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Indications for Outpatient Antenatal Fetal Surveillance

ABSTRACT: The purpose of this Committee Opinion is to offer guidance about indications for and timing and frequency of antenatal fetal surveillance in the outpatient setting. Antenatal fetal surveillance is performed to reduce the risk of stillbirth. However, because the pathway that results in increased risk of stillbirth for a given condition may not be known and antenatal fetal surveillance has not been shown to improve perinatal outcomes for all conditions associated with stillbirth, it is challenging to create a prescriptive list of all indications for which antenatal fetal surveillance should be considered. This Committee Opinion provides guidance on and suggests surveillance for conditions for which stillbirth is reported to occur more frequently than 0.8 per 1,000 (the false-negative rate of a biophysical profile) and which are associated with a relative risk or odds ratio for stillbirth of more than 2.0 compared with pregnancies without the condition. Table 1 presents suggestions for the timing and frequency of testing for specific conditions. As with all testing and interventions, shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth. It is important to emphasize that the guidance offered in this Committee Opinion should be construed only as suggestions; this guidance should not be construed as mandates or as all encompassing. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Recommendations and Conclusions

The American College of Obstetricians and Gynecologists makes the following recommendations and conclusions regarding indications for antenatal fetal surveillance:

- This Committee Opinion provides guidance on and suggests surveillance for conditions for which stillbirth is reported to occur more frequently than 0.8 per 1,000 (the false-negative rate of a biophysical profile or modified biophysical profile) and which are associated with a relative risk (RR) or odds ratio for stillbirth of more than 2.0 compared with pregnancies without the condition.
- When data on gestational age-adjusted risk of occurrence of stillbirth were not available, the Committee's suggestions regarding when to begin antenatal fetal surveillance are based on the reported risk of stillbirth, generally falling into three major categories of when to begin: (1) at or by 32 0/7 weeks, (2) at or by 36 0/7 weeks, or (3) at or beyond 39 0/7 weeks of gestation (if undelivered). However, individualization about if and when to begin antenatal fetal surveillance is advised.
- Initiating antenatal fetal surveillance at 32 0/7 weeks of gestation or later is appropriate for most at-risk patients. However, for pregnant individuals with multiple or particularly worrisome high-risk conditions (eg, chronic hypertension with suspected fetal growth restriction), antenatal fetal surveillance might begin at a gestational age when delivery would be considered for perinatal benefit.
- As with all testing and interventions, shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth. This can be particularly important in situations

that involve fetal structural or genetic anomalies or when initiating antenatal fetal surveillance around the threshold of viability, where the pregnant individual's goals for pregnancy care are critical in decision making.

- Table 1 presents suggestions for the timing and frequency of antenatal fetal surveillance for specific conditions.
- It is important to emphasize that the guidance offered in this Committee Opinion should be construed only as suggestions; this guidance should not be construed as mandates or as all encompassing. There is a paucity of evidence for the efficacy of antenatal fetal surveillance and for evidence-based recommendations on the timing and frequency of antenatal fetal surveillance; consequently, for most conditions, recommendations for antenatal fetal surveillance are largely based on expert consensus and relevant observational studies.

Introduction

Purpose

The purpose of this Committee Opinion is to offer guidance about indications for and timing and frequency of antenatal fetal surveillance in the outpatient setting. In most cases, the specific type of antenatal testing will not be recommended because the types of antenatal testing are addressed elsewhere (1, 2). It is important to emphasize that the guidance offered in this Committee Opinion should be construed only as suggestions; this guidance should not be construed as mandates or as all encompassing. There is a paucity of evidence for the efficacy of antenatal fetal surveillance and for evidence-based recommendations on the timing and frequency of antenatal fetal surveillance; consequently, for most conditions, recommendations for antenatal fetal surveillance are largely based on expert consensus and relevant observational studies. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Background

