Prelabor rupture of the membranes

1 Introduction

Prelabor rupture of the membranes is defined as spontaneous rupture of the membranes before the onset of regular uterine contractions. It is often referred to as ‘premature rupture of the membranes’, but that name may be misleading, because the word ‘premature’ has also been associated with low birthweight and preterm birth. The expression ‘prelabor rupture’ is more appropriate and precise.
When prelabor rupture of the membranes occurs before 37 weeks gestation, we refer to it as 'preterm prelabor rupture of the membranes'; at or after 37 weeks, it is referred to as 'term prelabor rupture of the membranes'. The distinction, while arbitrary, is important both for prognosis and for care.

2 Diagnosis

2.1 Ruptured membranes
It is important to be certain whether or not the membranes are ruptured. Sometimes the diagnosis is obvious from the sudden gush of clear amniotic fluid from the vagina and its continued leaking thereafter. Sometimes it can be difficult to differentiate rupture of the membranes from other leaks of body fluid, such as vaginal discharge or urine. If the rupture has occurred recently, it may be possible to confirm the diagnosis by collecting some fluid, either by asking the woman to sit on a suitable receptacle or obtaining a sample from a pool of amniotic fluid in the posterior fornix on speculum examination.

The nitrazine test is probably the most widely used test for differentiating amniotic fluid from other body fluids, but it has a false-positive rate of about 15%. For this reason an additional test, usually microscopic observation of ferning, is worthwhile. The fern test is less likely to produce false-positive results, although it has a higher rate of false-negatives.

If the suspected rupture has occurred some hours previously and most of the fluid has escaped from the vagina, it may be not be possible to establish or confirm the diagnosis with any degree of confidence. In these circumstances, much depends on taking a careful history from the woman. Information can be obtained as to when and how the gush of fluid occurred; whether anything like it has ever happened before; approximately how much fluid was lost; what the colour was like; whether it smelled of anything; and whether there was anything else remarkable. The latter question may elicit a comment on the presence of white or greasy particles. The ultrasound finding of oligohydramnios is strong confirmatory evidence of prelabor rupture of membranes, when there is a history of sudden release of fluid.

It is not clear whether or not high (hindwater) rupture of the membranes should be considered as clinically distinct from low rupture. There is little information about how these two types of rupture can be differentiated, or whether or not they warrant different
forms of care. In the absence of such data, the only practical approach is to consider them as equivalent.

2.2 Vaginal examination
It is likely that vaginal examinations can introduce or increase the risk of intra-uterine infection, although no controlled comparisons have been conducted to substantiate or refute this belief. A vaginal examination should only be performed to obtain information that would be useful in determining further care, and that cannot be obtained in a less invasive way. There is probably little benefit to be derived from performing both digital and speculum examinations. The information that can be obtained by speculum examination is likely to be superior to that obtained by digital examination. It may include visualization of amniotic fluid ‘pooling’ in the posterior fornix, and collection of some of that fluid for nitrazine test, and microscopic examination for ferning to confirm that the membranes are ruptured. There may be sufficient fluid for phosphatidylglycerol determination as a measure of fetal lung maturity. Material may be collected for culture or screening for pathogens, including group B streptococci. On the other hand, speculum examination is likely to be more unpleasant for the mother than digital examination. No controlled comparisons have been conducted to establish the benefit, if any, of either digital or speculum examination.

2.3 Assessing the risk of infection
Any woman with prelabor rupture of the membranes, at any period of gestation, should be assessed for signs of intra-uterine infection. These include fever and maternal or fetal tachycardia. If any one of these is accompanied by a tender uterus and foul-smelling liquid, there will be no doubt about the diagnosis. Uterine tenderness and fetid discharge are, however, late signs of intra-uterine infection.

The earliest clinical signs of intra-amniotic infection are fetal tachycardia and a slight elevation of maternal temperature, but both these signs are rather nonspecific. The estimation of C-reactive protein in the maternal circulation, which is used in some settings, may be a reasonably reliable early sign of intra-uterine infection, but the value of this test has never been assessed in a controlled comparison.

