Reviewed By
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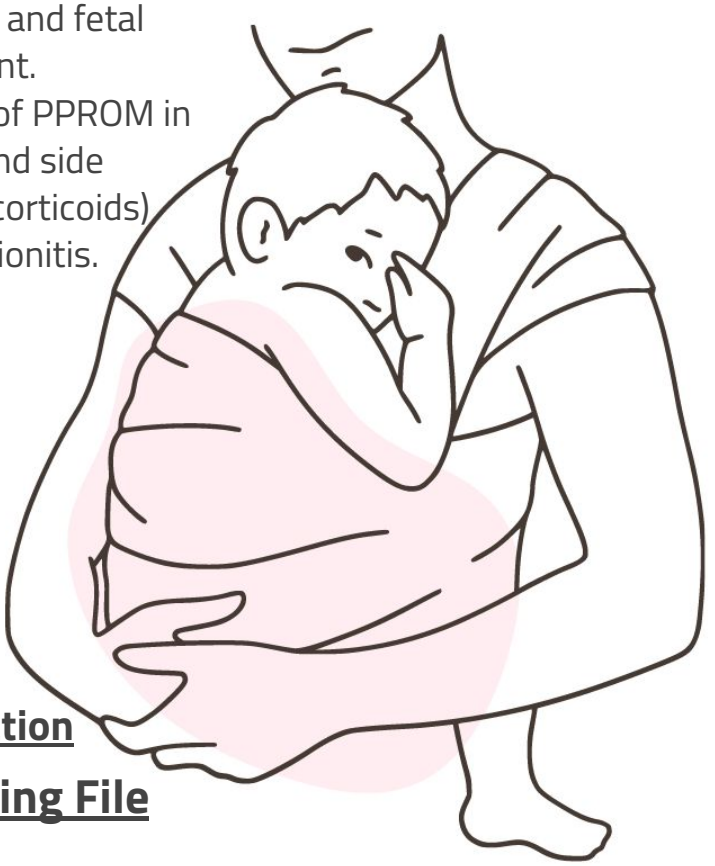
Video Case

PROM

Objectives:

- → Define premature rupture of membranes (PROME) preterm PROM (PPROM).
- → Describe clinical presentation of patients PROM.
- → List the diagnostic tests to confirm PROM.
- → Describe the etiology and risk factors for PROM.
- → Compare the risks and benefits of conservative expectant management and immediate delivery.
- → Describe the methods used for maternal and fetal monitoring during expectant management.
- → Discuss the drugs used in management of PPROM in terms of indications, contraindications and side effects (antibiotics, tocolytics, and glucocorticoids)
- → Describe the management of chorioamnionitis.



- → Slides
- → Important
- → Golden notes
- → Extra
- → 439 Doctor's notes
- → 441 Doctor's notes
- → 441 Female Presentation
- → Reference

Female presentation

Video Case | Editing File

Premature rupture of membranes (PROM)

Overview:

- **Amniotic fluid** starts to be continuously produced approximately **16 weeks** gestation. primarily dependant on fetal urine production.
- Amniotic fluid allows for **fetal movement and breathing** which are important for fetal skeletal, lung and chest development, so decrement in amniotic fluid lead to compression of the umbilical cord and decrease placenta flow.
- Decreased amniotic fluid volume called oligohydramnios. Ultrasonic definition of oligohydramnios is when amniotic fluid index (AFI) less than 5 cm.
- Disruption of the fetal membranes leads to a loss of these protective effects and the developmental roles of amniotic fluid.
- Preterm birth (PTB) is defined as deliveries occurring from 20 weeks up to 37 weeks of gestational age. Labor that occurs between these gestational ages is defined as preterm labor. The diagnosis of preterm labor based on cervical dilation and uterine contraction in patients with ruptured or intact membranes
- Preterm birth occurs either spontaneously or in the presence of premature rupture of the membranes (PROM).

Definition:

PROM and PPROM are rupture of the fetal membranes before the onset of labor at term (PROM), preterm (PPROM), or preferable<24 weeks without evidence of labor (cervical dilation and uterine contraction)

Premature Rupture of Membranes (PROM) more common	**Preterm Premature Rupture of Membranes (PPROM)**
Before the onset of labor at term (>37 weeks)	Before 37 weeks estimated gestational age

We separate them bc the management is different (the amount of amniotic fluid she loss bc rupture it will not change the management, once she rupture it rupture)

PPROM

- It is a leading cause of neonatal morbidity and mortality and is associated with 30% of preterm deliveries.
- The consequences of PPROM depend on the **gestational age at the time of occurrence**.
- When PPROM occurs between 24 and 26 weeks there is likely to be survival, however there will be possible substantial morbidities from extreme prematurity.
- Persistent oligohydramnios at **<22 weeks /** estimated gestational age leads to:
    - **Incomplete fetal alveolar development.**
    - **Pulmonary hypoplasia (inadequate ventilation).**

Premature rupture of membranes (PROM)

Clinical presentation:

- Typical **history:** is a sudden **gush** of copious vaginal fluid.
- External **examination**: clear fluid is flowing out of the vagina.
- **Ultrasound**: oligohydramnios is seen.
- Look for: foul smelling amniotic fluid , fever (>38° C), maternal and/or fetal tachycardia, maternal leukocytosis (defined as a white blood cell count >15,000), uterine tenderness which associated with chorioamnionitis / Intraamniotic infection syndrome