Antenatal fetal surveillance is performed to reduce the risk of stillbirth. Fetal hypoxemia and acidosis represent the common pathway to fetal death in many high-risk pregnancies. Fetal hypoxemia and acidosis may result in changes in amniotic fluid, fetal movements, and fetal heart rate characteristics. This provides the rationale for offering antenatal fetal surveillance to individuals whose pregnancies are complicated by conditions associated with increased risk for stillbirth. However, there is a paucity of evidenced-based recommendations on the timing and frequency of antenatal fetal surveillance because of the challenges of conducting prospective trials in pregnancies complicated by stillbirths and the varying conditions that place pregnancies at high risk for stillbirth. As a result, evidence for the efficacy of antenatal fetal surveillance, when available, is largely circumstantial and is based on the observation that the rates of fetal death in tested populations are lower than the rates both in individuals with untested contemporaneous pregnancies from the same institutions and individuals with pregnancies with similar complications managed before the advent of currently used techniques of antenatal fetal surveillance (3–5). Such study design is subject to an important intervention effect; any test that results in a higher subsequent overall delivery rate will result in a lower stillbirth rate than in a nontested population (6). For most conditions, recommendations for antenatal fetal surveillance are largely based on expert consensus and relevant observational studies.

A number of maternal, fetal, and placental complications have been shown to be associated with an increased risk of stillbirth. Moreover, large epidemiologic studies have demonstrated that several factors are independent predictors of stillbirths (7–9); thus, when present concurrently, they may lead to a concomitant cumulative risk of stillbirth. In spite of its unproven value, antenatal fetal surveillance is routinely used in pregnancies in which the risk of fetal demise is increased. However, because the pathway that results in increased risk of stillbirth for a given condition may not be known and antenatal fetal surveillance has not been shown to improve perinatal outcomes for all conditions associated with stillbirth, it is challenging to create a prescriptive list of all indications for which antenatal fetal surveillance should be considered.

Rationale

Conditions

There are multiple factors in identifying conditions for which antenatal fetal surveillance may be appropriate, including the false-negative rate of antenatal fetal surveillance tests and the RR of stillbirth due to a specific condition. In 2013, the stillbirth rate at or after 20 weeks gestational age in the United States was 5.96 per 1,000 births across all gestational ages. A retrospective cohort study of nonanomalous term births (10) found the stillbirth rate per 1,000 ongoing pregnancies to be 0.21 at 37 weeks, 0.27 at 38 weeks, 0.35 at 39 weeks, 0.42 at 40 weeks, 0.61 at 41 weeks, and 1.08 at 42 weeks. It has been suggested that when determining the conditions for which antenatal fetal testing should be performed, one should consider the risk of false-negative antenatal fetal surveillance test (6): approximately 1.9 per 1,000 after a nonstress test; 0.3 per 1,000 after a contraction stress test; and 0.8 per 1,000 after a biophysical profile (BPP) or modified biophysical profile (1). Additionally, based on expert consensus, the Committee felt that antenatal fetal surveillance could be considered for conditions that would result in at least twice the increased risk of stillbirth as compared to the risk if the condition were not present. Therefore, this Committee Opinion provides guidance on and suggests surveillance for

conditions for which stillbirth is reported to occur more frequently than 0.8 per 1,000 (the false-negative rate of a BPP or modified BPP) and which are associated with a RR or odds ratio for stillbirth of more than 2.0 compared with pregnancies without the condition. Table 1 presents suggestions for the timing and frequency of testing for specific conditions.

Initiation Timing

Both theoretic models and large clinical studies suggest that initiating antenatal fetal surveillance at 32 0/7 weeks of gestation or later is appropriate for most at-risk patients. However, for pregnant individuals with multiple or particularly worrisome high-risk conditions (eg, chronic hypertension with suspected fetal growth restriction), antenatal fetal surveillance might begin at a gestational age when delivery would be considered for perinatal benefit (1). Because antenatal fetal surveillance tests have high false-positive rates (nonreassuring test results in a noncompromised fetus) and low positive predictive value (low risk of stillbirth after an abnormal test result), abnormal test results (particularly at low gestational ages) are often followed by another test to evaluate fetal status. Any decision to proceed with delivery should be based on the complete clinical picture including antenatal fetal surveillance test results, overall maternal and fetal condition, and gestational age. Antenatal fetal surveillance must be interpreted with caution if performed before 32 weeks of gestation because the nonstress test of a normal preterm fetus is nonreactive in up to 50% of fetuses between 24 and 28 weeks of gestation and 15% of fetuses between 28 and 32 weeks of gestation. Thus, the predictive value of nonstress tests based on a lower threshold for accelerations (at least 10 beats per minute above the baseline and at least 10 seconds from baseline to baseline) has been evaluated in pregnancies at less than 32 weeks of gestation and has been found to sufficiently predict fetal well-being (1). When data on gestational age-adjusted risk of occurrence of stillbirth were not available, the Committee's suggestions regarding when to begin antenatal fetal surveillance are based on the reported risk of stillbirth, generally falling into one of three major categories of when to begin: (1) at or by 32 0/7 weeks, (2) at or by 36 0/7 weeks, or (3) at or beyond 39 0/7 weeks of gestation (if undelivered). However, individualization about if and when to begin antenatal fetal surveillance is advised.

