
- Family counselling: feeding, temperature, growth, danger signs
- Discharged on exclusive breast feeding
- High risk follow up
- ROP Screen