Etiology:

The etiology of PROM remains unclear, but a variety of factors are purported to contribute to its occurrence, including:

- Vaginal and cervical infections
- Abnormal membrane physiology
- Incompetent or short cervix
- Nutritional deficiencies

Risk factors:

01 Issue of membrane :
membrane defects (ex. collagen not strong enough)
Inflammation of membrane (it become thin bc it produce cytokines and damage membrane)

02 Hx of prior PROM ((if positive history, we immediately start prevention measurement).

03 Pulmonary disease in pregnancy; especially chronic (because coughing will increase intraabdominal pressure).

04 Other risk factors are the same for preterm delivery:
History of preterm delivery.
Bleeding during pregnancy.
Low socioeconomic state = nutritional deficiency.
Low BMI.

05 Ascending infections:
STD(chlamydia and gonorrheacan lead to preterm labor).
GBS;causing septicemia leading to lung infection.
Bacterial vaginosis .

06 Smoking(lead to inflammation)

07 Overdistention of the uterus:
Polyhydramnios,Multiple gestations

08 Issue on the cervix: anything affect the structure of the cervix ex :
Cervical incompetence (when cervix is short (<2cm) and dilate), causes of incompetence:
Cone biopsy.
Trauma of cervix during surgery.
Congenital causes (ex;CTD).
D&C (by excessive dilation of cervix).

Premature rupture of membranes (PROM)

Diagnosis:

Diagnosis of PROM is **based on the history of vaginal loss of fluid and confirmation of amniotic fluid in the vagina.** Patients can describe it as gush of fluid or steady leakage of small amount of fluid.

Physical examination:

Sterile speculum examination should be performed to

- visually assess the cervical dilation and length
- look for watery amniotic fluid in the posterior vaginal fornix (pooling test)
  Ask patient to cough, Valsalva maneuver or slight fundal pressure may expel fluid from the cervical os, which is diagnostic of PROM
- obtain swab for Gonorrhea and Chlamydia. A group B strep culture should be obtained.

- An U/S should be performed to assess fetal position and the amount of amniotic fluid (oligohydramnios will be present).
- Minimize digital cervical examination to decrease the risk of infection.

Diagnostic testing:

- **Nitrazine paper test :** Will turn blue in the presence of alkaline amniotic fluid. (false + in presence of alkaline urine, blood, or cervical mucus in sample).
- **Ferning / fern test:** it's the pattern of arborization when amniotic fluid is placed on a slide and is allowed to dry (presence of blood, may make the pattern appear to be skeletonized)
- **AmniSure test** : measuring placental alpha microglobulin-1 (PAMG-1), which is present in high levels in amniotic fluid. **(Highly accurate bc it's not effect by the presence of blood or infection.)**

How to know if it is rupture of the membrane and not anything else (diagnosis)?
First : History

- Fluid characters = water like : clear color (infection = green) – thickness – odor (odorless) - quantity > 2 possible characters :
  - **Continuous small amount of the fluid** (so if it's on and off no way to be rupture of the membrane)
  - **Sudden Gush of the fluid**
- Risk factors: smoking – infection (fever – constant severe abdominal pain)…

Second : Physical Examination:

1. **Vital signs**: temperature – heart rate (tachycardia = infection) – blood pressure
2. **Abdominal** exam: tenderness (sign of infection) – contraction – fundal height
3. **Pelvic exam**: speculum (cervix dilation and length " to rule out labor "– Pooling test - sample)


Ferning

Third : Lab test

- Nitrazine paper test : become blue
- Ferning test : filling of speculum with amniotic fluid
- Amnisure test: detect specific protein , it is the most accurate test and that what we use these day

Confirmatory test:

- US: gestational age – To make sure there is no compression of the cord (lose fluid lead to compression)
- CTG: 28w

Management of PROM

- Expected management **'watchful waiting**' OR **immediate delivery.**
- The choice **depends on**: gestational age , infection, placental abruption, labor, fetal status.

If term (>37 weeks):

- 90% will go into **spontaneous labor within 24hrs.**
- If no spontaneous labor → give **oxytocin or prostaglandin** to induce labor.
- **Labor induction will reduce:** time of delivery, admission to NICU, rate of chorioamnionitis and endometritis.

If preterm (<37 weeks):

Risk of **uterine infection** vs risk of **prematurity** need to weighed carefully to decide on the management.

Late preterm (34-36+6 days):

- The management is the same as term for the risks of infection outweigh the risks of prematurity.

If between (24-33+6 days)

- Presence of **uterine infection** → **Delivery** needs to be initiated **immediately**.
- **Absence** of uterine infection → **Steroids + Tocolytics + Antibiotics.**
  - **Inpatient**: Hospitalization with U/S to assess amniotic fluid volume and antepartum testing such as non-stress testing.
  - **Steroids (IM betamethasone**) are given to promote lung maturity, intraventricular hemorrhage and necrotizing enterocolitis.
  - **Antibiotics** are used to increase the latency period (which is the time between rupture of membranes and spontaneous labor)
    - ✓ Obtain cervical cultures and start **7 days course of ampicillin and erythromycin** (2 days IV " why ? If pt state progress, usually will be in 2 days" and then oral for 4 days)
    - ✓ Note that antibiotics are administered because they have been shown to increase the amount of time before spontaneous labor, the antibiotics are not to treat an infection.
  - **Tocolytics (ex. Magnesium sulfate)** to decrease contraction if indicated-at 34 / 32 weeks and less. **But in the presence of infections they are usually unsuccessful.**
  - Delivery will be induced between 32 and 34 weeks

