

# Timing of Indicated Late-Preterm and Early-Term Birth

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The growing public health awareness of prematurity and its complications has prompted careful evaluation of the timing of deliveries by clinicians and hospitals. Preterm birth is associated with significant morbidity and mortality, and affects more than half a million births in the United States each year. In some situations, however, a late-preterm or early-term birth is the optimal outcome for the mother, child, or both owing to conditions that can result in worse outcomes if pregnancy is allowed to continue. These conditions may be categorized as placental, maternal, or fetal, including conditions such as placenta previa, preeclampsia, and multiple gestations. Some risks associated with early delivery are common to all conditions, including prematurity-related morbidities (eg, respiratory distress syndrome and intraventricular hemorrhage) as well as maternal intrapartum morbidities such as failed induction and cesarean delivery. However, when

continuation of the pregnancy is associated with more risks such as hemorrhage, uterine rupture, and stillbirth, preterm delivery maybe indicated. In February 2011, the Eunice Kennedy Shriver National Institute of Child Health and Human Development and the Society for Maternal-Fetal Medicine held a workshop titled "Timing of Indicated Late Preterm and Early Term Births." The goal of the workshop was to synthesize the available information regarding conditions that may result in medically indicated late-preterm and early-term births to determine the potential risks and benefits of delivery compared with continued pregnancy, determine the optimal gestational age for delivery of affected pregnancies when possible, and inform future research regarding these issues. Based on available data and expert opinion, optimal timing for delivery for specific conditions was determined by consensus.

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For a list of speakers and moderators who participated in the workshop, see the Appendix online at <http://links.lww.com/AOG/A249>.

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Preterm birth, defined as delivery before 37 completed weeks of gestation, is a public health priority affecting more than half a million pregnancies in the United States each year. Because preterm birth can result in significant morbidities and mortality, considerable effort and expense have been focused on understanding and preventing this devastating pregnancy outcome. In 2005, the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) held a workshop focusing on those deliveries occurring between 34 and before 37 weeks of gestation. The workshop highlighted the importance of this growing segment of preterm births, coined the designation "late-preterm delivery" (34 0/7 to 36 6/7 weeks), and provided details of the morbidities associated with these deliveries.<sup>1</sup> Although at less risk than those born before 34 weeks of gestation, infants born late preterm are more likely to have long-term neurodevelopmental problems and infant death than those born at term.<sup>2,3</sup> In addition, neonates born between 34 and 37 weeks account for most admissions to the neonatal intensive

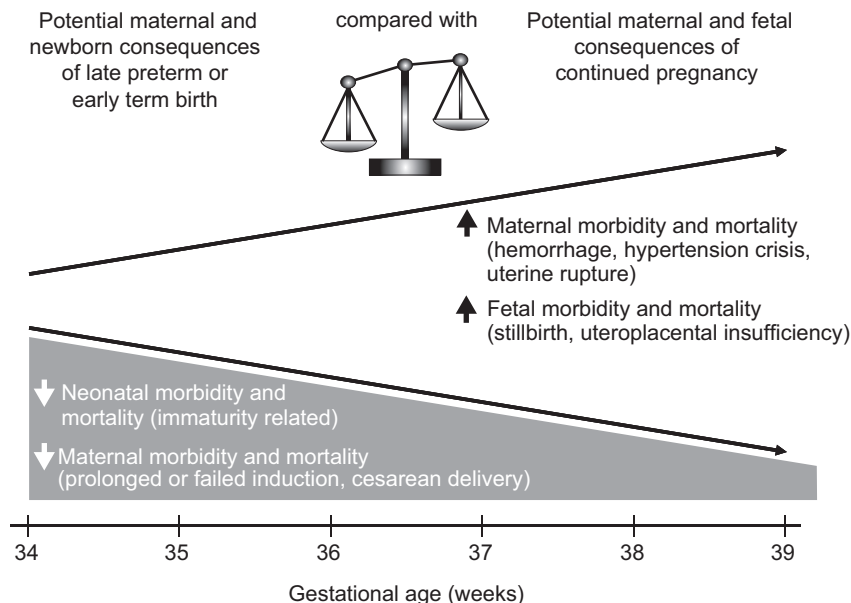


care unit and for large proportion of health care expenditures. In a large study,<sup>4</sup> more than one third of elective (not medically indicated) cesarean deliveries at term occurred before 39 weeks of gestation, with neonates born before 39 weeks being at increased risk for significant complications compared with those born after 39 weeks. The March of Dimes, NICHD, Society for Maternal-Fetal Medicine, and American College of Obstetricians and Gynecologists since have championed the idea of preventing unnecessary preterm births and “early-term births” (37 0/7 to 38 6/7 weeks). Several large health care groups have pushed to decrease the number of nonindicated deliveries before 39 weeks, with demonstrable success.<sup>5,6</sup> Nationally, the percentage of children born in the late-preterm period declined 3%, from 9.1% in 2006 to 8.8% in 2008, after rising 25% from 7.3% to 9.1% between 1990 and 2006.<sup>7</sup>