Frequency

There are no large clinical trials to guide the recommended frequency of antenatal fetal surveillance and, thus, the optimal frequency remains unknown. If the maternal medical condition is stable and test results are reassuring, tests of fetal well-being (nonstress test, BPP, modified BPP, or contraction stress test) have often, in practice, been repeated at weekly intervals (1). However, in the presence of certain high-risk conditions, some investigators have performed more frequent antenatal fetal surveillance (1, 2). The Committee's suggestions regarding frequency of antenatal fetal surveillance for each condition are, therefore, based on the approach of testing at least weekly, unless additional information is available that supports more frequent antenatal fetal surveillance (eg, abnormal Doppler results), multiple conditions are present that each warrant antenatal fetal surveillance, or a patient's status is deteriorating.

Application

The risk of fetal stillbirth increases markedly in the last few weeks of pregnancy (10). This has also been quantified for many maternal conditions including maternal age, race, and obesity, and it is plausibly related to the concept of placental senescence leading to placental dysfunction (11). It would, therefore, seem prudent and cost effective to limit antenatal fetal surveillance to the last part of the third trimester for most high-risk conditions. However, given the lack of documented efficacy of antenatal fetal surveillance for prevention of stillbirth in most high-risk conditions, coupled with the increase in risk of stillbirth at term with advancing gestational age and the results of the ARRIVE trial (12) in a low-risk population, delivery at 39 weeks (with its associated elimination of risk of stillbirth) may be considered instead of antenatal fetal surveillance protocols beyond 39 weeks (6). Furthermore, the risks associated with antenatal fetal surveillance itself (eg, false-positive tests resulting in cesarean delivery or induction of labor, iatrogenic prematurity) and costs (eg, performance and interpretation of tests, time spent by patients and practitioners in testing) of antenatal fetal surveillance must be weighed against potential benefits (13).

When multiple indications for antenatal fetal surveillance exist, timing and frequency of antenatal fetal surveillance should be individualized. As with all testing and interventions, shared decision making between the pregnant individual and the clinician is critically important when considering or offering antenatal fetal surveillance for individuals with pregnancies at high risk for stillbirth or with multiple comorbidities that increase the risk of stillbirth. This can be particularly important in situations that involve fetal structural or genetic anomalies or when initiating antenatal fetal surveillance around the threshold of viability, where the pregnant individual's goals for pregnancy care are critical in decision making. In counseling individuals regarding the risks, benefits, and efficacy of antenatal fetal surveillance, it should be acknowledged that often unaccounted-for costs of antenatal fetal surveillance include the potential for additional visits that may require transportation, taking time off from work, and additional copays. Acknowledging these costs and reviewing them with patients are important aspects of providing this additional surveillance. The health care team should be aware of circumstances related to social determinants of health that

Table 1 Factors Associated With an Increased Risk of Stillbirth and Suggested Strategies for Antenatal Fetal Surveillance After Viability