Although intra-uterine infection may on occasion precede rupture of the membranes, the main risk is infection ascending from the vagina into the uterine cavity. Information on the presence of pathogens in the vagina may, therefore, be useful, particularly about those
organisms that are responsible for the majority of fetal infections, such as the group B streptococci, *Escherichia coli*, and *Bacteroides*. Intrapartum antibiotic treatment of mothers carrying group B streptococci in the vagina reduces the incidence of neonatal sepsis and neonatal death from infection due to group B streptococci.

In populations with a high prevalence of group B streptococci carriers, either screening for the organism or routine intrapartum antibiotic treatment after prolonged rupture of membranes should be adopted as standard care. In other populations, an initial culture should be part of the care provided after preterm prelabor rupture of the membranes.

Amniocentesis has been advocated to assess the risk of infection particularly in the preterm period. Problems with amniocentesis include the invasiveness and risks associated with the procedure, failure to obtain amniotic fluid in a proportion of cases, and, most importantly, the poor correlation between the results of diagnostic tests applied to the fluid and the development of fetal infection. Bacteria are not found in all women with clinical signs of intra-amniotic infection, nor are they always absent in women without signs of infection. Some observational studies have suggested that white cells in the amniotic fluid are more predictive of infectious morbidity than bacteria, but this has not been confirmed by others.

There has been only one controlled trial to assess the value of amniocentesis for detection of intra-uterine infection by Gram stain and culture after preterm prelabor rupture of the membranes. The use of amniocentesis did not reduce the proportion of women delivered because of clinical amnionitis or the number of perinatal deaths. It did result in a reduced frequency of abnormal fetal heart patterns in labor and a reduction in the average number of days that the infants remained in hospital after the mother had been discharged. On the whole, there is inadequate evidence to judge whether the use of amniocentesis in women with prelabor rupture of the membranes preterm confers more benefit than harm to mother and baby.

A number of observational studies suggest that fetal breathing movements and gross body movements cease when intra-amniotic infection develops. These changes in fetal behavior require further assessment, but may prove to be as reliable for the detection of intra-uterine infection as the more invasive technique of amniocentesis.
2.4 Assessing the risk of fetal immaturity
Assessing the risk of fetal immaturity largely depends on a careful
determination of gestational age, including ascertainment of any ultra-
sound assessments made in early pregnancy. There will usually be little
difficulty in identifying fetuses who are either profoundly immature or
who are clearly close to term. In between these two categories, and most
typically between 26 and 34 weeks of gestation, weighing the risk of
relative immaturity is considerably more difficult.

Pulmonary maturity, as determined by analysis of amniotic fluid, is
associated with a decreased risk of mortality and morbidity from respir-
atory disorders, but does not necessarily imply that other hazards
associated with preterm birth, most notably periventricular hemor-
rhage, will be avoided.

3 Preterm prelabor rupture of the membranes

3.1 Risks
The most serious, and most common, consequence of preterm
prelabor rupture of the membranes is preterm birth. The risk associ-
ated with this is directly related to the gestational age and maturity of
the fetus. At the extreme lower end of the gestational age range,
improvement in perinatal outcome will depend entirely on continuing
the pregnancy. At the other end of the preterm gestational age range,
care policies should differ little, if at all, from those that apply after
rupture of the membranes at term. Prelabor rupture of the membranes
at gestational ages between these two extremes (roughly between 24
and 34 weeks) presents the difficult dilemma of balancing the risks of
immaturity against those of infection.

Infectious morbidity, mostly due to ascending intra-uterine infec-
tion, is the second most important hazard for the baby. This risk
is greater at lower gestational ages, possibly because of the relative
immaturity of antibacterial defense mechanisms, and the under-
developed bacteriostatic properties of amniotic fluid at early gesta-
tional age.