Addressing the issue of late-preterm and early-term birth requires balancing the risks of continuing the pregnancy with the risks of delivery before term (Fig. 1). Although there is clear benefit to allowing uncomplicated pregnancies to reach full term, continuing pregnancy in the face of medical or obstetric complications potentially can increase the risk to mother, the fetus, or both. In addition to potential acute complications from

continuing the pregnancy in the presence of medical or obstetric complications, fetal exposure to a hostile intra-uterine environment has the potential to affect long-term outcomes of the offspring through altered fetal programming.<sup>8</sup> To better understand the obstetric, fetal, and maternal conditions that could lead to late-preterm or early-term birth, the NICHD and Society for Maternal-Fetal Medicine held a workshop in February 2011 titled “Timing of Indicated Late Preterm and Early Term Births” (for a list of speakers and moderators at the NICHD and Society for Maternal-Fetal Medicine workshop on the “Timing of Indicated Late Preterm and Early Term Births,” see the Appendix online at <http://links.lww.com/AOG/A249>). The goals of the workshop were to synthesize the available information regarding conditions that can result in indicated late-preterm and early-term births in order to determine the potential risks and benefits of delivery compared with continued pregnancy, determine the optimal gestational age for delivery of affected pregnancies when possible, and inform future research regarding these issues.

The workshop focused on three topic areas that reflect the most common reasons that may lead to consideration of early delivery: placental or uterine,



**Fig. 1.** Conceptual diagram representing the competing risks and benefits of indicated late-preterm or early-term birth compared with pregnancy continuation. The figure does not represent specific magnitudes or rates of changes in risks because these will vary according to the specific pregnancy complication and individual circumstances. Neonatal morbidity and mortality decreases with advancing gestation; these typically are related to prematurity. For these deliveries in the late-preterm or early-term period, maternal morbidity and mortality generally are higher as a result of prolonged or failed induction and resultant cesarean deliveries. Potential maternal consequences of continued pregnancy in the setting of complicated conditions and maternal morbidity and mortality are related to hemorrhage, hypertensive crises, and uterine rupture. Continued pregnancy in these settings also can result in fetal morbidity and stillbirth due to uteroplacental insufficiency. Spong. *Timing of Indicated Late-Preterm and Early-Term Birth. Obstet Gynecol* 2011.



fetal, and maternal conditions. For each condition, the epidemiology, risks, advantages of early delivery, and maternal or perinatal risks of continued pregnancy were discussed. In addition, the workshop developed consensus recommendations regarding gestational age for delivery to optimize maternal, fetal and neonatal outcomes (Table 1), and identified high priority research gaps (Box 1) related to these conditions. For many conditions, delivery recommendations in Table 1 are based on the presence of the specific condition without additional complications (see footnote). In situations where comorbidities are present, even earlier delivery may be indicated.

Although the workshop focused on conditions that might benefit from late-preterm or early-term delivery, this list is not exhaustive. Other conditions, such as cholestasis of pregnancy, history of uterine rupture or dehiscence, and vasa previa, were identified as being appropriate to consider for late-preterm or early-term delivery but were not reviewed at the meeting.

### Caveats

A number of caveats need to be taken into account when deciding on the optimal timing of delivery, including the potential for conflict between maternal and neonatal benefit, the role of amniocentesis for determining fetal lung maturity, the need to individualize care, and the need for accurate pregnancy dating. Determination of the optimal timing for delivery is complex as multiple factors may contribute to the risk of mortality and morbidity. In some circumstances, the major reason for delivery may be to limit maternal risk, whereas in other cases, delivery is pursued primarily for fetal benefit. In certain conditions, it is necessary to weigh opposing maternal and fetal risks of continued pregnancy compared with early delivery, whereas, in others there is benefit to both from early delivery, but the optimal timing to limit risk to the mother compared with fetus needs to be considered. This document is not intended to serve as a standard of care - individualization of clinical management is warranted. Decision-making regarding the optimal timing of delivery should incorporate the totality and relative magnitude of maternal or fetal risks, the presence of maternal comorbidities or underlying risk factors, practice setting, and patient preferences. This conference focused on those indicated deliveries occurring in the late-preterm and early-term periods, from 34 weeks to 36 6/7 weeks and from 37 to 38 6/7 weeks of gestational age, respectively. Because of this, accurate gestational age determination is needed to optimally use these recommendations in

clinical practice. The terminology used to report gestational age varies between publications. For clarity, in this manuscript we refer to gestational age in completed weeks, thus "34 weeks" includes 34 0/7 weeks through 34 6/7 weeks. Finally, this manuscript focuses on timing of delivery after 34 weeks. Some of the conditions addressed may occur before 34 weeks and their management may be different than that proposed in this document. For example, management of severe preeclampsia before 34 weeks may depend on various findings relating to end-organ damage, but delivery is recommended after 34 weeks regardless of presence or absence of end-organ damage.

