Antenatal Monitoring After Preterm Prelabor Rupture of Membranes

Angela K. Shaddeau, MD, MS, Irina Burd, MD, PhD*

INTRODUCTION AND DEFINITIONS

Preterm prelabor rupture of membranes (PPROM) occurs in approximately 2% to 3% of pregnancies. Management of patients in which PPROM occurs requires careful consideration of multiple factors, including gestational age and risks of expectant management compared with risks of delivery for both mother and fetus. Some prenatal complications associated with PPROM include preterm labor, intra-amniotic infection, placental abruption, and assurance of fetal well-being. Given the risk of these significant complications, it is important that a full initial evaluation be performed on these patients to determine if initial signs of infection, abruption, or fetal distress exist. If not, then a comprehensive plan for antepartum monitoring should be formulated if expectant management is deemed appropriate and accepted by patients after thorough counseling.

According to the most recent guidelines from the American College of Obstetricians and Gynecologists (ACOG), published in March 2020, gestational age remains the most important consideration with regard to determining timing of delivery in the absence of a clear indication, such as infection, abruption, or concern for fetal well-

KEY POINTS

- Preterm prelabor rupture of membranes after viability requires inpatient admission for monitoring of both maternal and fetal status.
- Antepartum monitoring includes close monitoring for signs of intra-amniotic infection, placental abruption, and assurance of fetal well-being.
- Future studies are needed regarding utilization of readily available surveillance technologies to assist in determining which patients for delivery at term versus the late preterm period.
Traditionally, PPROM occurring after 34 weeks has been considered an indication for delivery because the risks of expectant management with monitoring were considered to outweigh the risks of delivery and prematurity. A recent meta-analysis of 12 randomized controlled trials, however, found higher rates of neonatal respiratory distress, ventilation requirement, mortality, neonatal intensive care admission, and cesarean delivery in patients undergoing immediate delivery compared with expectant management, with no significant difference in neonatal sepsis rates. The neonatal benefits for expectant management must be balanced with the potential maternal risks. A recent trial specifically evaluating women with PPROM between 34 0/7 and 36 6/7 randomized patients to immediate delivery or expectant management found lower rates of neonatal respiratory distress and mechanical ventilation and no increase in neonatal sepsis in the expectant management group. This trial noted a lower cesarean delivery rate, but had a 2-fold higher rate of maternal complications, including hemorrhage and infection in the expectant management group. Given the results of these recent studies showing neonatal benefits to expectant management, current guidelines from ACOG indicate that either expectant management or immediate delivery are reasonable options with rupture of membranes between 34 0/7 and 36 6/7 weeks after thorough counseling and shared decision making. The decision to manage expectantly requires a detailed plan for antepartum monitoring of both mother and fetus and this monitoring should be performed in an inpatient setting. Rupture of membranes occurring at 37 weeks or beyond is a clear indication for delivery.

PPROM occurring before 37 weeks requires prompt evaluation for signs of overt uterine infection or placental abruption and assessment of fetal well-being to determine if expectant management with antenatal monitoring is appropriate. If expectant management is appropriate, a plan of care for the patient should be established with consideration to gestational age and other concurrent pregnancy complications. Development of this plan should include a discussion with the patient regarding the risks associated with expectant management compared with immediate delivery and the plan for antepartum monitoring of both mother and fetus should expectant management be chosen.

In general, antepartum monitoring in PPROM is performed in an inpatient setting. When PPROM occurs prior to neonatal viability, however, outpatient management and surveillance can be considered after patient counseling and the decision has been made for expectant management. Once the pregnancy reaches a gestational age where neonatal viability is possible, they typically are admitted for inpatient management and monitoring.

The goal of fetal surveillance is prevention of fetal death. With PPROM, there are associated maternal risks, including maternal infection and hemorrhage from placental abruption. Given the significant risk for both maternal and fetal morbidity and mortality, antepartum monitoring in PPROM is of significant importance. This article discusses evidence for fetal and maternal antepartum monitoring modalities in the patient with PPROM and indications for maternal and fetal interventions.