Previable PPROM (<24 weeks):

- Occurs in <1% of pregnancies.
- Poor outcome; either induce labor or manage patient with bed rest at home
- Important risks of prematurity to discuss: (counseling)
  - **Pulmonary hypoplasia** (very high) rates are approximately 10-20 % .
  - **Prolonged oligohydramnios** can cause fetal **deformations** and **limb contractures** because the fetus cannot move freely within the amniotic sac.
  - Neonatal death and morbidity rates decrease with a longer latency period and advancing gestational age.
  - Significant **maternal complications** that can occur with prolonged rupture of membranes with increased risks of **systemic infections.**
- Tell her to come back immediately if contraction or fever develop. (infection).
- **Antibiotics and corticosteroids are not recommended before viability.**

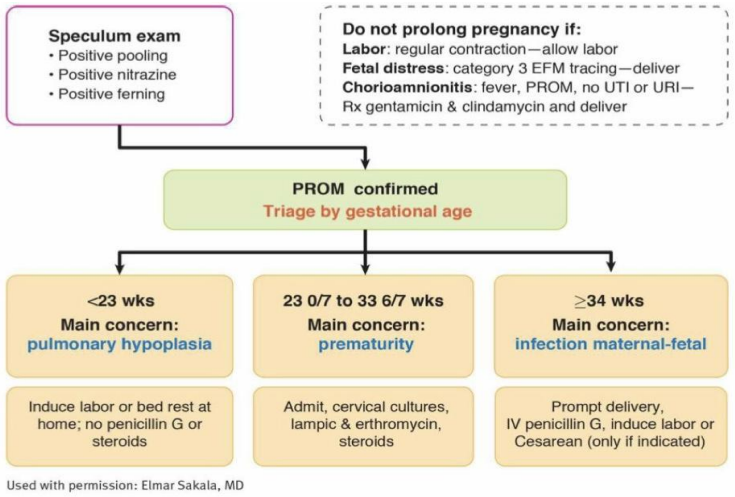
Premature rupture of membranes (PROM)

Complications:

Table I-8-3. Hazards Associated with PROM

If Fetus Remains In Utero	If Preterm Delivery Occurs
Neonatal conditions • Infection and sepsis • Deformations • Umbilical cord compression • Pulmonary hypoplasia	**Neonatal conditions** • Respiratory distress syndrome (most common) • Patent ductus arteriosus • Intraventricular hemorrhage • Necrotizing enterocolitis • Retinopathy of prematurity • Bronchopulmonary dysplasia • Cerebral palsy
Maternal conditions • Chorioamnionitis, sepsis • Deep venous thrombosis (DVT) • Psychosocial separation	

Summary:



Used with permission: Elmar Sakala, MD

Figure I-8-6. Diagnosis and Management for Premature Rupture Membranes

Chorioamnionitis

Diagnosis:

- **It is diagnosed clinically with the following criteria:**

Maternal fever + continuous uterine tenderness in the presence of confirmed PROM in the absence of a URI (clear lungs) or UTI (urine has no WBCs/bacteria).

Other signs and symptoms: baseline fetal tachycardia (earliest sign) , purulent fluid from cervical os and maternal leukocytosis and maternal tachycardia.

If chorioamnionitis is present, obtain cervical cultures, start broad-spectrum therapeutic IV antibiotics, and initiate prompt delivery (vaginal or c-section if breech)

Teaching case

P0000

1st(0)=term , 2nd(0)=preterm , 3rd(0)=abortion , 4th(0)=ectopic pregnancies

A 26-year-old G2P0100 woman, who is 31 weeks gestation, presents to the labor unit complaining of leakage of fluid and she thinks that her "bag of water broke." She has had increased vaginal discharge and intermittent lower back pain for the last two days. She reports a gush of fluid about 2 hours ago. The fluid ran down her leg and appeared clear with no noticeable odor. Her prior pregnancy was complicated by preterm labor and premature rupture of the membranes at 26 weeks gestation. The neonate's course was complicated by necrotizing enterocolitis, respiratory distress, and death at 28 days of life.

Q1: What risk factors are associated with premature rupture of membranes (PROM)?

Slide 3 as well as the following:

- 2nd and 3rd trimester bleeding.
- Cervical conization/LEEP.
- Deficiencies of copper and ascorbic acid.

Q2: What should be the next step in this patient's diagnosis?

- Check doctors notes.
- Sterile speculum examination to confirm the diagnosis.
- Pooling of fluid per cervical OS.
- Fern – cervical mucus broad fern vs. amniotic fluid narrow fern .
- PH, Nitrazine – turns blue as the pH of amniotic fluid is usually 7.1-7.3 while vaginal discharge is normally acidic. False positive Nitrazine may occur due to:
  - Alkaline urine.
  - Cervical Mucus.
  - Semen.
  - Antiseptic solutions.
  - Blood.
  - Bacterial vaginosis.
- Ultrasound evaluation AFI in equivocal cases – not diagnostic.
- AmniSure Test : Test kits for amniotic proteins - considered ancillary to standard methods of diagnosis.