In addition to these two main risks, other hazards of preterm
prelabor rupture of the membranes include: prolapse of the umbilical
cord; cord compression due to the loss of the protective amniotic fluid;
pulmonary hypoplasia and various deformities associated with persis-
tent oligohydramnios; placental abruption; and the mechanical diffi-
culties (if cesarean section becomes necessary) of delivering a baby
from a uterus that contains little, if any amniotic fluid and has a poorly
developed lower segment.

Prolapse of the umbilical cord may occur either at the time of
membrane rupture or later with the onset of labor. Any change in an
apparently stable situation, such as a recurring loss of amniotic fluid
or the onset of uterine contractions, should alert the caregiver to this
possibility. Frequent assessments of the fetal heart rate, either by
auscultation or cardiotocography and a careful ultrasound examina-
tion may be useful in these circumstances.

Compression of the umbilical cord may occur due to the loss of the
protective effect of amniotic fluid. The risk of local increase in pressure
escalates with the onset of uterine contractions, and the incidence of
severe fetal heart rate decelerations is directly related to the degree
of oligohydramnios.

Prolonged rupture of the membranes with oligohydramnios for
several weeks may lead to a spectrum of fetal postural and compres-
sion abnormalities. Adequate amounts of amniotic fluid are necessary
for normal lung development. Early onset and prolonged rupture of
the membranes may lead to pulmonary lung hypoplasia and when
severe, to neonatal death. It is not clear whether the presence of fetal
breathing movements or ultrasonographic chest measurements are
useful to indicate that lung growth is preserved; the reported observa-
tional studies have yielded conflicting results.

Placental abruption should be considered whenever blood loss or
abdominal pain occur in a woman with preterm ruptured membranes.

3.2 Care before the onset of labor

Preterm birth is the main consequence of preterm prelabor rupture of
the membranes. Where adequate facilities for intensive perinatal and
neonatal care are lacking, the most effective form of care is referral
of the woman to a perinatal center, where such facilities are readily
available.

Most women will go into labor within hours or a few days after
rupture of the membranes in the preterm period. In some women,
however, labor will be delayed much longer. Among these women will
be some in whom the diagnosis of ruptured membranes may have been
made in error; in others a high leak may have sealed over, so that amni-
otic fluid returns to normal. This, however, is the exception rather than
the rule. Renewed accumulation of amniotic fluid may imply that the
woman can return home with a reasonable degree of safety, although
this has never been assessed in a controlled comparison.
Provided that mother and fetus are well at the initial assessments, the main concerns in the first few days after rupture of the membranes relate to detecting the onset of infection or uterine contractions. Care should center on detecting these by regular assessments of maternal temperature and pulse, fetal heart rate, and uterine contractility. It is not clear whether serial leukocyte counts or C-reactive protein levels provide additional accuracy to this surveillance. Variation in leukocyte counts and C-reactive protein levels can be quite large, particularly when the influences of labor or corticosteroid administration are added.

Other elements of surveillance are guided by the need to detect other complications that may occur after preterm prelabor rupture of the membranes.

3.2.1 Prophylactic antibiotics
Treatment with prophylactic antibiotics reduces the risk of preterm birth occurring within one week, of infections in the mother before delivery, and of infection in the baby. No effect has been shown on the overall incidence of preterm birth (less than 37 weeks), on maternal postpartum infectious morbidity, or on the risk of neonatal pneumonia.

One would expect that the reduction in neonatal infection, coupled with the improved fetal maturity achieved by prolonging the time until birth, would increase neonatal survival. Although controlled trials so far have failed to demonstrate this, the cumulative evidence would be in favor of antibiotic treatment. It is not clear which antibiotics would provide the best results, nor what duration of treatment is necessary. Treatment probably should be guided by bacterial culture, and continued until delivery.

3.2.2 Prophylactic tocolytics
Two small studies on the use of oral ritodrine have addressed the question of whether the administration of tocolytic drugs might improve outcome in women not in labor after preterm prelabor rupture of the membranes. There was no difference in the proportion of women who delivered within 10 days. The number of women involved was too small to assess the influence, if any, on neonatal infection, respiratory distress syndrome, or perinatal mortality.