There are important definitions to consider with regard to antepartum monitoring in PPROM. Antepartum fetal surveillance is defined as a group of tests and techniques utilized to monitor fetal well-being with the purpose of attempting to prevent fetal death. Two of the most common testing techniques utilized include nonstress tests (NSTs) and biophysical profiles (BPPs). An NST uses a continuous fetal heart rate tracing to identify fetal heart rate accelerations with movement as long as the fetus. This test can exclude fetal acidemia in a neurologically intact fetus. In this test, the fetal heart rate is monitored for a period of at least 20 minutes utilizing an electronic fetal monitor and the results are either reactive or nonreactive. An NST is considered...
reactive if the fetal heart rate accelerates at least twice by 15 beats per minute for a period of 15 seconds during the 20 minutes. If the gestational age of the fetus is less than 32 weeks, the threshold for reactivity often is lowered to heart rate accelerations of 10 beats per minute for a period of 10 seconds to be considered reactive. A BPP is another common technique utilized for assessing fetal well-being and consists of an NST with the addition of 4 ultrasound markers. These sonographic components include an assessment of amniotic fluid, fetal movement, fetal tone, and fetal breathing. The presence of each component scores a value of 2 points, or 0 points if absent. Each component is defined as follows: the presence of a 2-cm pocket of amniotic fluid, the presence of 3 or more discrete limb or body movements, extension and flexion of a fetal limb or opening and closing of fetal hands, and presence of sustained fetal breathing for 30 seconds or more. If the 4 sonographic components of the BPP are present without the NST component, fetal well-being is considered reassuring.

FETAL AND MATERNAL COMPLICATIONS NECESSITATING ANTENATAL MONITORING AND SURVEILLANCE

Regardless of management strategy, at least half of patients presenting with PPROM deliver within 1 week of ruptured membranes, but the timing of latency from rupture to delivery appears to be inversely related to gestational age at the time of rupture. There are both maternal and fetal risks associated with PPROM, necessitating inpatient management in order to facilitate rapid intervention. A common maternal complication associated with PPROM is an intra-amniotic infection, often referred to as chorioamnionitis. Clinically apparent intra-amniotic infection occurs in approximately 15% to 35% of patients with PPROM in the antepartum period and in approximately 15% to 25% of patients in the postpartum period. Ureaplasma urealyticum, Escherichia coli, Chlamydia trachomatis, Mycoplasma hominis, and Enterococcus faecalis are the most common bacteria associated with PPROM. Rarely, infection can progress to maternal sepsis or death related to maternal infection.

Placental and umbilical cord complications can contribute to poor maternal and fetal outcomes. Placental abruption and subsequent maternal hemorrhage occur in approximately 2% to 5% of pregnancies complicated by PPROM. Umbilical cord compression or prolapse is a common complication that can lead to the need for emergency cesarean delivery or fetal death. Spontaneous intrauterine fetal demise occurs in 1% to 2% of patients who are expectantly managed with PPROM. Neonatal complications often are identified in pregnancies complicated by PPROM include primarily complications associated with prematurity. These complications can be associated with intra-amniotic infection or placental abruption. Neonates are at increased risk for sepsis, necrotizing enterocolitis, intraventricular hemorrhage, periventricular leukomalacia, and pulmonary hypoplasia. Pulmonary hypoplasia is a significant concern when occurring in the periviable or previable period. These potential complications highlight the importance of admission for inpatient management of these patients.

ANTENATAL ASSESSMENT AND FETAL MONITORING

Initial Evaluation

Management and monitoring of patients who present with PPROM begins at the time of initial evaluation, which includes history, physical examination, and tests to confirm ruptured membranes. The physical examination should include a sterile speculum examination but a digital examination should be avoided. An examination may be
indicated if there is a concern for labor. At the time of speculum examination, assessment for pooling of amniotic fluid in the vagina is performed, in addition to assessment of pH of the fluid (often referred to as nitrazine test), and collection of a slide of fluid for microscopic assessment for ferning once the fluid has dried. Amniotic fluid is basic (high pH) and turns nitrazine pH paper blue. Ferning is created when amniotic fluid dries creating an arborization pattern due to the electrolytes present within amniotic fluid. A swab for group B streptococcus culture should be collected at the time of evaluation, prior to starting any antibiotics for latency. Additionally, the fluid is assessed for vaginal bleeding, purulent discharge, or other concerning signs of intra-amniotic infection. A visual assessment of dilation is performed looking for fetal parts or prolapsed umbilical cord that may protrude through the cervix.

A maternal physical examination is performed to identify signs of infection. Vital signs are assessed to ensure absence of fever, normal blood pressure, and pulse. An abdominal examination is performed to assess for any signs of fundal tenderness. Assessment for signs of preterm labor, including subjective discussion with the patient regarding symptoms of abdominal pain, contractions, or vaginal bleeding, is performed and fetal heart rate evaluation is performed with close attention to tocometry to assess for contractions and fetal tachycardia. An ultrasound is performed to determine fetal presentation and to assess the volume of amniotic fluid. Other components to assess for fetal well-being on initial monitoring include the presence of moderate variability on the fetal heart rate tracing, accelerations in the heart rate, and presence or absence of decelerations. If the initial steps of the evaluation and management are concerning for intra-amniotic infection, delivery may be warranted. If after initial evaluation the patient does not have findings concerning for infection and fetal well-being is reassuring, then the patient may be a candidate for expectant management with antepartum monitoring depending on gestational age.