The utility of amniocentesis before delivery was discussed across the conditions. In general, the recommendation was that if an indication for delivery is present, the use of amniocentesis to assess fetal lung maturity would not assist in guiding management. This is in part due to the rationale that, if significant maternal or fetal risk exists, delivery should occur regardless of biochemical maturity and, if delivery could be deferred owing to the absence of pulmonary maturity, there is not a stringent indication for prompt delivery. Additionally, it is recognized that a mature fetal lung profile denoting the presence of pulmonary surfactant does not necessarily translate to maturity of other organ systems.<sup>9</sup> Thus, unless amniocentesis is recommended for a specific indication, it is not otherwise addressed.

Another issue that was relevant for most conditions was the administration of antenatal corticosteroids before the indicated preterm birth, especially for patients naive to antenatal corticosteroids or who have an immature lung profile if amniocentesis is performed. A course of antenatal corticosteroids is recommended for women at risk for preterm birth before 34 weeks. The benefit of antenatal corticosteroids after 34 weeks is unclear, and there are ongoing studies evaluating this question.<sup>10</sup> Current recommendations do not include antenatal corticosteroids administration before delivery at or after 34 0/7 weeks of gestation.<sup>11,12</sup> Although there is one trial that found improved respiratory outcomes in neonates delivered to women who had received antenatal corticosteroids before elective cesarean delivery at term, the data are limited.<sup>13</sup>

The types of risks and benefits of early delivery generally are similar regardless of obstetric or medical condition. Newborn risks include gestational age dependent morbidities (eg, respiratory distress syndrome, intraventricular hemorrhage, necrotizing enterocolitis, hyperbilirubinemia, feeding difficulties, temperature instability, among others). Maternal risks of early delivery include complications associated



**Table 1. Guidance Regarding Timing of Delivery When Conditions Complicate Pregnancy at or After 34 Weeks of Gestation**

Condition	Gestational Age* at Delivery	Grade of Recommendation†
Placental and uterine issues		
Placenta previa‡	<b>36–37 wk</b>	B
Suspected placenta accreta, increta, or percreta with placenta previa‡	<b>34–35 wk</b>	B
Prior classical cesarean (upper segment uterine incision)‡	<b>36–37 wk</b>	B
Prior myomectomy necessitating cesarean delivery‡	37–38 wk (may require earlier delivery, similar to prior classical cesarean, in situations with more extensive or complicated myomectomy)	B
Fetal issues		
Fetal growth restriction-singleton	<b>38–39 wk:</b>	B
	• Otherwise uncomplicated, no concurrent findings	
	<b>34–37 wk:</b>	B
• Concurrent conditions (oligohydramnios, abnormal Doppler studies, maternal risk factors, co-morbidity)		
	<b>Expedient delivery regardless of gestational age:</b>	
• Persistent abnormal fetal surveillance suggesting imminent fetal jeopardy		
Fetal growth restriction-twin gestation	<b>36–37 wk:</b>	B
	• Dichorionic-diamniotic twins with isolated fetal growth restriction	
	<b>32–34 wk:</b>	B
	• Monochorionic-diamniotic twins with isolated fetal growth restriction	
	• Concurrent conditions (oligohydramnios, abnormal Doppler studies, maternal risk factors, co-morbidity)	B
	<b>Expedient delivery regardless of gestational age:</b>	
• Persistent abnormal fetal surveillance suggesting imminent fetal jeopardy		
Fetal congenital malformations‡	<b>34–39 wk:</b>	B
	• Suspected worsening of fetal organ damage	
	• Potential for fetal intracranial hemorrhage (eg, vein of Galen aneurysm, neonatal alloimmune thrombocytopenia)	
	• When delivery prior to labor is preferred (eg, EXIT procedure)	
	• Previous fetal intervention	
• Concurrent maternal disease (eg, preeclampsia, chronic hypertension)		
• Potential for adverse maternal effect from fetal condition		
	<b>Expedient delivery regardless of gestational age:</b>	B
• When intervention is expected to be beneficial		
• Fetal complications develop (abnormal fetal surveillance, new-onset hydrops fetalis, progressive or new-onset organ injury)		
• Maternal complications develop (mirror syndrome)		
Multiple gestations: dichorionic-diamniotic‡	<b>38 wk</b>	B
Multiple gestations: monochorionic-diamniotic‡	<b>34–37 wk</b>	B
Multiple gestations: dichorionic-diamniotic or monochorionic-diamniotic with single fetal death‡	If occurs at or after 34 wk, consider delivery (recommendation limited to pregnancies at or after 34 wk; if occurs before 34 wk, individualize based on concurrent maternal or fetal conditions)	B

