

Neonatal infections

اول 28 يوم

Bacterial Infections in the Neonate

- sepsis in the **1st month** of life
- **70%** **دوبولت الحياج** → **sepsis** Clinical syndrome
- any change from normal → **sepsis**
- **1st month** with cough **DDx** → **Pneumonia** ✗
 ✓ sepsis ←
- **1st month** with diarrhoea **DDx** → **gastroenteritis** ✗
 ✓ sepsis ←
- **35%** of early sepsis → **Complicated Meningitis** ^{1/3}
 hydroceph ← **ممكن**
- **75%** of late sepsis → **Complicated Meningitis** ^{2/3}
 (after 7 days)

No isolated infection

- * **sepsis** ✓
- * **Meningitis** ✓
- * **septic shock** ✓

* Most sensitive sign & symptom for Neonatal sepsis → **hypoactive, Poor suckling**

(rarely) : fever **السحر**
 Euthermic or hypothermic **سحر**

* 2 types
 ↙ early
 ↘ late

- **(GBS)** → **M.c** & important microorganism
- **(GC)**
- **Listeria**
- **ureaplasma**
- **Chlamydia**
- **Gram negative sepsis**

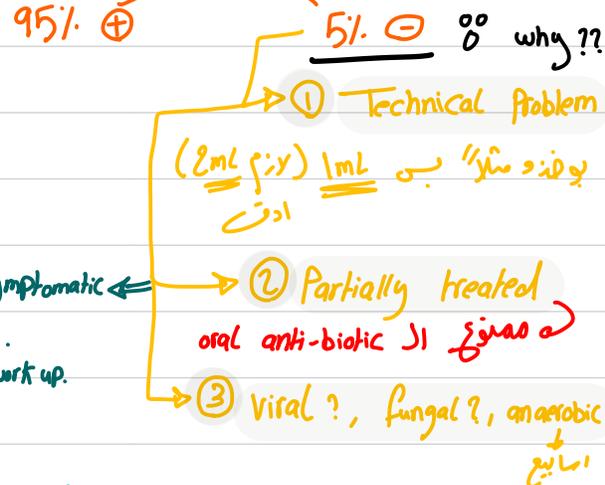
the presentation of (GBS) in neonatal sepsis is rapid & fulminant.

* **45%** of sexually active females carrier for (GBS)

* **70%** of early sepsis infected by GBS

Incidence is 1-8/1000 live births

An ill-appearing infants less than 1 month with a positive **blood culture** → **Gold standard**



- * any baby symptomatic
- 1 admission.
- 2. full septic work up.
- 3. IV antibiotic

No need Prophylaxis # 4 doses

* **45%** colonised → should do swab at 35 w. (neonatal sepsis) → vaginal or cervical

* blindness



Gonorrhea fte :- ① بان كانو يحلوه
② erythromycin eye drop (silver nitrate)
after delivery → ③ vit. K + 2 drops

Routes of Infection

Bacteria can infect a previously sterile fetus:

- **Transplacental** (syphilis, listeria, mycobacterium)
- **Ascending** immediately before delivery, (early onset GBS)
- During passage through **birth canal** (gonococcal ophthalmia, E. coli)
- **Colonization** at time of birth, with subsequent **late** onset infection (GBS, listeria)



Most Common Cause of acquired virus

Gonorrhea

واحدة

* GBS can infect the baby up to 3 months

old classification : # وهو الازرق

- ① early → < 7 days
- ② late → 7 - 1 month
- ③ late late → 1 month - 3 months

* listeria can infect the baby up to 3 months , & chlamydia e.p.g.