The previable patient with PPROM is the only patient who is considered a candidate for outpatient surveillance and management if this is desired. Prior to discharge for outpatient surveillance, it is recommended that a period of monitoring occur and that the patient have counseling to include the options of immediate delivery by induction or dilation and evacuation or expectant management. If possible, a maternal-fetal medicine consultation and a neonatology consultation should occur to ensure the patient has all of her questions answered prior to making her decision. After this period of monitoring and once counseling has occurred, the patient may be discharged for outpatient management with scheduled follow-up and instructions on when to return. At the time she leaves, she should understand she has an increased risk of infection and placental abruption in addition to her increased risk of preterm labor and fetal demise. She should be made aware that she should return at the first sign of infection to include fevers, abdominal pain or contractions, vaginal bleeding, or purulent vaginal discharge. She should have weekly follow-up to assess for signs of infection. Her plan should include growth ultrasounds at regular intervals and admission at viability for inpatient monitoring at that time.

In the patient with a viable fetus with no signs of infection and reassuring fetal status, admission for inpatient management and antepartum monitoring is recommended. Immediately after diagnosis of PPROM, latency antibiotics are started, a course of betamethasone should be given for fetal lung maturity when appropriate, and magnesium can be considered for fetal neuroprotection. These interventions are discussed elsewhere in this series.
Patients with PPROM should continue to be monitored carefully for signs of impending complications. The patient should have daily physical examinations to monitor for fundal tenderness and close monitoring of vital signs. Serial laboratory tests to evaluate for leukocytosis or other inflammatory markers has not been shown to be beneficial but may help when clinical condition changes. Laboratory tests should be performed with significant vaginal bleeding or concern for abruption. Early findings of infection can be subtle, and providers should have a high index of suspicion in order to detect an evolving intrauterine infection in early stages.

Additionally, fetal heart rate monitoring (NSTs) typically are performed at regular intervals. There is no consensus on the specific interval of monitoring, but most centers monitor at least daily. A recent study comparing various regimens, including continuous electronic fetal monitoring with daily BPP to periodic monitoring with NSTs, 3 times daily, found that patients undergoing continuous monitoring were more likely to have an intervention or cesarean delivery. The study did not find a difference, however, in intratertine or perinatal mortality. Regardless of chosen interval of monitoring, in the event that a patient has a nonreactive NST, a BPP can be performed to assess fetal status. Additionally, fetal growth ultrasounds should be performed every 3 weeks to 4 weeks to monitor for appropriate interval fetal growth.

An area of interest and research in antepartum monitoring for patients with PPROM has been in surveillance with fetal Dopplers. No large studies have been done to demonstrate the utility of fetal Doppler in patients with PPROM, but several smaller studies have been performed looking at Doppler changes and compared various aspects of pregnancy in patients with PPROM. A study by Carroll and colleagues, in 1995, evaluated Doppler changes in the uteroplacental and fetal circulation. They performed amniocentesis and cordocentesis for microbial culture within 1 hour of Doppler evaluation. The study concluded that there were no differences in doppler values between groups with and without evidence of intra-amniotic infection and that they could not conclude that chorioamnionitis was associated with a significant degree of vasoconstriction based on their data. Shortly thereafter, Yücel and colleagues published a small study in which uterine artery (UA) Dopplers and BPPs were performed on patients with PPROM and the placentas were examined for histologic signs of inflammation after delivery. They found that placentas with microscopically confirmed signs of inflammation were more likely to belong to patients who had abnormal BPP scores and increased systolic-to-diastolic (S/D) ratios on UA Doppler measurement. Based on these findings, they concluded that abnormal BPP scores and elevated S/D ratios on UA Dopplers were associated with impending clinical infection. Aviram and colleagues reported on a larger more contemporary cohort, which included 504 patients with PPROM at a tertiary care center in which they assessed the utility of ultrasound markers for surveillance of patients with PPROM. They found that the median pulsatility index (PI) in the UA doppler was slightly higher in the suspected chorioamnionitis group, but there were similar rates of elevated PI values that were greater than 95% for gestational age. No differences between the 2 groups to other sonographic markers, such as mean amniotic fluid volume, overall BPP scores, or BPP scores less than 6 were identified. Additionally, none of the ultrasound markers was predictive of adverse neonatal outcomes, although neonates in the suspected chorioamnionitis group did have increased rates of adverse outcomes overall. A recent study by Kelleher and colleagues utilized ultrasound doppler technology in a nonhuman primate...
model to monitor fetal hemodynamics after intra-amniotic inoculation with \textit{Urea-plasma} in addition to assessing the impact of maternal treatment with antibiotics. The study design involved 3 arms: a control group, an intra-amniotic infection (IAI) group, and an IAI group that was treated with azithromycin. Dopplers were assessed in the fetuses, and the UA PI was significantly elevated in the IAI group compared with controls. Treatment with azithromycin restored the values to the levels of the controls.\textsuperscript{10} Further studies are needed to assess whether fetal Doppler studies as a marker of fetal infection during expectant management. Additionally, based on the primate study by Kelleher and colleagues,\textsuperscript{10} further studies may be warranted investigating therapeutic interventions (eg, continued maternal antibiotics) if early signs of fetal hemodynamic changes are noted on ultrasound without any overt signs of intrauterine infection.