Q3: What should be the next step in management once PROM has been confirmed?

- Check doctors notes.
- **Assess fetal status**: continuous fetal monitoring, ultrasound to assess the estimated fetal weight (EFW), amniotic fluid volume and fetal presentation.
- **Rule out labor** (uterine activity monitoring).
- **Rule out intraamniotic infection**: This diagnosis may be made clinically. In some cases amniocentesis may be helpful to rule out an intraamniotic infection. Amniotic fluid may be sent for gram stain, aerobic and anaerobic cultures, glucose and cell count.
- Obtain swabs to **rule out Chlamydia** trachomatis, Neisseria **gonorrhoea** and **group B streptococcal** infection.

Teaching case

- **Digital cervical examinations should be avoided unless the patient appears to be in active labor or imminent delivery is planned.** Digital exams are associated with an increased risk of infection and add little information to that available with speculum examination.
- Once labor and intraamniotic infection have been ruled out, if patient is preterm (< 34 weeks) consider:
  - Antibiotics: Ampicillin and erythromycin to prolong the latency period.
  - Steroids to enhance fetal lung maturation and decrease risk of RDS.
- Patients with preterm PROM at a viable gestational age should be observed closely in the hospital on modified bedrest. They should be assessed periodically for evidence of infection,placental abruption, umbilical cord compression, fetal well-being, and labor. There is no consensus on the optimal frequency and type of assessment that is optimal. An acceptable strategy would include periodic ultrasound monitoring of amniotic fluid volume and daily or twice-daily fetal heart rate monitoring
- The decision to deliver the fetus is based on gestational age and fetal status.
- If there is evidence of intraamniotic infection or evidence of fetal compromise at any gestational age, the fetus should be delivered.
- The timing of delivery may vary among institutions:
  - The patient who experiences PROM between 24 weeks and 31 completed weeks of gestation should be cared for expectantly if no maternal or fetal contraindications exist until approximately 34 weeks of gestation.
  - At 32–33 completed weeks of gestation, the risk of severe complications of prematurity is low if fetal pulmonary maturity is confirmed by amniotic fluid samples collectedvaginally or by amniocentesis. Therefore, labor induction may be considered if pulmonary maturity has been documented. If pulmonary maturity cannot be established, expectant management may be beneficial.

Q4: What are the risks associated with preterm PROM?

Maternal risk	Fetal risk
• Chorioamnionitis. • Cesarean delivery for malpresentation and failed induction. • Placental abruption.	• Cord prolapse • RDS • Necrotizing Enterocolitis • Intraventricular hemorrhage • Limb deformities • Infection • <24weeks=increase risk of pulmonary hypoplasia **check Dr notes**

Q5: What treatment can this patient be offered in a future pregnancy to decrease recurrence for preterm PROM and preterm delivery?

Studies suggest **progesterone therapy** to reduce the risk of recent spontaneous preterm birth resulting from preterm labor or PROM.

The butter For a patient who have a **Hx of PROM**, in future pregnancies we do:

1-Vaginal swab.

2-Give Abx locally ex:clindamycin.

3-Give progesterone injections weekly till 32 weeks to delay the contractions to prevent preterm labor causing the PROM

Doctors notes

Q2/For the diagnosis of PROM (done in ER):

1. Examine the vagina using a speculum and you will see pooling of fluid through the vagina.
2. To confirm that the pooling is amniotic fluid we do:
   - Vaginal swab for culture.
   - Nitrazine test for PH (blue is a positive test since amniotic fluid is alkaline and vaginal fluid is acidic);not used anymore.
   - Fern.
   - Amnisure test (take a vaginal swab and culture in special media;it detects the fetal protein present in the amniotic fluid and its more accurate than nitrazine since theirs high false positives rates using it)

If there is no fluid (pooling) seen and you don't have amnisure then do **US** to check for (AFV,GA,weight of baby,presentation).

Q3/Patient came to the **ER** complaint of fluid leakage so first step to **manage** her is:

1. Rule out **labor** by vaginal examination.
   - If the patient was in active labor the deliver is either vaginally=if cephalic or CS=if breech or cord prolapse
   - If we find decelerations and cervix 8 cm dilated then deliver vaginally
   - If we find mild decelerations then we can start augmentation
   - If the decelerations are very bad and cervix is closed i go for CS

If she's not in labor then:

- Immediately start with antibiotics I.V in PROM to prolong the latency period(the period between rupture of the membrane till spontaneous labor.
- The latency period for term is 24 h and for preterm is 2 weeks)to have time to give the patient **dexamethasone** for 48 hours to promote lung maturation;if the vaginal swab of patient came positive then continue Abx for **5 days.**

And:

Admit to Antenatal ward and :

1. Order US to check baby's weight, AFV, presentation
2. Order (CTG 1-2 daily) to check for (fetal HR , any deceleration, contractions). If decelerations are present we may need to do an emergency CS. Tachycardia is acceptable at 31 weeks.
3. Order MSU;for urine culture cause one of the most common causes of preterm labor or PROM is UTI
4. Check for Chorioamnionitis (a serious infectious complication of PROM which can lead to septicemia and organ failure in the mother)by:
   - Checking for fever,CBC (2/weekly),bad odor, tenderness uterus=indicating endometritis which is the first sign of Chorioamnionitis .
   - If while doing the routine exams in the ward and you found that the patients has only clinical signs of Chorioamnionitis, then deliver the baby immediately cause as we mentioned earlier it can cause septicemia and organ failure to the mother;if the cervix is closed then induce her with prostaglandins, if breech then CS.