(continued)



**Table 1. Guidance Regarding Timing of Delivery When Conditions Complicate Pregnancy at or After 34 Weeks of Gestation (continued)**

Condition	Gestational Age* at Delivery	Grade of Recommendation†
Multiple gestations: monochorionic-monoamniotic‡	<b>32–34 wk</b>	B
Multiple gestations: Monochorionic-monoamniotic with single fetal death‡	Consider delivery; individualized according to gestational age and concurrent complications	B
Oligohydramnios—isolated and persistent‡	<b>36–37 wk</b>	B
<b>Maternal issues</b>		
Chronic hypertension—no medications‡	<b>38–39 wk</b>	B
Chronic hypertension—controlled on medication‡	<b>37–39 wk</b>	B
Chronic hypertension—difficult to control (requiring frequent medication adjustments) ‡	<b>36–37 wk</b>	B
Gestational hypertension§	<b>37–38 wk</b>	B
Preeclampsia—severe‡	At diagnosis (recommendation limited to pregnancies at or after 34 wk)	C
Preeclampsia—mild‡	<b>37 wk</b>	B
Diabetes—pregestational well controlled‡	LPTB or ETB not recommended	B
Diabetes—pregestational with vascular disease‡	<b>37–39 wk</b>	B
Diabetes—pregestational, poorly controlled‡	<b>34–39 wk</b> (individualized to situation)	B
Diabetes—gestational well controlled on diet‡	LPTB or ETB not recommended	B
Diabetes—gestational well controlled on medication‡	LPTB or ETB not recommended	B
Diabetes—gestational poorly controlled on medication‡	<b>34–39 wk</b> (individualized to situation)	B
<b>Obstetric issues</b>		
Prior stillbirth-unexplained‡	LPTB or ETB not recommended	B
	Consider amniocentesis for fetal pulmonary maturity if delivery planned at less than 39 wk	C
Spontaneous preterm birth: preterm premature rupture of membranes‡	<b>34 wk</b> (recommendation limited to pregnancies at or after 34 wk)	B
Spontaneous preterm birth: active preterm labor‡	Delivery if progressive labor or additional maternal or fetal indication	B

LPTB, late-preterm birth at 34 0/7 weeks through 36 6/7 weeks; ETB, early-term birth at 37 0/7 weeks through 38 6/7 weeks.

\* Gestational age is in completed weeks; thus, 34 weeks includes 34 0/7 weeks through 34 6/7 weeks.

† Grade of recommendations are based on the following: recommendations or conclusions or both are based on good and consistent scientific evidence (A); limited or inconsistent scientific evidence (B); primarily consensus and expert opinion (C). The recommendations regarding expeditious delivery for imminent fetal jeopardy were not given a grade. The recommendation regarding severe preeclampsia is based largely on expert opinion; however, higher-level evidence is not likely to be forthcoming because this condition is believed to carry significant maternal risk with limited potential fetal benefit from expectant management after 34 weeks.

‡ Uncomplicated, thus no fetal growth restriction, superimposed preeclampsia, etc. If these are present, then the complicating conditions take precedence and earlier delivery may be indicated.

§ Maintenance antihypertensive therapy should not be used to treat gestational hypertension.

with labor induction (including increased risk of cesarean delivery, hemorrhage, infection, prolonged hospital stay). The benefits of early delivery may include avoidance of stillbirth or fetal compromise due to uteroplacental insufficiency, removal of the fetus from a hostile uterine environment, as well as resolution of the under-

lying condition (eg, preeclampsia) before it worsens or secondary complications develop.