Classification of sepsis

* > 6 hours viral

① early onset :-

- during 1st 7 days
- ↑ incidence during preterm infants
- M.C Microorganism **GBS**
: الالها بروتوكول بالنام 95

intrapartum you have to give 4 doses of Ampicillin
you can prevent infection (Rapid fulminant sepsis)
(severe Respiratory \$)
RDS



Risk factors interconnected with vertical transmission of causative organisms include:

- Premature → The mos imp. single RF
- prolonged rupture of chorioamniotic membranes (PROM). 2nd > 18 hours
- Maternal colonization with (GBS).
- Intrapartum maternal fever. leading cause
- Maternal **UTI**. → intrapartum prophylaxis
- Preterm delivery. من ال asymptomatic
- Chorioamnionitis. bacteriuria should be kept
- Meconium aspiration. Meconium Aspiration can cause chemical pneumonitis, leading to severe respiratory distress in newborns. Risk for sepsis + Preterm Labor

بنا في الاسبوع 14 to treat GBS.
 * اذا بقي الـ baby GA = 35 w. with RDS
 Full term و واوله with RDS due to GBS
 Fertility Rate $\approx 95\%$
 من ذفولان الجنين 75% الخطر
 you can prevent
 PPHTN (Primary Pulmonary HTN)

* Presentation of GBS :-
 ✓ severe RDS after delivery
 with Rapid Pulminant sepsis
 (serious)
 hypotensive و وودو
 sepsis ياتي الـ

Protocols of ttt depends on Cause
 • Risk factor من الـ
UTI ← GBS الـ اسباب الـ sepsis
 فقط حالات الـ (congenital pneumonia)

- MC: E. coli 1st, 2nd: Klebsella
 GBS 69%
 GN bacilli 15%
 Enterococcus 3% rare
 Coag Neg staph 2%
 Staph Aureus 2%
 Other 8%
 MC in late

اقل Risk الـ int
GBS → bacteremia اذا كان
 How to treat ???
2 w.
 سؤال
 ارستيف

لما نجزي ما فنته ← (1) ممكنة (2) ممكن بل premature يتاها
 (3) ممكن بولنه secondary infection

Gram-positive organisms Group B beta hemolytic streptococcus is the most common and is associated with the rapid onset of fatal respiratory disease and shock.

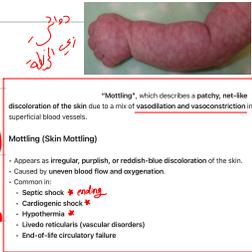


أي تغيير ← any change from Normal

Presentation

Presentation signs are nonspecific and may include any of the following:

- Poor feeding
- Lethargy
- Temperature instability Irritability → bad sign (Mottling of skin)
- Apnea → cessation of breathing 20 sec. associated w/ cardiovascular manifestation
- Respiratory distress
- Hypo/hyperglycemia
- Shock
- Metabolic acidosis → another bad (↓ Perfusion)
- Cyanosis and skin color change
- Seizures → سعال Late (Meningitis) → brain insult → SIADH → severe hyponatremia → demyelination
- Hypotonia
- Gastro intestinal symptoms such as vomiting and diarrhea
- Jaundice



* Coag Neg staph :
 infection في وقت مبكر
 gradual → SO, sepsis
Not rapid

G⁻ → Rapid
 Pseudomonas → Rapid
 GBS → Rapid

* Culture : $\frac{36h}{initial} - \frac{70h}{final}$] كم تحتاج ؟؟

anemia mask the symptoms. $O_2 sat$
 50 is low! 75 is fair
 80 is Polycythemia low
 COPD...

* central cyanosis : bluish discoloration of mucous membrane with deoxyhemoglobin > 25% with normal hemoglobin.

* average deoxy Hgb in Adults = 5g
 * " " " Neonates = > 25

② late onset

less than early onset sepsis

start early feeding

↓

to stimulate Normal Flora

↓

≠ Normal flora of the gut → ^{تغيير} immunity + hormonal changes

① M.C organism → Staph

② 8-28 days of life

③ invasive procedure

الدم ما القاع دفل

Risk factors :

- 1. Anti-pseudomonal Beta-lactam:
 - Piperacillin-Tazobactam (preferred if stable)
 - Ceftazidime or Cefepime (3rd & 4th generation cephalosporins with Pseudomonas coverage)
 - Meropenem (preferred in critically ill neonates or if concern for ESBL-producing strains)

هو الوباء مني gradual

Pseudomonas → Rapid

اعراض Pneumonia

erythromycin (abpyrac) Pneumonia

In Pseudomonas infections (ventilated infants) the presentation may include any signs mentioned in the early onset sepsis.