If the patient is still in the ward and doesn't have any signs of labor, decelerations or Chorioamnionitis?

Then wait until >34 weeks by giving her antibiotics to increase the latency period for the dexamethasone to mature the lung and continue evaluating for any complications then deliver the baby.

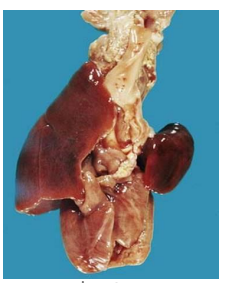
(If the patients have signs of blood in the amniotic fluid(abruption) then deliver immediately)

So if patient goes in labor deliver her immediately either vaginally are by CS according to the situation!!

(Tocolytics are given only in preterm labor without rupture of the membrane)

Pulmonary hypoplasia

If <19 weeks and PROM then dont give steroids and just terminate the pregnancy, cause if we deliver the baby he will have pulmonary hypoplasia and live the rest of his life in the hospital dealing with pulmonary infections and resuscitation will have no effect on him cause the lungs are solid and will eventually die at the age of 7 or 8, if the mother refuses then just give Abx and wait.



*extra

Doctors notes 439 + 441

PROM:
-Membranes rupture (water breaking) but the patient doesn't progress into labour -No contractions on CTG
-No palpable contractions during examination
-Cervical OS is closed (no cervical dilation)
Labour/Preterm labour:
-Regular contractions
-Cervical dilation
-Rupture of membranes

Cases:
-If a patient presents to you with water breaking at 37 weeks & she is 6cm dilated→ she is labouring (NOT PROM)
-If a patient ruptured her membranes at 26 weeks & she is 5-6cm dilated → preterm labour (NOT PROM)
-If a patient is in labour & 3cm dilated & you want her to progress into labour → we rupture the membranes which will release prostaglandins causing her to progress into labour.
-**if a patient ruptures her membranes and doesn't progress into labour** → PROM
-**Usually, membranes rupture happen shortly before labour (in 2-3 hours she will be 1-2cm dilated). if the OS is still closed after 2-3 hours it means she's not progressing into labour** → PROM

Previable PPROM: happens before the fetus is viable or lung maturity (<24 weeks) (some hospitals depend on the fetus' weight rather than the gestational age)
-**Early PPROM:** (24-34 weeks)
-Late PPROM: (34-36+6 weeks)
Each have different management

The Fetus produces urine to make up the amniotic fluid then he swallows the urine, so if the baby has: -Renal problems→ oligohydramnios→ immature lungs
No or little fluid causes compression leading to growth abnormalities & lung hypoplasia

-GI problems→ polyhydramnios

Risk factors for PROM can be divided into 3 categories:
1-Previous history (Preterm labour, PROM)
2-Causes leading to thinning of membrane (Multiple pregnancies,polyhydramnios,smoking, infection

- Infection causes local inflammation which leads to the thinning of the membranes causing it to easily rupture. Most likely it will be ascending infection so it's important to ask in the history about (UTI symptoms, Itchiness, fever, foul smelling green or dark brown discharge). An increase in vaginal secretions is normal and is not a risk factor cause a pregnant patient usually has increased secretions due to progesterone
- Smoking causes inflammation of the membranes leading to thinning of the membranes

3-Cervical abnormalities: Short cervix (due to genetics), cervical incomplete
If any trauma or infection happens it will easily be transmitted to the membranes causing them to rupture

Patient presents to the ER with water breaking:
1-Take history
-HPI

- Amount (gush of fluid/ continuous small amounts/ or you noticed small amounts then it stopped and after awhile you noticed small amounts of fluid again→ this will most likely be vaginal secretions)
- How did you notice it
- What were you doing

-Ask her about (Previous preterm labour/PPROM, symptoms of labour, symptoms of UTI)

Doctors notes 439 + 441

2- Physical exam

-Vital signs (Signs of infection: Fever, tachycardia, hypotension)

-Abdominal examination:

- Tenderness (Chorioamnionitis) if there is Chorioamnionitis you will immediately deliver regardless of the baby's outcome or gestational age

-Contractions on CTG (If there are no contractions don't do VE)

-Speculum (to check the cervix/ rule out labour/ pooling)

- Make sure to perform Nitrazine/ Ferning/ Amnisure test (most accurate) before using the speculum because if i used the speculum the gel on the speculum will mix with the secretions leading to false results.

3- Investigations

-Labs

- CBC (Check WBC for infections)
- Urine culture (for infection)
- High vaginal swab/culture (for chlamydia, gonorrhea and GBS)

If infection if present, treat it to prevent chorioamnionitis GBS treatment

-Ultrasound

- Biophysical profile (fetal movement, fetal tone and fetal breathing)
- Check for amniotic fluid volume the amniotic fluid index (AFI) ; a semiquantitative tool used to assess amniotic fluid volume (normal range: 8–18 cm)
    - Determined by dividing the uterus into 4 quadrants, holding the transducer perpendicular to the patient's spine, and adding up the deepest vertical pocket of fluid in each quadrant.
    - Oligohydramnios: ≤ 5
    - In pregnancies < 24 weeks and multiple gestations, the single deepest pocket is used (normal range: 2–8 cm).