The guidance offered in this table should be construed only as suggestions, not mandates. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Factor	Suggested Gestational Age to Begin Antenatal Fetal Surveillance	Suggested Frequency of Antenatal Fetal Surveillance
Fetal		
Growth restriction[1]		
UAD: normal or with elevated impedance to flow in umbilical artery with diastolic flow present; with normal AFI and no other concurrent maternal or fetal conditions	At diagnosis[2]	Once or twice weekly
UAD: AEDV or concurrent conditions (oligohydramnios, maternal comorbidity [eg, preeclampsia, chronic hypertension])	At diagnosis[2]	Twice weekly[3] or consider inpatient management
UAD: REDV	At diagnosis[2]	Inpatient management[3]
Multiple gestation		
Twins, uncomplicated dichorionic	36 0/7 weeks	Weekly
Twins, dichorionic, complicated by maternal or fetal disorders, such as fetal growth restriction	At diagnosis[2]	Individualized
Twins, uncomplicated monochorionic-diamniotic	32 0/7 weeks[4]	Weekly
Twins, complicated monochorionic-diamniotic (ie, TTTS)	Individualized	Individualized
Twins, monoamniotic	Individualized	Individualized
Triplets and higher order multiples	Individualized	Individualized
Decreased fetal movement	At diagnosis[3]	Once[5]
Fetal anomalies and aneuploidy	Individualized	Individualized
Maternal		
Hypertension, chronic		
Controlled with medications	32 0/7 weeks	Weekly
Poorly controlled or with associated medical conditions	At diagnosis[2]	Individualized
Gestational hypertension/preeclampsia		
Without severe features	At diagnosis[2,3]	Twice weekly
With severe features	At diagnosis[2,3]	Daily
Diabetes		
Gestational, controlled on medications without other comorbidities	32 0/7 weeks	Once or twice weekly
Gestational, poorly controlled	32 0/7 weeks	Twice weekly
Pregestational	32 0/7 weeks[6]	Twice weekly
Systemic lupus erythematosus		
Uncomplicated	By 32 0/7 weeks	Weekly
Complicated[7]	At diagnosis[2]	Individualized
Antiphospholipid syndrome	By 32 0/7 weeks[8]	Twice weekly
Sickle cell disease		
Uncomplicated	32 0/7 weeks	Once or twice weekly
Complicated[9]	At diagnosis[2]	Individualized
Hemoglobinopathies other than Hb SS disease	Individualized	Individualized
Renal disease (Cr greater than 1.4 mg/dL)	32 0/7 weeks	Once or twice weekly
Thyroid disorders, poorly controlled	Individualized	Individualized
In vitro fertilization	36 0/7 weeks	Weekly
Substance use		
Alcohol, 5 or more drinks per week	36 0/7 weeks	Weekly
Polysubstance use	Individualize	Individualized

(*continued*)

Table 1 Factors Associated With an Increased Risk of Stillbirth and Suggested Strategies for Antenatal Fetal Surveillance After Viability *(continued)*

The guidance offered in this table should be construed only as suggestions, not mandates. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

Factor	Suggested Gestational Age to Begin Antenatal Fetal Surveillance	Suggested Frequency of Antenatal Fetal Surveillance
Prepregnancy BMI		
Prepregnancy BMI 35.0–39.9 kg/m2	37 0/7 weeks	Weekly
Prepregnancy BMI 40 kg/m2 or above	34 0/7 weeks	Weekly
Maternal age older than 35 years	Individualized[10]	Individualized
Obstetric		
Previous stillbirth		
At or after 32 0/7 weeks	32 0/7 weeks[11]	Once or twice weekly
Before 32 0/7 weeks of gestation	Individualized	Individualized
History of other adverse pregnancy outcomes in immediately preceding pregnancy		
Previous fetal growth restriction requiring preterm delivery	32 0/7 weeks	Weekly
Previous preeclampsia requiring preterm delivery	32 0/7 weeks	Weekly
Cholestasis	At diagnosis[2]	Once or twice weekly
Late term	41 0/7 weeks	Once or twice weekly
Abnormal serum markers[12]		
PAPP-A less than or equal to the fifth percentile (0.4 MoM)	36 0/7 weeks	Weekly
Second-trimester Inhibin A equal to or greater than 2.0 MoM	36 0/7 weeks	Weekly
Placental		
Chronic placental abruption[13]	At diagnosis[2]	Once or twice weekly
Vasa previa	Individualized	Individualized
Velamentous cord insertion	36 0/7 weeks	Weekly
Single umbilical artery	36 0/7 weeks	Weekly
Isolated Oligohydramnios (single deepest vertical pocket less than 2 cm)	At diagnosis[2,3]	Once or twice weekly
Polyhydramnios, moderate to severe (deepest vertical pocket equal to or greater than 12 cm or AFI equal to or greater than 30 cm)	32 0/7–34 0/7 weeks[14]	Once or twice weekly

Abbreviations: AEDV, absent end-diastolic velocity; AFI, amniotic fluid index; BMI, body mass index; Cr, creatinine; MoM, multiples of the median; PAPP-A, pregnancy-associated plasma protein A; REDV, reversed end-diastolic flow; TTTS, twin to twin transfusion syndrome; UAD, umbilical artery Doppler.