These data, and data from placebo-controlled trials on the prophylactic use of betamimetic drugs in women without ruptured mem-
branes, offer no support for suggestions that prophylactic tocolysis before the onset of uterine contractions is worthwhile.

3.2.3 Corticosteroid administration
The theoretical concerns that corticosteroids might be both superfluous and hazardous in women with prelabor rupture of the membranes have not been confirmed by the results of controlled trials. These concerns were based on the observation that rupture of the membranes per se may enhance fetal pulmonary maturity, and thus make the use of other agents to promote maturity unnecessary. In addition, there were fears that the immunosuppressive effects of corticosteroids might both increase susceptibility to intra-uterine infection and mask early signs of infection in women with prelabor rupture of the membranes.

These concerns are not supported by the evidence. A systematic review of the randomized trials of corticosteroid administration to women with preterm prelabor rupture of the membranes clearly shows that the incidence of respiratory distress syndrome is further reduced by corticosteroid administration, irrespective of any effects that prelabor rupture of the membranes itself may have on fetal pulmonary maturity. Overall, the frequency of maternal infection is not increased after corticosteroids, although maternal infection may be increased in women whose membranes have been ruptured for longer than 24 h.

The risk of neonatal infection was not statistically significantly increased in the corticosteroid-treated group, compared with the control group. Nevertheless, neonatal infection following maternal corticosteroid treatment remains a possible risk. The concomitant use of antibiotics may be appropriate (see Chapter 25).

3.2.4 Induction of labor
Controlled comparisons between an ‘active’ policy of elective delivery after preterm prelabor rupture of the membranes and a control policy without elective induction show no protective effect of the active policy against any adverse outcome. Indeed, there is a tendency for outcomes to be less favorable in the ‘active’ policy group. These adverse outcomes include maternal sepsis and several forms of infant morbidity (neonatal infection, respiratory distress syndrome, intracranial hemorrhage, and perinatal death from causes other than congenital malformations).

Even when corticosteroids, to improve pulmonary maturity, are used along with induction of labor, the active policy confers no benefit on
the infant. In this case, the beneficial effects of prenatal corticosteroids in preterm prelabor rupture of the membranes appear to be offset by shortening the duration of pregnancy with elective delivery.

3.3 Care after the onset of labor
The onset of uterine contractions may be the result of intra-uterine infection. Whether or not the fetus is mature, preterm labor starting after the membranes have been ruptured for some time should probably be allowed to proceed to preterm birth, because of the risk of infection. When the fetus is so immature as to have no chance of extra-uterine survival, attempts to prolong pregnancy should depend not only on what little might be gained in terms of infant outcome, but even more on the maternal risks and the opinions of the parents. Decisions about the method of delivery and whether cesarean section will be necessary, should differ little from those for other preterm births (see Chapter 37).

3.3.1 Antibiotics
Whether or not antibiotics should be administered at once in these circumstances has not been addressed adequately by controlled studies. Both clinical common sense and data from studies that have compared intrapartum with immediate postpartum antibiotic treatment for intra-amniotic infection tend to support the use of antibiotic treatment as soon as a diagnosis of intra-uterine infection is suspected.

3.3.2 Tocolysis
The small controlled trials that have compared tocolysis with no tocolysis in preterm labor following prelabor rupture of the membranes show no differences in any of the outcomes examined. These include delay of birth, recurrence of preterm labor, preterm birth, birthweight, mortality, and respiratory morbidity.