Management:

If there is Signs of chorioamnionitis (Maternal Fever, Fetal/ maternal tachycardia, abdominal tenderness, Foul smelling discharges) → immediately deliver regardless of the baby's outcome or gestational age & start her on antibiotics.

-Term+ PROM → induce labor

- If you want to induce labour → admit into labour room
- If you want to wait for spontaneous labour → admit into antenatal ward

-Late PPROM (34-36+6 weeks) → Induce labor (high risk of chorioamnionitis)

-**Early PPROM (24 - 34 weeks)** → Induce labour when patient reach to 34 weeks , before that do :

1. Dexamethasone 6mg Q12 for 2 days (total 4 doses)
2. Tocolytics are only given in preterm labour in order to complete the dexamethasone course to induce lung maturity
3. Antibiotics for 7 days (IV for the first 2 days then switch to oral)
4. Observation by CTG & doppler

Discharge patient after antibiotic course if patient was vitally stable but follow up visits should be more than that of a normal pregnancy.

If patient has low socioeconomic status/ not living in the same city → don't discharge

-**Previable PPROM(<24 weeks)**→ observation or induce labour (terminate)

GBS Prophylaxis:

-**If a patient with normal pregnancy labours at 37 weeks while & she has Positive GBS result at 35 weeks** → give her the prophylaxis intrapartum (due to risk of vertical transmission) no need to treat her while she is pregnant.

-**If a patient goes into preterm labour and GBS status is unknown (Because GBS swab is usually done at 35 weeks)** → give her prophylaxis

-**If a patient is at term, membranes ruptured for 18 hours, unknown GBS status** → give her prophylaxis

Online MedEd

- **Rupture of membranes happens when the sac around the fetus opens and the baby is allowed to engage the cervix and start the birthing process**
- **Rupture of membranes is a normal process of delivery. It happens when the fetus is term, and contractions are present**
- **PROM depends on onset of labor + presence of contractions:**
  - **Premature: term + no contractions**
  - **Preterm; fetus is preterm (<37 weeks)**
- **Normally, the duration of labor (time of membranes rupture → delivery of the placenta) should not exceed 18 hours. Longer than that = prolonged ROM**

	ROM	PROM	pPROM	Endometritis/chorioamnionitis
Path	- Spontaneously - Artificially - Infection (GBS, STI, vaginal flora)	Infection (GBS)	Infection (GBS)	Vaginal flora ascends into mom's sterile uterus
Patient	Gush of fluid (might be mixed with meconium, blood, or clear)	+ ROM + term -ve contractions	+ ROM -ve contractions - term	Prolonged ROM Mom: fever/toxic
Dx	- Speculum: pooling - Nitrazine: blue - Slide: ferning - US: oligohydramnios	- ROM: clinical - Screen for GBS	- ROM: clinical - Screen for GBS	Rule out other infections (UTI by U/A, RTI by CXR, blood culture)
Tx		- Delivery depends on the severity - GBS + (or unknown status): give ampicillin - GBS -ve: watch & wait	>24 weeks: deliver <24 weeks: abortion In between: steroids for lung maturation	Treat vagina flora, gram -ve, anaerobes —> ampicillin + gentamicin +/- clindamycin

Reference

Premature Rupture of the Membranes

DEFINITION AND INCIDENCE

Premature rupture of the membranes (PROM) is defined as amniorrhexis (spontaneous rupture of the membranes as opposed to amniotomy) before the onset of labor at any stage of gestation. Preterm PROM (PPROM) should be used to define those patients who are preterm with ruptured membranes, whether or not they have contractions.

ETIOLOGY AND RISK FACTORS

The etiology of PROM remains unclear, but a variety of factors are purported to contribute to its occurrence, including vaginal and cervical infections, abnormal membrane physiology (apoptosis secondary to oxidative stress), incompetent cervix, and nutritional deficiencies.

DIAGNOSIS

Diagnosis of PROM is based on the history of vaginal loss of fluid and confirmation of amniotic fluid in the vagina. Episodic urinary incontinence, leucorrhea, or loss of the mucus plug must be ruled out. **Because of the risk of introducing infection and the usually long latency period from the time of examination until delivery, the examiner's hands should not be inserted into the vagina of a patient who is not in labor, whether preterm or term.** A sterile vaginal speculum examination should be performed to confirm the diagnosis, to assess cervical dilation and length, and if the patient is preterm, to obtain cervical cultures and amniotic fluid samples for pulmonary maturation tests.

On speculum examination, pooling of amniotic fluid in the posterior vaginal fornix can usually be seen. A Valsalva maneuver or slight fundal pressure may expel fluid from the cervical os, which is diagnostic of PROM. **Confirmation of the diagnosis can be made by (1) nitrazine paper test: amniotic fluid will turn blue in the presence of the alkaline amniotic fluid, (2) fern test: placing a sample of amniotic fluid on a microscopic slide left to air dry will show ferning, and (3) AmniSure test: a highly accurate test measuring placental alpha microglobulin-1 (PAMG-1), which is present in high levels in amniotic fluid.** A fluid sample is obtained with a vaginal swab and placed in a test solution and the result read as positive or negative in 5 to 10 minutes. False-positive nitrazine test results occur in the presence of alkaline urine, blood, or cervical mucus. For the fern test, the presence of blood, which is usually seen in patients in early labor, may make the pattern appear to be skeletonized. The AmniSure test is not affected by the presence of blood or infection. As in the case of preterm labor with intact membranes, a complete ultrasonic examination should be carried out to rule out fetal anomalies and to assess gestational age and amniotic fluid volume.