Informed decision making and family counseling should consider the risks of the underlying condition and concurrent complications, as well as the potential for reduction of prematurity-related neonatal morbid-



## Box 1.

Guidance offered in this report is based on expert opinion in many cases because high-level evidence is lacking regarding the risks and benefits of early delivery or continued pregnancy at or after 34 weeks of gestation and optimal timing of delivery in these complicated pregnancies. Additional research questions that were identified during the workshop include the following:

- Does earlier delivery improve long-term outcome in hypertensive disease or diabetes (Barker hypothesis)?
- Does the degree of glucose control in diabetes affect fetal maturation and pulmonary outcomes?
- Are there certain patients who can benefit from continued pregnancy with preterm premature rupture of the membranes beyond 34 weeks?
- Can predictive calculators regarding maternal neonatal outcomes according to delivery gestation be developed for specific conditions?
- Can clinical or biochemical markers predict newborn complications other than those related to pulmonary immaturity?
- Is there a role for initial or rescue antenatal steroids after 34 weeks when late-preterm or early-term birth is anticipated?
- What are the specific risks of continued pregnancy and delivery and optimal timing of delivery for pregnancies complicated by:
  - prior uterine rupture or dehiscence, including those with rupture before labor?
  - low-lying placenta?
  - prior endometrial ablation?
  - prior cesarean delivery with painful contractions but without progressive labor?
  - cholestasis of pregnancy?
- What imaging modalities can be used to predict the risk for uterine rupture?
- What is the clinical utility of imaging modalities to diagnose placenta accreta, increta, or percreta?
- What is the role of and optimal timing for testing to evaluate the status of the anomalous fetus?
- Does early delivery of fetuses with congenital malformations alter long-term outcomes?
- Does early delivery improve outcome in the setting of congenital anomaly with new-onset hydrops fetalis?
- What are the benefits of the EXIT procedure for various fetal conditions?
- What tools can accurately diagnose fetal growth restriction and assess the ongoing risk of intrauterine and postnatal complications?
- How are the competing risks of stillbirth, newborn complications of early delivery, and deteriorating maternal health in complicated pregnancies best judged to guide obstetric decision making?
- What is the optimal definition of discordant twin growth to identify pregnancies at risk of fetal or newborn complications?
- What is the effect of fetal growth restriction on the appropriately growing cotwin in monochorionic and dichorionic twin gestations?
- What are the outcomes after single fetal demise according to gestational age and placentation, and how is long-term morbidity best predicted in the surviving co-twin?
- What are the causes of late fetal death in otherwise uncomplicated monochorionic twin gestations?
- What is the optimal method to estimate amniotic fluid volume in late-preterm and early-term gestation, and how can this information best be used in clinical practice?

ities if pregnancy is continued, compared with the likelihood of stillbirth, neonatal death or long-term sequelae. When considering fetal conditions, the results of fetal testing, such as nonstress test, biophysical profile (BPP), or both, should be taken into consideration. A “reassuring” fetal testing result may allow delay of delivery by few days, either to allow further maturation or cervical ripening. However, antenatal testing is imperfect. Stillbirth is possible and has been reported for several conditions (eg, diabetes, cholestasis) even shortly after a reassuring antenatal test result.<sup>14–16</sup> Antenatal testing only assesses “chronic” uteroplacental insufficiency and not more acute phenomena such as abruption, change in maternal state, or infection; all of which potentially can affect the risk–benefit ratio. On the other

hand, timing of delivery in conditions affecting the mother may be dictated by the maternal status independent of fetal testing results. It is critical that the totality of the clinical picture be taken into account when deciding on the optimal timing for delivery. The risks and benefits of continued pregnancy compared with late-preterm or early-term delivery specific to each condition are discussed individually. Overall the available data are limited, and thus the provided recommendations are largely based on consensus expert opinion and extrapolations from relevant articles.

### Placental and Uterine Issues

The goals of late-preterm and early-term birth for pregnancies complicated by placental and uterine



conditions are to avoid acute catastrophic maternal complications and to limit the potential for fetal death or compromise. Additionally, early delivery can avert an emergent unscheduled delivery performed under suboptimal circumstances. Relevant conditions include placenta previa; placenta accreta, increta, or percreta (hereafter referred to as “placenta accreta”); chronic abruptio placentae; and conditions that carry a significant risk of uterine rupture such as prior classical cesarean delivery and prior myomectomy.