Mechanical Ventilation
Endotracheal intubations

- Indwelling urinary and vascular catheters
- Lack of enteric feeding
- Inborn error of metabolism
- Exposure to broad spectrum antibiotics, which may alter normal flora and permit overgrowth and dissemination of fungal species.

we can't differentiate btw RDS & GBS

Causative Organisms ::

non-specific

leading cause

gram-positive organisms predominate most of the cases.

Coag Neg staph 43% → Preterm infants ^{تولد} (common skin flora)

GBS 11% → Ampicillin + gentamycin

GN Bacilli 15%

Enterococcus 5% Ampicillin

Staph Aureus 4% +

MRSA 2% 3rd Cephalosporin

Fungal 2%

* empirical ttt :

high index of suspicion
↑ Microorganism to
choose Ab. according #

✓ Feeding intolerance

✓ Need for increased environmental oxygen

✓ Persistent tachycardia.

90% No fever (Not Mandatory)

Fungal infections with Candida species occur frequently in small preterm infants.

Fever:
- More commonly in term infants than preterm
- A temperature of 38.0°C measured in the lower 1/3 of the distribution of fever
- Temperature instability is seen in only 55-60% of sepsis infants

slowly deteriorate ← late onset



Infant with Umbilical Catheter cause

Staph → Vancomycin

Resistance ↓

amoxicillin ← Penicillin Resistance Penicillinase

20%

Diagnosis

* any symptomatic baby → full septic work up

* How you will confirm the suspicious organism??

↳ Most specific (48 hours)

initial culture

بنای اجتی هلا → سکن بهها وقت → نظای

blood
urine
CSF
LP
Catheter
CSF (LP)
source of infection
No need

CBC

Count

WBCs ① → 4,000-11,000 (adult)

→ 4,000-25,000 (Neonates) Normal

< 4,000 (bad prognostic sign) leukopenia

> 50,000 (leukemoid reaction)

↳ septic shock

A leukemoid reaction is a reactive, excessive leukocytosis (WBC count >50,000/ μ L) that mimics leukemia but is caused by an underlying condition, such as infection, inflammation, malignancy, or severe stress.

Differential

② Neutrophils >65%

ITR

③ ITR Ratio = $\frac{\text{immature Neutrophil}}{\text{Total}}$

> 20% (bacterial sepsis)

1-5 - infection

Platelets (low) (Negative acute base reactant) ^{ESR}

- Pro Calcitonin

بعضی
کوبن در
late

Hgb.

سکن تقیر

↓, Intracranial Hge.

CRP

acute base reactant.

→ every 6 hours.

↑ : sepsis

↓ : appropriate antibiotic choice

Titer ۱۱ v۱

۱۲ ساعه
۹۸ ساعه
for follow-up

serial

Clinical Picture, CRP ← بنای من فلان

اسل (في)

Gram stain

(GBS or E. coli or Klebsilla) ??

(+)

GBS

(-)

E. coli

lattice agglutination test

→ organism في سائل نقيع

- Latex particle agglutination
- Rapid antigen test

- EEG duration :