MANAGEMENT

General Considerations

An intact amniotic sac serves as a mechanical barrier to infection, but in addition, amniotic fluid has some bacteriostatic properties that may play a role in preventing chorioamnionitis and fetal infections. **Intact membranes are not an absolute barrier to infection,** because bacterial colonization still occurs in the decidual space/membrane interface in 10% of patients in term labor and in up to 25% of patients in preterm labor.

For preterm fetuses with PPROM, the risks associated with preterm delivery must be balanced against the risks of infection and sepsis. For the mother, the risks include not only the development of chorioamnionitis, but also the possibility of failed induction in the presence of an unfavorable cervix, resulting in subsequent cesarean delivery.

Management is dictated to a large extent by the gestational age at the time of membrane rupture, although **the quantity of amniotic fluid remaining after PPROM may be as important as gestational age in determining pregnancy outcome.**

Ultrasonic definition of oligohydramnios has been standardized. Objective criteria include measurement of the vertical axis of amniotic fluid present in four quadrants, the total being called the **amniotic fluid index (AFI).** A value of less than 5 cm is considered abnormal.

Oligohydramnios associated with PROM in the fetus at less than 24 weeks may lead to the development of pulmonary hypoplasia. Factors that may be responsible include fetal crowding with thoracic compression, restriction of fetal breathing, and disturbances of pulmonary fluid production and flow. The duration of membrane rupture is an important consideration. Constraints placed on fetal movements in utero can also result in a variety of positional skeletal abnormalities, such as talipes equinovarus.

If PROM occurs at 36 weeks or later and the condition of the cervix is favorable, labor should be induced after 6 to 12 hours if no spontaneous contractions occur. In the presence of an unfavorable cervical condition with no evidence of infection, it is reasonable to wait 24 hours before induction of labor to decrease the risk of failed induction and maternal febrile morbidity. The following discussion applies when premature membrane rupture occurs before 36 weeks' gestational age.

Laboratory Tests

In addition to the laboratory tests obtained for the patient in preterm labor, sufficient amniotic fluid can usually be obtained from the vaginal pool for **pulmonary maturation studies.** Because of the higher incidence of chorioamnionitis in association with PROM, amniotic fluid should also be examined with **Gram stain and culture.**

Conservative Expectant Management

Conservative management applies to the care of patients with PPROM who are observed with the expectation of prolonging gestation. **Because the risk of infection appears to increase with the duration of membrane rupture, the goal of expectant management is to continue the pregnancy until the lung profile is mature.** Careful surveillance must be maintained to diagnose chorioamnionitis at an early enough stage to minimize fetal and maternal risks. In its fulminant state, chorioamnionitis is associated with a high maternal temperature and a tender, sometimes irritable, uterus.

In cases of subclinical infection, diagnosis and treatment may be delayed. A combination of factors should alert the clinician to the possibility of chorioamnionitis, including maternal temperature greater than 100.4° F (38° C) in the absence of any other site of infection, fetal tachycardia, a tender uterus, and uterine irritability when noted on nonstress testing while measuring fetal heart rate and uterine activity.

The presence of bacteria by Gram stain or culture of amniotic fluid obtained at amniocentesis correlates with subsequent maternal infection in about 50% of cases and with neonatal sepsis in about 25%. The presence of white blood cells alone in amniotic fluid is less predictive of infection. The decision to perform amniocentesis is based on the gestational age, the presence of early signs of infection, and the AFI as measured by real-time ultrasonography. Recently, investigators have described elevation of inflammatory cytokines in the amniotic fluid and in the fetal circulation in preterm infants who have subsequently developed chronic lung disease during the neonatal period. A similar response may be associated with a greater risk of damage to the preterm baby's brain, thus increasing the risk of cerebral palsy. Therefore, the management of patients with PROM is critical for the prevention of neonatal morbidity. Some centers around the world do not conservatively manage PROM.

Ampicillin or erythromycin significantly prolongs the interval to delivery in patients with PPROM. The neonates delivered from patients receiving prophylaxis also have less morbidity.

Management of Chorioamnionitis

Once chorioamnionitis has been diagnosed, antibiotic therapy should be delayed only until appropriate cultures have been taken. Ampicillin and gentamycin in combination are the drugs of choice. In the penicillin-sensitive patient, cephalosporins may be indicated, noting the 12% incidence of crossover sensitivity. Once antibiotics have been started, labor should be induced. **If the condition of the cervix is unfavorable, and there is evidence of fetal involvement, it may be necessary to perform a cesarean delivery.**

The presence of active genital herpes is an important concern in the presence of ruptured membranes. Herpes infection at a site remote from the cervix and vagina is probably not associated with an increased risk of fetal infection, so the site of infection should be taken into consideration before recommending immediate cesarean delivery.