Placenta previa occurs in 0.3–0.5% of pregnancies.<sup>17</sup> Placenta accreta, the term being used overall for abnormal trophoblastic invasion into the myometrium or adjacent maternal tissues or both, occurs in 1 in 333 deliveries,<sup>18</sup> in 0.2% of all pregnancies in women with a prior cesarean delivery, and in 3.3% of those with both prior cesarean delivery and placenta previa. The frequency of placenta accreta is increasing. Both placenta previa and accreta can result in severe obstetric hemorrhage with subsequent maternal shock, need for transfusion, disseminated intravascular coagulation, hysterectomy, damage to adjacent organs, intensive care unit admission, and death. Placenta previa is likely to result in hemorrhage before delivery of the fetus. For the asymptomatic patient near term, the risk of continuing pregnancy is of an unscheduled delivery due to hemorrhage or labor. Suboptimal timing can result in decreased availability of needed resources (eg, blood products, dedicated operating room staff and surgical specialists), and in fetal or neonatal hypoxemia or acidemia resulting from maternal hypovolemic shock. Of 230 cases with placenta previa, the risk of an emergent bleed for hemorrhage was 4.7% at 35 weeks, 15% at 36 weeks, 30% at 37 weeks and 59% at 38 weeks.<sup>19,20</sup> A decision analysis and expert opinion recommended delivery at 36–37 weeks of gestation in women with uncomplicated placenta previa.<sup>17,20</sup> Forty-four percent of women with placenta accreta will require emergency surgery if delivery is planned after 36 weeks.<sup>21</sup> Case-controlled studies of placenta accreta have demonstrated that catastrophic bleeding is common after 36 weeks and planned delivery at 34–35 weeks after antenatal steroids resulted in decreased blood loss and blood transfusions.<sup>21,22</sup> A decision analysis came to similar conclusions that in the setting of placenta accreta, delivery without confirmation of fetal lung maturity after 34 weeks results in the highest quality-adjusted life years.<sup>23</sup>

Chronic abruptio placentae is not well-defined in the literature, but has been described as intermittent or persistent uterine bleeding in the third trimester

without other evident cause. Typically, those with abruptio placentae and maternal hemodynamic compromise or nonreassuring fetal testing are delivered rather than managed conservatively. Between 0.65% and 1.0% of pregnancies are complicated by abruptio placentae, but the incidence of chronic abruptio is unknown. Risk factors include trauma, preeclampsia, maternal vascular disease and substance use. Complications of the condition include uteroplacental insufficiency which in turn can result in fetal growth restriction and stillbirth, as well as complications similar to those noted for placenta previa. Although early delivery potentially could avoid further placental separation with subsequent acute hemorrhage requiring emergent delivery, the lack of a standard definition and limited data regarding the clinical course of this condition preclude recommendations regarding the optimal timing of delivery.

Several conditions carry a significant risk of uterine rupture. Prior cesarean delivery with a vertical incision involving the upper muscular portion of the uterus (eg, classical cesarean) accounted for 9% of indicated repeat cesarean deliveries in one large prospective observational study.<sup>24</sup> The prevalence of prior classical cesarean affecting pregnancy is 0.3–0.4%, with a risk of uterine rupture in subsequent pregnancies ranging between 1% and 12%. Similarly, myomectomy can involve the muscular portion of the myometrium, but the frequency of this condition complicating pregnancy is unknown. When myomectomy involves the muscular portion of the myometrium, delivery by cesarean is typically recommended (in contrast to myomectomy of a pedunculated myoma where vaginal delivery remains an option). One study found uterine rupture risks of 0.49–0.7% after laparoscopic myomectomy and 1.7% after resection at laparotomy, however it is unknown if any differences in risk relate to the surgical technique or the characteristics of patients selected for one approach over the other. Little is known regarding the effect of the location of the leiomyoma (eg, transmural compared with intramural compared with serosal and upper compared with lower uterine segment), extent of resection (number excised) on uterine rupture risk. Risks of uterine rupture include maternal hemorrhage and hypovolemic shock, as well as need for transfusion and emergency laparotomy. Importantly, uterine rupture can occur before the onset of labor. After uterine rupture, the fetus is at risk for stillbirth, as well as hypoxia or acidosis and their sequelae. In women with prior uterine surgery involving the muscular portion uterine rupture can also occur before the onset of labor.<sup>25,26</sup> Early delivery can avert the risk of uterine



rupture and its sequelae. Based on cohort studies and a decision analysis, delivery at 36–37 weeks is recommended in the setting of prior classical cesarean, with an estimated trade-off of 22 cases of respiratory distress syndrome to prevent one case of hypoxic ischemic encephalopathy after uterine rupture.<sup>24,27,28</sup> Although the potential risk for uterine rupture after myomectomy is low, the consequences can be catastrophic. Thus when cesarean is planned for women with prior myomectomy, the strategy of delivery at 37–38 weeks may be considered, with individualization based on the type and extent of the myomectomy surgery.

## Fetal Issues

A number of fetal conditions place the fetus at risk for stillbirth, hypoxia or acidosis, cardiac failure, or all of these. Examples include fetal growth restriction, congenital malformations, multiple gestations and isolated oligohydramnios. Late-preterm or early-term birth may be beneficial under such circumstances to avoid further fetal risk secondary to a progressively, or even stable, hostile intrauterine environment.