The guidance offered in this table should be construed only as suggestions, not mandates. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised.

[1]Estimated fetal weight or abdominal circumference less than the 10th percentile.

[2]Or at a gestational age when delivery would be considered because of abnormal test results.

[3]If not delivered.

[4]In addition to routine surveillance for twin–twin transfusion syndrome and other monochorionic twin complications.

[5]Repeat if decreased fetal movement recurs.

[6]Or earlier for poor glycemic control or end organ damage.

[7]Such as active lupus nephritis, recent lupus flare, antiphospholipid antibodies with prior fetal loss, anti-RO/SSA or anti-La/SSB antibodies, or thrombosis.

[8]Individualize, take into consideration obstetric history, number of positive antibodies, and current pregnancy complications.

[9]Such as maternal hypertension, vaso-occlusive crisis, placental insufficiency, fetal growth restriction.

[10]Based on cumulative risk when present with other factors.

[11]Or starting 1–2 weeks before the gestational age of the previous stillbirth.

[12]If serum screening for aneuploidy is performed, the results may be considered in determining whether antenatal fetal surveillance should be performed.

[13]In individuals who are candidates for outpatient management.

[14]Or at diagnosis if diagnosed after 32 0/7–34 0/7 weeks.

might present barriers to desired testing and should make appropriate referrals to enable recommended care (14).

The guidance offered in this Committee Opinion should be construed as suggestions, not mandates. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised. Finally, the Committee is cognizant of the anxiety, inconvenience, and costs this testing can impose on patients. This document is an attempt to balance the goals of improving patient outcomes with these other concerns in the face of sometimes limited data.

Fetal Conditions

Fetal Growth Restriction

The most widely used definition of *fetal growth restriction* in the United States is an estimated fetal weight or abdominal circumference less than the 10th percentile for gestational age (2, 15, 16). Several studies have shown an association between fetal growth restriction and stillbirth (17–19). The risk of stillbirth increases with gestational age and is inversely proportional to the percentile of birthweight for gestational age, with the risk in those with an estimated fetal weight that is lower than the third percentile as high as 5.8 stillbirths per 1,000 at-risk fetuses, 4.39 per 1,000 for an estimated fetal weight that is lower than the fifth percentile, and 2.63 per 1,000 for fetuses with an estimated weight that is lower than the 10th percentile compared with 0.51 per 1,000 for fetuses with normal growth (17). Abnormal umbilical artery Doppler waveforms reflect the presence of placental insufficiency and may differentiate the growth-restricted fetus from the fetus that is constitutionally small. Incorporation of umbilical artery Doppler evaluation in high-risk pregnancies has been shown to significantly reduce the risk of perinatal death, induction of labor, and cesarean birth. As such, it should be the primary modality for fetal surveillance in fetal growth restriction (2).

A finding of absent or reversed end-diastolic flow in the umbilical artery in the setting of fetal growth restriction is associated with an additively increased frequency of perinatal mortality; therefore, earlier delivery is typically indicated and discussed, with timing dependent on the specific clinical situation and the gestational age (2, 15, 20). Normal results of antenatal fetal surveillance consisting of nonstress tests or BPPs, in conjunction with normal umbilical artery Doppler velocimetry, have been associated with improved outcomes in pregnancies in which fetal growth restriction has been diagnosed (15). For an individual with a pregnancy complicated by fetal growth restriction with either a normal or elevated impedance to flow in umbilical artery (defined as systolic/diastolic ratio, pulsatility, or resistance index greater than the 95th centile for gestational age), but with diastolic flow still present, and with normal amniotic fluid volume and no other concurrent maternal or fetal conditions, once or twice weekly antenatal surveillance beginning at diagnosis or at a gestational age when delivery would be considered based on an abnormal test result, may be considered. For an individual with a pregnancy complicated by fetal growth restriction and abnormal umbilical artery Doppler waveforms characterized by absent end diastolic velocity or with other concurrent conditions (oligohydramnios, maternal comorbidity [eg, preeclampsia, chronic hypertension]) who is not being delivered (20), inpatient management or twice weekly antenatal fetal surveillance beginning at diagnosis or at a gestational age when delivery would be considered because of abnormal test results, may be considered (2). For an individual with a pregnancy complicated by fetal growth restriction and abnormal umbilical artery Doppler waveforms characterized by reversed end diastolic flow who is not being delivered, inpatient management is recommended (2). When these conditions are present, consultation with a maternal–fetal specialist is suggested.