There is no evidence that tocolytic agents per se improve perinatal outcome and they are not innocuous. They should be used only when the benefits of prolonging the pregnancy by a few days clearly outweigh the risks. Examples of this would be when the inhibition of labor permits implementation of other measures that are effective in improving outcome for the preterm infant, such as administration of maternal corticosteroids or transfer of the mother to a perinatal centre with adequate facilities for care around preterm birth and the preterm infant.
3.3.3 Amnio-infusion

Decelerations of the fetal heart rate during preterm labor occur more frequently if the membranes have ruptured before the onset of labor. Many of the abnormal fetal heart-rate patterns are suggestive of umbilical cord compression, and may well be due to the loss of the protective effect of amniotic fluid. The relative merits and hazards of using amnio-infusion during labor in women with preterm prelabor rupture of the membranes have not yet been thoroughly assessed. Available data, thus far, suggest a significant reduction in the number of severe fetal heart rate decelerations per hour during the first stage of labor, and increased umbilical artery pH, with amnio-infusion. The merits and hazards of this approach warrant further evaluation.

4 Term prelabor rupture of the membranes

Prelabor rupture of the membranes occurs in 6–19% of all term births. Most women with term prelabor rupture of membranes will go into labor soon after the membranes rupture. Almost 70% of these women will give birth within 24 h and almost 90% will do so within 48 h. A remarkably constant 2–5% will be undelivered after 72 h, and almost the same proportion will remain undelivered after 7 days. It is possible that these women may have a deficiency in prostaglandin production or in their prostanoid biosynthesis pathway, and that this is responsible, not only for their failure to go into spontaneous labor, but also for the frequently observed poor progress in cervical dilatation when labor is induced with oxytocin.

Infection, both maternal and neonatal, has been the main concern. This concern relates back to reports in the 1950s, when prelabor rupture of the membranes at term was associated with a high risk of maternal and perinatal mortality. Not surprisingly, immediate induction of labor was advocated to reduce this risk.

The prognosis of prelabor rupture of the membranes at term has changed considerably in the later decades of this century. Data collected over long periods, some of which include women who gave birth more than 25 years ago, are of questionable relevance to current obstetric practice. The maternal deaths noted in former years mostly occurred in women with prolonged, severe intra-uterine infection, who often had inadequate antibiotic therapy judged by today’s standards. Maternal mortality is almost never found in more recently conducted studies of prelabor rupture of the membranes at term, and perinatal
death from infection has also become a rarity. With the changed prognosis for women and their infants, and concern about the perceived increased risk of operative delivery after induction of labor, a more expectant approach has recently become popular.

The key question about the care of women with ruptured membranes, at or near term, is whether it is better to induce labor promptly after the membranes rupture or to delay induction in the expectation that labor will start spontaneously. The next question, in the event that prompt induction is chosen, is the method of induction: oxytocin or prostaglandins. Women need to be informed about the effects of the care options available to them, and encouraged to choose the treatment option they would prefer.

4.1 Induction of labor with oxytocin
Induction of labor with oxytocin, at or near term (when the main dangers of pulmonary immaturity have been overcome), decreases the risk of maternal infection (chorioamnionitis and endometritis) and shows a trend towards lowering the risk of neonatal infection compared to expectant care. Most of the controlled trials that have assessed neonatal infection, however, were of poor methodological quality, and the beneficial effect of induction of labor with oxytocin on neonatal infection may have been overstated. Induction of labor with oxytocin decreases the rate of admission to neonatal intensive care.

Induction with oxytocin carries a slightly, but not statistically significant, increased risk of operative delivery or cesarean section. It is associated with more frequent use of epidural analgesia and of internal fetal heart-rate monitoring.

4.2 Induction of labor with prostaglandins
The effects of induction of labor with prostaglandins, with or without concomitant oxytocin, for term prelabor rupture of the membranes, are similar to those for induction with oxytocin alone. Compared with expectant care, prostaglandin induction results in a lower risk of maternal infection and a trend towards less infection in the newborn, along with a decreased use of admission to the neonatal intensive care unit. There are no significant differences in the rates of operative vaginal delivery or cesarean section. The use of analgesia/anesthesia and of maternal side-effects (diarrhea) is more frequent in women induced with prostaglandins than in women managed expectantly.
4.3 Comparison of prostaglandins and oxytocin
Direct comparisons between oxytocin alone and prostaglandins (with or without oxytocin) for induction of labor for term prelabor rupture of membranes show little difference between the two methods with respect to the rates of operative delivery or cesarean section. Fewer epidurals are used in association with prostaglandins but no effect is seen on the overall use of analgesia/anesthesia.