Tocolytic Therapy

The use of tocolytics to control preterm labor in patients with PROM is controversial. The arguments against their use are that they may mask evidence of maternal infection (e.g., tachycardia) and that contractions associated with the membrane rupture may be indicative of uterine infection. Arguments for their use are that PROM is sometimes initially associated with evidence of uterine contractions, and time is gained for fetal pulmonary maturation. **In the presence of infection, tocolysis is usually unsuccessful.**

Use of Corticosteroids

There is a "natural" decreased incidence of RDS in infants who are born with PPROM 16 to 72 hours after membrane rupture, presumably because of the endogenous release of corticosteroids from the stress of decreased amniotic fluid volume and early infection. Perhaps for this reason, the National Institutes of Health (NIH) guidelines for glucocorticoid therapy

recommend they be given to patients with PPROM only up to 32 weeks, rather than up to 34 weeks as recommended when the membranes are intact.

Outpatient Management

Outpatient management is not recommended, unless there is no evidence of infection and a normal AFI after a period of inpatient observation for 2 to 3 days. In this situation, the site of rupture may have closed by overlapping of the amnionic and chorionic membranes. **To be eligible for such management, the patient should be reliable, fully informed regarding the risks involved, and prepared to participate in her own care.** The fetus should be presenting as **a vertex,** and the **cervix should be closed** to minimize the chance of cord prolapse. At home, restricted physical activity should be advised, no coital activity should occur, and the patient should monitor her temperature at least four times per day. Instructions should be given to return immediately if the temperature exceeds 100° F (37.8° C).

The patient should be seen weekly, at which time her temperature should be taken, nonstress testing performed after 28 weeks, and the baseline fetal heart rate and AFI evaluated. Ultrasonic evaluation of fetal growth should also be carried out every 2 weeks. **Any patient with oligohydramnios is not a candidate for outpatient management.**

Labor and Delivery

The same considerations discussed under preterm labor apply to patients with PROM. The decrease in amniotic fluid that is sometimes seen can result in early cord compression and the presence of variable fetal heart decelerations. This is true of both vertex and breech presentations; therefore, there is a necessity for abdominal delivery in a large number of cases.

and flank pain persist after 72 hours of therapy, ultrasonography or computed tomography should be considered to rule out a perinephric or intrarenal abscess or ureteral obstruction. A follow-up culture should be obtained 2 weeks after the completion of therapy.

Infections during and after Pregnancy

CHORIOAMNIONITIS

Intraamniotic infection syndrome (IAIS), also referred to as chorioamnionitis, is a clinically detectable infection of the amniotic fluid and fetal membranes during pregnancy. **Most cases of IAIS originate when vaginal microorganisms ascend into the intrauterine cavity after rupture of the membranes.** In full-term pregnancies, IAIS is associated with dysfunctional labor. Approximately 75% of infected women require augmentation of labor with oxytocin, and approximately **35% require cesarean delivery, usually because of arrest of progress in labor.** Risk factors for IAIS include prolonged duration of labor or rupture of membranes, multiple vaginal examinations, young age, low socioeconomic class, nulliparity, and preexisting bacterial vaginosis.

Women with IAIS have a select group of high virulence microorganisms, such as Group-B streptococcus, *Escherichia coli*, genital mycoplasmas, and pathogenic anaerobes, e.g., *Prevotella bivia*, present in significantly high quantities, causing an inflammatory response and systemic signs of infection. Many of these microorganisms (especially anaerobic bacteria, the mycoplasmas, and *Gardnerella vaginalis*) are associated with bacterial vaginosis.

The clinical diagnosis of IAIS is imprecise but is based on the presence of fever (>38° C or >100.4° F) and at least two other findings: maternal and/or fetal tachycardia, maternal leukocytosis (defined as a white blood cell count >15,000), uterine tenderness, and foul-smelling amniotic fluid. The vast majority of these gravidas will have concomitant ruptured membranes. Practically, clinicians tend to base the diagnosis on the presence of intrapartum fever plus one additional criterion. Maternal and fetal tachycardia are common with fever and add little additional information. **Uterine tenderness is often obscured by conduction anesthesia, and foul-smelling amniotic fluid is rare.** Maternal white blood cell counts increase with duration of labor, but no reliable breakpoint has been established to reliably distinguish fever from infectious and noninfectious causes.

Given the imprecision of the diagnosis of IAIS, antibiotic therapy should be considered in laboring gravidas with fever (>38° C or > 100.4° F). Antimicrobial therapy for IAIS is aimed at preventing bacteremia

in the mother as well as initiating intrapartum treatment of the fetus while awaiting delivery. **Improved neonatal and maternal outcome is noted when antibiotic therapy is begun intrapartum rather than immediately postpartum.** Delivery of the fetus and placenta removes the sites of infection, much like draining an abscess, making this intervention a significant part of therapy. Because group B streptococci and *E. coli* are the most common isolates from infected newborns and maternal therapy initiates fetal therapy, **a combination of ampicillin plus gentamicin is a reasonable initial regimen for IAIS.** This regimen is sufficient to treat the mother if the delivery is vaginal with only one additional dose of the antibiotic regimen needed postpartum. **If cesarean delivery is required, up to 15% of patients given only ampicillin and gentamicin will develop postpartum endometritis.** These patients require continued broad-spectrum antibiotic coverage, and a drug such as clindamycin or metronidazole should be added to the treatment regimen. This antibiotic regimen should be continued until the patient has been afebrile (temperature <38° C or <100° F) for 24 hours.

Although delivery is essential for cure, no critical diagnosis-to-delivery interval has been identified. Accordingly, labor must be managed actively, but cesarean delivery should be performed only for accepted obstetric indications.

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