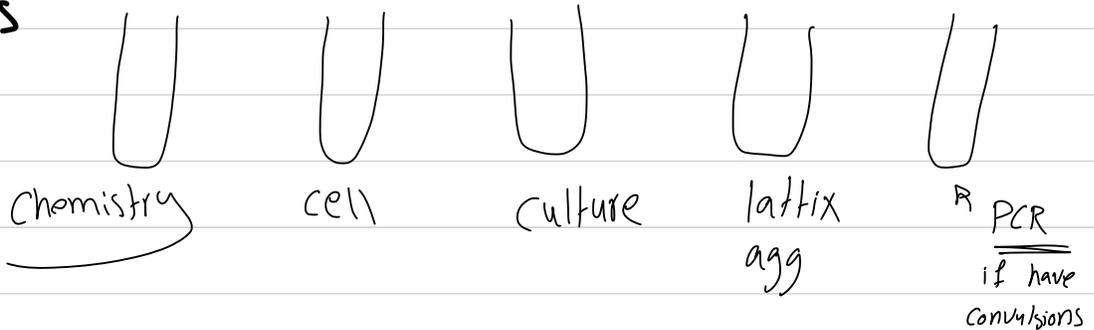
* Meningitis → 14 days G⁺

Convulsion → 21 days G⁻

Temporal lobe Hge (epilepsy) → resistance for EEG

* what is interpretation of CSF analysis (culture) (من)

5 tubes



- WBCs 0-5 except; Neutrophile اذا كان & Meningitis

Neonates 0-20 بغيره Normal

- RBCs zero, except Neonates (shearing)

↳ up to 100

Normal اول في وقت

sepsis + convulsions + RBCs → acyclovire → Mortality

→ Trauma → sepsis

- CXR because you can't differentiate
 ↳ if there is congenital pneumonia #

- **Respiratory distress**
 - signs of respiratory distress are **common** in infected infants and include :
 - tachypnea, grunting
 - flaring, retractions
 - rales, decreased breath sounds
 - **apnea** can occur, and is usually a **later sign**
- **Cardiovascular**
 - signs of CV effects can include :
 - Tachycardia
 - poor peripheral perfusion
 - Hypotension
- The **most reliable signs** of sepsis in infants ages 0 - 8 weeks:
 - change in behavior, respiratory effort and peripheral perfusion

- pleural fluid
 - joint fluid as indicated
 CRBC (G+ on gram stain Prep.)

Treatment

Before the specific organism is identified, and after cultures have been obtained, the antibacterial therapy is based on the **more causative agent and their anticipated susceptibilities.**

Ampicillin and amino glycoside or third generation cephalosporin are appropriate initial antibiotic therapy

- Supportive therapy includes:
- observation of vital signs
 - temporary discontinuation of oral feeding isolation
 - Hydration
 - Nutrition
 - oxygen
 - regulation of thermal environment
 - blood transfusion to correct anemia and shock, correction of electrolytes or acid-base imbalance.

Oral 3-5ml 4x/day *
 IV 100mg

<p>Abx</p> <ul style="list-style-type: none"> * septicemia or Pneumonia (IV) <ul style="list-style-type: none"> early → GBS → Ampicilline → E. coli → gentamicine * Meningitis (IV) <ul style="list-style-type: none"> Ampicilline + 3rd cephalosporine (cefotaxime) * anaerobic infection <ul style="list-style-type: none"> Clindamycin, Metronidazole 	<p>supportive (24-48hr)</p> <p>STABLE → labs ↓ ↓ ↓ sugar airway labi pr. temp. effective organ management</p> <hr/> <p>Adjuvant therapy</p> <p>Vancomycin, Trimeth</p>
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Observe for complications such as

- meningitis
- Shock
- adrenal hemorrhage
- disseminated intravascular coagulation
- Seizures
- UTI
- heart failure

Chorioamnionitis

* inflammation of chorioamniotic membrane

* complication on baby ?? سبب الاغنى

tbb for Mother :
Ad & deliver the mum

- sepsis
- preterm
- PVL

* brain will be complicated by multiple cystic lesions a CP
(Global developmental disability)

* one of the worst types of CP



periventricular leukomalacia (PVL) is one of the worst types of brain injury associated with spastic diplegic cerebral palsy (CP), particularly in preterm infants.

→ Treatment ranges from close observation to empiric antibiotics

* if the baby symptomatic → full set of work-up → treatment

(Pending culture results) **ampicillin + aminoglycosides or 3rd cephalosporine**

* Mother w/ chorioamnionitis & baby Asymptomatic ?