Multiple Gestation

A recent systematic review by the Global Obstetrics Network (GONet) Collaboration provided weekly stillbirth data for twins managed expectantly after 34 weeks of gestation (21). The risk of stillbirth increased in all twins with advancing gestational age, and it was significantly greater in monochorionic than dichorionic twins. In dichorionic twins, stillbirth rates were as follows:

- 0.8 per 1,000 at 35 0/7 to 35 6/7 weeks
- 1.5 per 1,000 at 36 0/7 to 36 6/7 weeks
- 3.4 per 1,000 at 37 0/7 to 37 6/7 weeks
- 10.6 per 1,000 at 38 0/7 to 38 6/7 weeks (21)

In monochorionic diamniotic twins the stillbirth rates were as follows:

- 0.9 per 1,000 at 34 0/7 to 34 6/7 weeks
- 2.8 per 1,000 at 35 0/7 to 35 6/7 weeks
- 4.5 per 1,000 at 36 0/7 to 36 6/7 weeks
- 9.6 per 1,000 at 37 0/7 to 37 6/7 weeks (21)

The optimal gestational age for initiation of surveillance in pregnant individuals with uncomplicated dichorionic twins is not known. However, for patients with uncomplicated dichorionic twin pregnancies, weekly antenatal fetal surveillance may be considered at 36 0/7 weeks of gestation (22–24). For patients with a dichorionic twin pregnancy complicated by maternal or fetal disorders, such as fetal growth restriction, antenatal fetal surveillance should be individualized and may be considered upon diagnosis, or at a gestational age after which delivery would be considered for abnormal testing. Any decision to implement surveillance and the timing and frequency of antenatal fetal surveillance should involve a discussion addressing the pregnant individual's wishes regarding management of the pregnancy, and

take into account the presence and severity of fetal growth restriction in either or both of the twins, Doppler findings, gestational age at diagnosis, and any maternal comorbidities.

Because of higher stillbirth risks in monochorionic-diamniotic twins and the potential for severe clinical consequences for the surviving twin, initiation of surveillance is typically recommended at 32 0/7 weeks of gestation (22–24). Implementation of such protocols has resulted in stillbirth rates in monochorionic-diamniotic twins similar to those of dichorionic-diamniotic twins (23, 24) and has lowered the rates of stillbirth in monochorionic-diamniotic twins to be comparable to those seen in singletons at similar gestational ages (22–24). Such protocols of surveillance result in negligible false-positive rates (1.9%; 95% CI, 1.0%–3.4%) (22). For a patient with otherwise uncomplicated monochorionic-diamniotic twin pregnancies, weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks of gestation. Serial sonographic evaluations for twin–twin transfusion should ideally begin by 16 weeks and continue on an every-other-week basis until delivery (25). Additional surveillance for twin–twin transfusion and other monochorionic twin pathologies should be individualized.

Perinatal mortality is increased in monoamniotic twins with estimates ranging from 12% to 23% (26, 27). For patients with monoamniotic twin pregnancies or with higher-order multiple pregnancies, antenatal fetal surveillance should be individualized in consultation with maternal–fetal medicine specialists.