Fetal growth restriction in singleton gestations has been variably defined using birth weight cutoffs of less than the 3rd, 5th, or 10th percentiles. Because many of these fetuses are constitutionally small and because fetuses can experience growth failure despite being larger than an arbitrary cutoff, some investigators have advocated incorporation of maternal and paternal characteristics to derive “individualized fetal growth assessment” as a more predictive marker of fetal risk from poor intrauterine growth.<sup>29</sup> In twin gestations, fetal growth restriction has been defined using standard cutoffs similar to singletons or growth curves specific to twins, with either method identifying about 20–25% of twin fetuses to be below the 10<sup>th</sup> percentile for all fetuses. Additionally, discordance in fetal size between twins of 20% or more is used to delineate a fetus that is not reaching its potential for intrauterine growth. The major aim of early delivery in the setting of fetal growth restriction is to minimize fetal and newborn risks, particularly fetal death and long-term neurologic sequelae. The presence of concurrent medical or obstetric conditions may shift the optimal timing of delivery toward an earlier gestation (Table 1).

More than 2% of pregnancies are complicated by major congenital anomalies, and 1% have anomalies that require delivery planning. The risks of complications are dependent on the particular anomaly. Examples of maternal complications include anxiety, pregnancy-related hypertension, mirror syndrome, hydramnios (with its risks of respiratory compromise, abruptio placentae or preterm labor), premature rup-

ture of membranes (PROM), or maternal respiratory compromise. The optimal gestational age of delivery to minimize fetal and newborn complications cannot be generalized because some fetal abnormalities require expeditious delivery whereas others can be managed expectantly. Many fetal anomalies do not necessitate either late-preterm or early-term birth, and these fetuses are better served by allowing time for growth and maturation in utero. Some overarching recommendations are provided in Table 1.

Multiple gestations, including dichorionic, diamniotic and monochorionic, or monoamniotic twins, carry increased maternal and fetal risks whether uncomplicated or affected by a single fetal death. Three percent of deliveries are twins and 50% of these deliver preterm with 30% delivering in the late-preterm period. In addition to preterm birth, twin pregnancies are at increased risk for fetal growth restriction, congenital anomalies (monochorionic twins) as well as issues specific to multiples (twin-twin transfusion syndrome [3–4%], fetal death [1–2% per week in monochorionic gestations after 32 weeks], and discordant fetal growth). In addition, maternal conditions such as gestational diabetes, preeclampsia, abruptio placentae, placenta previa, and postpartum hemorrhage are more common in twin pregnancies. Early delivery may reduce the risk of stillbirth, and allow timing of delivery to optimize staffing and resources for newborn care in complex cases. Uncomplicated dichorionic twins have optimal outcomes when delivered at 38 weeks. Uncomplicated diamniotic-mono-chorionic twins have higher risks of stillbirth; thus, a late-preterm delivery (34–37 weeks) is recommended. Because of the high risk of cord entanglement resulting in fetal death in monoamniotic twins, delivery at 32 to 34 weeks is recommended. In the setting of a multiple gestation with one fetal demise, early delivery may prevent a second fetal death. In dichorionic pregnancy with a single fetal demise, expectant management to 37 weeks with weekly surveillance is generally recommended; however due to limited data, delivery between 34 and 36 weeks may also be reasonable. In monochorionic (mono- and diamniotic) gestations with a single fetal demise, neurological injury may not be preventable due to the acute cardiovascular effects in the surviving co-twin, however the risk of stillbirth in the live fetus versus the risks of early delivery may need to be weighed. Regardless of chorionicity, maternal anxiety in these situations cannot be underestimated and may be a factor in the clinical judgment regarding the timing of delivery. Considerations regarding delivery timing for multiple gestations are presented in Table 1.





Isolated oligohydramnios has been defined by some as a single vertical pocket of 2.0 cm or less and by others as an amniotic fluid index of 5.0 cm or less. Using the single vertical pocket, oligohydramnios has been reported in 2.3% of pregnancies at 34–36 weeks and in 3% at 37 weeks or more. Using the amniotic fluid index, oligohydramnios is present in 4.8% of pregnancies at 34–36 weeks and 10% at 37 weeks or more. Oligohydramnios is associated with an increase in nonreactive nonstress tests (1.5-fold), fetal heart rate decelerations (1.8-fold), fetal intolerance in labor, and stillbirth (4.5-fold), as well as Apgar score  $\leq 3$  at 5 minutes (11-fold) and meconium aspiration (12-fold). Oligohydramnios in the presence of normal fetal growth may be less ominous than when it is associated with abnormal fetal growth. However, ultrasonography is insensitive in the diagnosis of fetal growth restriction when population-based nomograms are used. The advantage of early delivery is the avoidance of stillbirth, but the maternal risks of early delivery are those related to labor induction and cesarean delivery. The optimal definition of oligohydramnios has not been determined. There is no consensus on which method to use in defining oligohydramnios in the context of timing of delivery. There is no evidence that one method is a better predictor of adverse neonatal outcome than the other. Although either has been used to diagnose oligohydramnios, the single deepest pocket has higher specificity in the preterm period and would lead to lower rates of delivery.<sup>30</sup> In the setting of otherwise uncomplicated isolated and persistent oligohydramnios, delivery at 36–37 weeks is recommended (Table 1). It remains unknown whether different gestational thresholds should be applied for oligohydramnios diagnosed based on the single deepest pocket versus the amniotic fluid index. Given that amniotic fluid evaluation is a component of fetal surveillance tests, it would be prudent not to make the decision regarding timing of delivery for oligohydramnios in isolation, but include the results of the complete fetal testing (BPP or modified BPP) along with other clinical parameters such as maternal condition and fetal growth.