- Admission
- CBC, blood culture + observe $\geq 48h$

Obstetrical diagnosis:

- Maternal temperature > (38C)
- fetal tachycardia
- uterine irritability or tenderness
- foul smelling or cloudy amniotic fluid

Infection may be responsible for up to 20-40% of preterm deliveries:

- Chorioamnionitis consistently increased
- Increased clinical infections in preemies
- Positive amniotic fluid cultures in 10-15% of preterm deliveries.

Potential Neonatal Pathogens

• Group B streptococcus (GBS)	• Escherichia coli and other gram negative enteric organisms
• Chlamydia trachomatis	• Listeria monocytogenes
• Ureaplasma urealyticum	• Trichomonas vaginalis
• Neisseria gonorrhoeae	• Bacterial vaginosis

* Protocols of ttt depends on Risk factor

* Mother w/ Preterm delivery ^①, تو بعلي ?? GBS prophylaxis ✓
 > 30 w.

with intact Membrane

swap 35 w. سول اول اكله و اكله و اكله

* " " " " " ?
 with Ruptured memb.

Group B Streptococcus prophylaxis
 If between 24-32 weeks:
 Ampicillin plus erythromycin IV for 48 hours, then amoxicillin and erythromycin orally for up to 7 days
 If vaginosis is present:
 Substitute clindamycin for erythromycin

3 Risk factors

GBS

- *Streptococcus agalactiae*
- Normal flora in genitourinary tract, gastrointestinal tract, and occasionally the pharynx
- Colonization of pregnant women ranges from 5-35%

- 1- 4 cases/1000 live births
- Transmission occurs in utero or shortly after delivery
- Nosocomial spread can occur via hand contamination

Risk Factors

- Rupture of membranes > 18 hours
- Maternal chorioamnionitis
- Maternal GBS bacteruria
- Maternal age < 20 years *
- Gestational age < 37 weeks
- Previous child with GBS
- Twin with GBS

indication for GBS
intraPartum Prophylaxis

Early Onset Infection

- Usually occurs within the 1st 24 hours
 - Range is 0-6 days
- 3/4 of all neonatal GBS infections
- Occurs in ~ 1 infant/ 100-200 colonized mothers
- Presenting symptoms:
 - Respiratory distress
 - apnea
 - shock
 - pneumonia
 - and occasionally meningitis

VS

Late Onset Infection

- 3- 4 weeks of age
 - Range is 7 days - 3 months
- Presenting symptoms:
 - Occult bacteraemia
 - meningitis
- Rarely :
 - Cellulitis
 - osteomyelitis
 - septic arthritis

Prepartum Chemoprophylaxis

2 different strategies :-

option I

- Option I recommends : ALL women to have surveillance anogenital cultures at 35-37 weeks gestation

Option I: Recommendations for Intrapartum Antibiotics

- Positive GBS colonization documented by surveillance anogenital cultures at 35-37 weeks gestation with or without risk factors
- Unknown GBS status and presence of one of the following risk factors:
 - Gestational age < 37 weeks
 - Rupture of membranes > 18 hours
 - Maternal temperature > 38

option II

- Option II recommends : a prevention strategy based on risk factors alone and routine cultures are not obtained

Option II: Recommendations for Intrapartum Antibiotics

- Recommendations for intrapartum antibiotics based on presence of risk factors only
 - Gestational age < 37 weeks
 - Rupture of membranes > 18 hours
 - Maternal temperature > 38
- No screening cultures are obtained

General Considerations

- Oral antibiotics are not effective for Intrapartum prophylaxis
- Regardless of the prevention strategy adopted, the following women should be treated:
 - Any women with symptomatic or asymptomatic GBS bacteruria
 - Prior infant with GBS infection

Drugs of Choice Intrapartum prophylaxis

- Penicillin G:
 - 5 million units IV, then 2.5 million units every 4 hours until delivery
- Ampicillin:
 - 2 grams IV, then 1 gram every 4 hours until delivery
- Clindamycin or erythromycin acceptable in penicillin allergic patients

Management

Asymptomatic

- Routine prophylactic antibiotics in newborns of mothers who received intrapartum antibiotics is not recommended
- Routine cultures of infants to document colonization is not recommended
- As always, strict hand washing by hospital personnel is imperative