Decreased Fetal Movement

Maternal perception of fetal movements is the oldest and most commonly used method to assess fetal well-being. Decreased fetal movements have been associated with an increased risk of stillbirth (28–30) (odds ratio [OR], 2.9–4.51) with the rate of stillbirth after reduced fetal movement estimated to be 13 per 1,000 episodes (13). However, studies that assessed the relationship between fetal movement and perinatal mortality have used varying definitions of decreased fetal movement. It is hypothesized that decreased fetal movements may be an adaptive response to uteroplacental insufficiency that results in either acute or chronic fetal hypoxemia. Fetuses with decreased fetal movements before elective cesarean delivery have been shown to have relative hypoxemia and acidemia or evidence of abnormal placental morphology and function compared with those with normal movements (31, 32). For a pregnant individual reporting decreased fetal movement after viability, one-time antenatal fetal surveillance at the time the decreased movement is reported may be considered (1, 33). Fetal movement patterns normally change over the course of pregnancy with longer periods of quiescence near term as the fetal nervous system develops (34). Therefore, because of the episodic nature of decreased fetal movement, unless decreased fetal movement reoccurs, antenatal fetal surveillance for a single episode does not need to be repeated if the initial results are reassuring and there is no other indication for antenatal fetal surveillance (1, 33).

Fetal Anomalies

Large registries have consistently found that fetuses with congenital anomalies have an increased risk of stillbirth (35–37). For example, a greater than twofold increased risk of stillbirth has been reported for cardiac anomalies even in the absence of associated chromosomal anomalies or other major structural anomalies (38–40). The excess stillbirth risk is noted even for anomalies not affecting major vital organs, such as cleft lip and palate (35, 37). The mechanisms of stillbirth may be unrelated to placental insufficiency and may not be predicted by antenatal fetal surveillance. Different anomalies, or spectrums of anomaly, expose the fetus to different problems and risks and, therefore, different forms of surveillance may be required. Antenatal fetal surveillance for major fetal structural anomalies should be individualized in consultation with maternal–fetal medicine specialists.

Some fetal aneuploidies also are associated with increased risk of stillbirth (41). For example, the stillbirth rates in ongoing pregnancies affected by fetal trisomy 21 are estimated at 5–10% (42–44). Although the risk of stillbirth is elevated from 24 to 36 weeks (3–7 deaths per 1,000 ongoing pregnancies), the risk sharply increases at term (11–50 deaths per 1,000 ongoing pregnancies after 37 weeks) (43). It is presumed that much of this excess risk is related to structural abnormalities, fetal growth restriction, or placental dysfunction related to the coexisting placental aneuploidy. In a retrospective review of pregnancies affected by trisomy 21, among liveborn newborns, 36% were delivered for the indication of nonreassuring fetal testing and of these, over half had evidence of placental insufficiency on histopathologic review (44).

When pregnancies are complicated by fetal anomalies or aneuploidies, it is especially important that the decision whether and when to begin antenatal fetal surveillance should be individualized, based on patient preference, with obstetrician–gynecologists, maternal–fetal medicine specialists and other health care clinicians who support patients and their families in a shared decision-making process.

Congenital Infection

In high-income countries, between 10% and 25% of stillbirths may be caused by an antepartum maternal or fetal infection, whereas in low-income countries the contribution of infection to the stillbirth rate is much greater. Infection may cause stillbirth by placental infection or damage or other mechanisms that may not be predicted with antenatal fetal surveillance, including direct fetal infection and severe maternal illness (45).

Across nearly 20 studies, *Plasmodium falciparum* malaria infection treated during pregnancy increased the odds of stillbirth by 1.47 times, whereas in more than 30 studies, infections in the pregnant individual at delivery increased the odds of stillbirth by 1.81 times and malaria in the placenta increased the odds of stillbirth by 1.95 times. (46). The rate of fetal loss among pregnant individuals with serologically proven parvovirus B19 infection ranges from 8% to 17% before 20 weeks of gestation to 2% to 6% after 20 weeks of gestation (47). With the exception of parvovirus infection in which serial ultrasonography and middle cerebral artery Doppler evaluations for evidence of fetal anemia and fetal hydrops are recommended (47), maternal infection without evidence of fetal effect would not seem to warrant routine antenatal fetal surveillance. If there is evidence of fetal effect, testing should be individualized.

Maternal Conditions

For many maternal medical conditions such as cardiac disease, pulmonary disease, or seizure disorder, the risk of stillbirth is highest during periods of acute maternal decompensation and the degree to which the risk of stillbirth increases is determined by disease severity and control during pregnancy. Such conditions are not included in this guidance because individualization about if and when to offer fetal testing is advised. When these conditions are present, consultation with a maternal–fetal specialist is suggested. This list of maternal conditions is not meant to be exhaustive and is based on the conditions for which there are the most published data.