Recommendations concerning the amount of daily activity remains controversial. Given that PPROM is a leading cause of maternal and perinatal morbidity, there is an inclination to question whether bed rest is a reasonable recommendation for these patients in order to prevent potential complications. Antenatal bed rest is widely prescribed in patients with PPROM. Bed rest has not been shown to be beneficial in a variety of obstetric complications and has been associated with increased risk of thromboembolic events and physical deconditioning with resulting muscle atrophy. Two small pilot studies have been recently performed to assess whether bed rest has an effect on latency duration. The first study, performed by Bigelow and colleagues,\textsuperscript{11} randomized 36 women to either bed rest or activity without limitation and requiring at least 20 minutes of walking 3 times a day. This study found a decrease in latency that was not statistically significant in the activity group and a “possible” increase in infants diagnosed with necrotizing enterocolitis in the activity group. The second study, performed by Martins and colleagues\textsuperscript{12} randomized 32 women with PPROM between 24 weeks and 33 weeks 6 days to complete bed rest (defined as confinement to hospital bed including the requirement to use a bedpan) or activity restriction, which allowed walks on the ward with bathroom privileges. This study found that bed rest did not increase latency to delivery and did not improve maternal or neonatal morbidity.\textsuperscript{12} Both of these studies were small, randomized controlled trials. The study by Martins and colleagues\textsuperscript{12} utilized the data obtained to calculate a sample size for a randomized control trial. Based on current available evidence, bed rest should not be routinely utilized in the antenatal management of patients with PPROM.

Expectant management with inpatient admission and close antenatal monitoring of mother and fetus is continued as long as the maternal and fetal status remains stable. Certain circumstances necessitate termination of expectant management and monitoring. Evidence of overt intra-amniotic infection as evidenced by maternal or fetal tachycardia, fever, fundal tenderness, or purulent vaginal discharge or amniotic fluid is an indication for delivery in addition to rapid initiation of treatment with antibiotics in order to prevent maternal sepsis. Additionally, new-onset, worsening, or bright red vaginal bleeding should heighten concern for placental abruption and prompt evaluation of fetal status in addition to maternal evaluation. Vaginal bleeding is concerning especially for placental abruption if associated with abdominal pain, contractions, and nonreassuring fetal heart rate pattern. Abnormal coagulation studies with low fibrinogen is strongly suggestive of placental abruption. Antenatal fetal testing showing recurrent fetal heart rate decelerations, persistent fetal tachycardia, or decreased variability may necessitate delivery if unresponsive to intrauterine resuscitative measures. A BPP score of less than 6 of 10 is also suse as an indication to move toward delivery.
SUMMARY

PPROM is a major cause of maternal and perinatal mortality. Given the high risk of morbidity associated with this complication, admission and antepartum monitoring are used to minimize adverse maternal and fetal outcomes. At this time, inpatient antepartum monitoring includes monitoring of maternal vitals and serial examination for signs of infection or placental abruption and daily assessment of fetal status with NSTs. Ultrasound is used to evaluate fetal growth but the utility of Doppler has not been found to be of clear benefit. There is no evidence that bed rest during these admission prolongs latency to delivery or decreases maternal or perinatal morbidity. It is important that providers maintain a high level of suspicion and concern for signs of worsening maternal or fetal status during these admissions that would prompt immediate delivery. Antepartum monitoring of maternal and fetal status is used to determine when delivery should be initiated.

CLINICS CARE POINTS

- PPROM is a complication of pregnancy with a high risk for maternal and fetal morbidity that requires admission and close monitoring after viability.
- Prior to proceeding with expectant management with antepartum surveillance, a thorough evaluation of maternal and fetal status should be performed to rule out infection and ensure fetal well-being.
- Evidence of overt or developing clinical infection, placental abruption, or worsening fetal status should prompt consideration of movement toward delivery.

DISCLOSURE

The authors have nothing to disclose.

REFERENCES