The use of prostaglandins results in more frequent maternal infections, possibly related to an increased number of vaginal examinations. It also appears to increase the risk of neonatal infection, particularly if women are known to be colonized with group B streptococcus (although, as the assessment of neonatal infection was made blind to treatment allocation and duration of membrane rupture in only one of the 18 controlled trials, the harmful effect on this outcome may be less than that suggested by the data). Overall admissions to neonatal intensive care are more frequent with prostaglandin induction.

The evidence thus suggests that if early induction of labor after term prelabor rupture of the membranes is chosen, induction with oxytocin rather than with prostaglandins would offer the greatest benefit with the least harm.

4.4 Prophylactic antibiotics
That appropriate therapeutic antibiotics are required when there are signs of infection with prelabor rupture of membranes goes without saying. The place of antibiotics in the care of women with no evidence of infection is much less clear. The two controlled trials of prophylactic antibiotics conducted in the 1960s, utilized antibiotic treatments that are no longer in use. Although they failed to show any effect on the incidence of fetal and neonatal infection, a statistically significant reduction in the incidence of postpartum infectious maternal morbidity was observed after antibiotic prophylaxis. In some centers, this has led to the adoption of policies involving routine administration of antibiotics after delivery to women with prolonged rupture of the membranes at term. Although the utility of this approach has not been addressed in randomized comparisons, it would be worth assessing which women, without overt signs of infection, might benefit from postpartum administration of antibiotics.

One small randomized trial has addressed the question of whether prophylactic antibiotics should be given to the baby after birth in women with prolonged prelabor rupture of membranes. There was some support for the idea that prophylactic antibiotics reduced the risk
of infection, but the trial requires replication on a larger sample, with blind assessment of infant outcomes.

5 Conclusions

Any woman with a history suggestive of prelabor rupture of the membranes should be assessed as soon as possible. Attention should be directed to whether the membranes are indeed ruptured; to a careful review of the menstrual history and assessment of gestational age; to possible signs of incipient or established infection; to signs of fetal distress due to cord compression or prolapse; and to signs of uterine contractions.

For the woman with preterm prelabor rupture of the membranes who is not in labor, is not infected, and shows no evidence of fetal distress or other fetal or maternal pathology, continuation of the pregnancy is more likely to be beneficial than harmful. Administration of antibiotics prophylactically to women with preterm prelabor rupture of the membranes delays the birth and reduces the risk of both maternal and neonatal infection. No effect has yet been demonstrated on perinatal mortality. In women known to be carrying group B streptococci, intrapartum antibiotics should be adopted as standard care (see Chapter 19).

There is no evidence that the prophylactic use of betamimetic agents before uterine contractions begin is of value in preventing the onset of preterm labor.

Because preterm birth frequently follows preterm prelabor rupture of the membranes, corticosteroids should be administered if there is no evidence of sufficient pulmonary maturity, to reduce the risk of respiratory distress syndrome. Although there is no evidence from controlled trials, combining antibiotics with corticosteroids may do more good than harm.

The routine use of measures to effect early delivery after preterm prelabor rupture of the membranes does not reduce the risk of infection, and is more harmful than beneficial. If there are signs of intrauterine infection, however, antibiotic treatment should be started and delivery effected as soon as possible. A skilled neonatologist should be present at birth.

For women with term (or near term) prelabor rupture of the membranes, the effects of induction over expectant care must be carefully weighed. The risks of infection (both maternal and neonatal) are
somewhat higher with expectant management. If early induction of labor is chosen, oxytocin rather than prostaglandins offers the greatest benefit with the least harm.

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