- 1 RF < 35 weeks gestation and full maternal IAP
CBC, blood culture
observe at least 48 hours
- 2 RF < 35 weeks and only 1 dose of antibiotics
CBC, blood culture
and treat for 48h while under observation
D/C treatment at 48h if cultures negative
- 0 RF > 35 weeks and 2 or more doses of antibiotics given to mother:
No labs
observe for at least 48 hours) Zero No work-up
No ttt
- 1 RF > 35 weeks and only 1 dose of antibiotics:
CBC, blood culture,
observe for 48 hours

symptomatic

Symptomatic Infants

- Full sepsis work up regardless of risk factors
- Amplification Ampicillin plus an aminoglycoside pending cultures
- May use Penicillin G alone when GBS is isolated
- GBS bacteraemia: treat for 10 days
- GBS meningitis: treat for 14-21 days
- GBS osteomyelitis: treat for 4-6 weeks

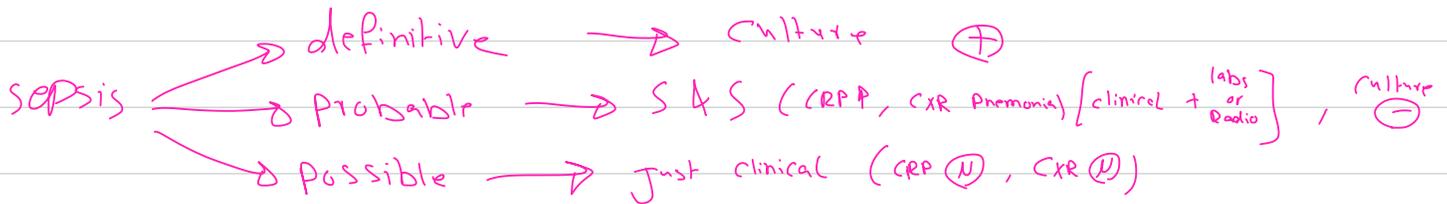
or Ampicillin + cephalo (3rd)

1 Risk → No ttt

(work-up) culture + CBC + observation

2 Risks → work-up + ttt

No Risk → No
No



* ductus arteriosus

إذا سكت بعد 1 أو 2 أسابيع

aortic stenosis

سواء كان محيياً بالقلب أو سبباً

* in sepsis → hypothermia Wig

Tenderness + hyperthermia إذا

septic arthritis → بكتري

STDs

1 Chlamydia

Neonatal Sepsis Chlamydia

STD

- The presence of *Chlamydia trachomatis* in the cervix is associated with **preterm deliveries**
- Neonatal **chlamydial conjunctivitis**
 - 1st few days to several weeks after birth
 - Not prevented by routine eye prophylaxis**
- Pneumonitis** occurs between 2-19 weeks after birth

Maternal Treatment Recommendations

- Treatment with **erythromycin** may prevent disease in infant
 - 80% respond
 - 20% other cause
- routine screening in 1st and 3rd trimesters
- Treat partner
- screen for other sexually transmitted disease

Infant Treatment Recommendations

- Infants born to **untreated** mothers should be treated with **oral erythromycin for 14 days**
- Neonatal **chlamydial conjunctivitis**
 - Topical therapy is **ineffective**
 - Oral erythromycin 50mg/kg/day in 4 divided doses for 14 days
 - ~80% effective (may need 2nd course)

2 Ureaplasma

Neonatal Sepsis Ureaplasma

* aggressive ECG

Chlamydia
lower Resp Tract inf.
Fibrosis

- Associated with **lower respiratory tract infections** and **chronic lung disease** in preemies
- Rarely causes **CNS infection** in newborns
- No proven benefit from **prepartum or intrapartum** antimicrobial therapy in colonized women

يمكن يصل Fibrosis تنس الRDS

Adults Pneumonia مزيج الوراثة
Chronic lung diseases Neonates

erythromycin

تنس Chlamydia

Pyloric stenosis



association Not a Cause

3 gonorrhea (GC)