### Maternal and Obstetric Issues

Maternal and obstetric issues that may require consideration of late-preterm or early-term delivery can be divided into those that are acute or those that have ongoing risk. Acute issues include preterm labor and preterm PROM; those with ongoing risk include hypertensive diseases and diabetes and obstetric complications such as preeclampsia and prior stillbirth.

Pregnancy-related hypertension (gestational hypertension and preeclampsia) occurs in about 30% of

nulliparous pregnancies.<sup>31</sup> The majority of preeclampsia (80%) occurs after 38 weeks of gestation. The risks of continued pregnancy in the setting of gestational hypertension or preeclampsia include development of severe preeclampsia and its complications (hypertensive crisis, HELLP syndrome [hemolysis, elevated liver enzymes and low platelets], abruptio placentae, renal failure, disseminated intravascular coagulation, eclampsia, death) and fetal morbidity (fetal growth restriction, asphyxia after hypertensive crisis and placental abruption, and death). Gestational diabetes occurs in up to 15% of pregnancies, however this rate may change if the criteria for its diagnosis are changed.<sup>32</sup> Three to 4% of pregnant women have pregestational diabetes. Early delivery in the setting of diabetes may reduce the risks of macrosomia, associated birth trauma, and stillbirth. Women with diabetes are at increased risk for uncontrolled hyperglycemia and cesarean delivery. The optimal timing of delivery in gestational hypertension, preeclampsia and diabetes depends on the severity of the condition, presence of comorbidities, whether treatment with medication is needed, and the occurrence of superimposed obstetric conditions (Table 1).

Recurrence of stillbirth is estimated to be up to 8%, and this is more likely with prior earlier loss, recurrent losses, accompanied fetal growth restriction, and black race.<sup>33</sup> Women with a history of stillbirth are also at increased risk for other complications including fetal growth restriction, preterm birth, and preeclampsia. Continued pregnancy in the setting of a prior stillbirth may result in maternal anxiety. Fetal risks include stillbirth. Delivery before 39 weeks of gestation has not been proved to reduce the risk of recurrent stillbirth or adverse pregnancy outcomes in women with prior stillbirths (Table 1). In the absence of fetal growth restriction and comorbidities, a history of an unexplained stillbirth is not an indication for late-preterm or early-term birth. Given the lack of demonstrable benefit from early delivery in this situation, amniocentesis for lung maturity may be prudent if scheduled delivery is intended due to maternal anxiety, preferences, or both before 39 weeks of gestation. Importantly, however, a mature pulmonary profile in the late-preterm or early-term period does not assure the absence of neonatal complications.

Women presenting with preterm labor or PROM may proceed to deliver spontaneously, but this does not occur in all cases. Expectant management of late-preterm or early-term PROM is associated with increased risks of chorioamnionitis and the potential for fetal death from umbilical cord compression, but the latency until delivery is brief in most cases. Because of brief latency, newborn outcomes are un-



likely to be improved with expectant management after late-preterm or early-term PROM, and delivery is recommended with preterm PROM occurring at or after 34 weeks of gestation, or in patients with PROM who have reached 34 weeks.

Another frequent reason for late-preterm or early-term delivery is augmentation of labor or repeat cesarean delivery because the patient presents with contractions. The decision to augment contractions or to proceed with a previously planned cesarean delivery for women in labor in the late-preterm or early-term period should be reserved for those with progressive labor or a concurrent medical or obstetric complication.

## SUMMARY

With the push to reduce preterm birth and the recent public health awareness of the complications of prematurity, it is important to realize that some preterm births benefit the mother, child, or both. In specific situations, a preterm birth is the optimal outcome to pregnancy. Given the unique situations individual patients present with, the evidence to help determine the best timing for delivery may be difficult to find and generalize. We have reviewed many of the common conditions that could benefit from early delivery to help, and provide guidance to the practitioner using available evidence and expert opinion.

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