- Preterm deliveries
- Ophthalmia neonatorum:**
 - Historically the leading cause of **acquired blindness** in the United States
- Less commonly:
 - Scalp abscess
 - vaginitis
 - bacteremia
 - arthritis
 - Endocarditis
 - meningitis

- All pregnant women should have routine **cervical cultures for GC** as part of their prenatal care
- Repeat culture in 3rd trimester for **high risk women**
- Positive cultures require work up for **other sexually transmitted disease** and work up and treatment of partner(s)

EGE:- should be treated

Asymptomatic carrier والبي

نظف البي Dose Prophylaxis 1

Infants born to mothers with gonorrhea:

- Routine eye prophylaxis as before
- Single dose of **ceftriaxone** 25-50 mg/kg (125mg maximum) or **cefotaxime** 100mg/kg

Contraindication
80% Neonatal jaundice

افضل

as Prophylaxis

- ALL infants should receive **routine eye prophylaxis** regardless of maternal history:
 - 1% tetracycline, 0.5% erythromycin (1% silver nitrate, of historical interest only)

as Prophylaxis
نظف الالتهاب

Disseminated Neonatal إذا كان

Disseminated Neonatal (GC)

- Arthritis or septicemia:
 - Ceftriaxone 25-50 mg/kg once per day for 7 days
 - Cefotaxime 50-100 mg/kg/day in two divided doses for 7 days
- Meningitis:
 - Ceftriaxone or cefotaxime for 10-14 days

2 weeks افضل احي

إذا كان اليبس عين

(symptomatic) eye infection

Ophthalmia Neonatorum

- Crystalline penicillin G 50,000-75,000 units/kg/day in 2 divided doses for 7-10 days
- Alternatives include ceftriaxone or cefotaxime in a single dose
- Local saline eye washes every 1-2 hours initially, then increased to every 6-12 hours as infant improves
 - Saline washes should be followed by topical administration of chloramphenicol or tetracycline

4 Trichomonans

Trichomonas

- May cause newborn vaginal discharge
- Inconsistently associated with preterm delivery
- Reasonable to screen and treat high risk or symptomatic mothers
- Treatment is with metronidazole

5 Bacterial vaginosis

Bacterial Vaginosis

- Gardnerella vaginalis
- Clinical or laboratory confirmed bacterial vaginosis consistently associated with preterm delivery
- Pregnancy outcomes improved when treated with metronidazole (with or without erythromycin)

vaginal discharge

6 G- bacilli

its clinical picture:

Rapid fulminant sepsis
 موج بين 24 ساعة
 C/P + gram stain

- Gram negative neonatal septicemia or meningitis cannot be differentiated clinically from other pathogens
- Fever
- temperature instability
- apnea
- cyanosis
- jaundice
- Hepatosplenomegaly
- lethargy, irritability, anorexia
- vomiting, abdominal distention
- Diagnosis by culture

all bad prognostic

- Empiric therapy:
 - Ampicillin plus an aminoglycoside or cephalosporin active against gram negative bacilli (cefotaxime, ceftriaxone, ceftazidime)
- Septoemia: treat for 10-14 days
- Meningitis: treat for 21 days
- Close follow up for hearing loss or residual neurologic abnormalities

7 Listeria

very bad microorganism → abortion, ...

- Gram positive bacilli
- Food borne transmission via contaminated dairy products, meats and unwashed vegetables
- Asymptomatic fecal and vaginal carriage can result in:
 - neonatal infection
 - preterm delivery
 - spontaneous abortion
- Nosocomial outbreaks occur

- The organism is sensitive to penicillin and ampicillin
- Combined therapy with an aminoglycoside is more effective
- Cephalosporins are not active against listeria
- Treat sepsis for 10-14 days and meningitis for 21 days

resistance is 8 to cephalosporins

Maternal Recommendations

- Antimicrobial therapy for known infection in pregnancy may prevent onset of neonatal disease
- Pregnant women should avoid unpasteurized dairy products and undercooked meats
- All vegetables should be thoroughly washed if eaten raw