Hypertensive Disorders

The estimated rate of stillbirth in individuals whose pregnancies are complicated by chronic hypertension is 6–25 per 1,000 (OR, 1.5–2.7) (8), but when chronic hypertension is complicated by superimposed preeclampsia, the risk is increased more than fourfold (RR, 4.4; 95% CI, 2.2–8.8) (48). The estimated rates of stillbirth in pregnancies complicated by gestational hypertension with and without severe range blood pressure are 12–29 per 1,000 (OR, 1.8–4.4) and 9–51 per 1,000 (OR, 1.2–4.0), respectively (8). In a cohort of 109,932 pregnant individuals, including 1,417 with chronic hypertension, the median gestational age at delivery (presumably shortly following diagnosis) in cases of stillbirth was 28.2 weeks (interquartile range, 26.1–32.7 weeks) (49).

Antenatal fetal surveillance is recommended for pregnant individuals with chronic hypertension complicated by issues such as the need for medication, other underlying medical conditions that may affect fetal outcome, any evidence of fetal growth restriction, or superimposed preeclampsia (50). For patients with chronic hypertension that requires medication, weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks of gestation. When hypertension is associated with fetal growth restriction, fetal surveillance should be initiated at the time of fetal growth restriction diagnosis (see the Fetal Growth Restriction section) and testing frequency individualized. When hypertension is poorly controlled or is associated with other underlying medical conditions, when to begin and frequency of antenatal fetal surveillance should be individualized and may be considered upon diagnosis or at a gestational age when delivery would be considered because of abnormal test results. For individuals with gestational hypertension or preeclampsia, antenatal fetal surveillance is recommended at diagnosis or at a gestational age when delivery would be considered for perinatal benefit. For those without severe-range blood pressures or without other severe features, twice weekly surveillance is recommended until delivery. For those with severe-range blood pressure or with severe features, daily surveillance is recommended until delivery (51). See ACOG Practice Bulletin No. 222, *Gestational Hypertension and Preeclampsia*, and Practice Bulletin No. 203, *Chronic Hypertension in Pregnancy*, for more information.

Diabetes

Before 40 0/7 weeks of gestation, for an individual with gestational diabetes whose glycemic control is well managed by diet alone and with no other comorbidities, there is no consensus on whether antenatal fetal surveillance is necessary (52). For a patient with gestational diabetes that is controlled on medications without other comorbidities, once or twice weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks (52). For a patient with poorly controlled gestational diabetes, twice weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks (52). Factors such as glycemic control and the presence of other factors associated with increased risk of adverse pregnancy outcomes can be used to determine the frequency and timing of initiation of testing.

Pregestational diabetes is associated with an increased risk of stillbirth (adjusted odds ratio [aOR] 2.50; 95% CI, 1.39–4.48) (7). The overall stillbirth rate in a cohort of individuals with pregestational diabetes (53) was 13.9 per 1,000 pregnancies (95% CI, 9.7–19.9), and individuals with pregestational diabetes had a significantly higher stillbirth rate at all gestations after 32 weeks. Stillbirth occurs most commonly in individuals with poor glycemic control, those who require medical management to obtain glycemic control, and in those with polyhydramnios, fetal macrosomia, or declining insulin requirements (54). In patients with diabetes who have renal disease, vascular disease, fetal growth restriction, or concomitant hypertension, stillbirth may occur as early as the late second trimester (55). Because patients with pregestational diabetes have a higher rate of stillbirth within 1 week of a reactive nonstress test, twice weekly antepartum fetal surveillance has been widely

adopted (56) and may be considered beginning at 32 0/7 weeks. In the setting of poor glycemic control or end organ damage, antenatal fetal surveillance may be considered earlier. See ACOG Practice Bulletin No. 201, *Pregestational Diabetes Mellitus,* and ACOG Practice Bulletin No. 190, *Gestational Diabetes Mellitus,* for more detailed information.

Systemic Lupus Erythematosus

The risk of stillbirth among individuals with lupus is estimated to be 40–150 per 1,000 pregnancies (13) with the higher end of the range likely contributed to by coexisting hypertensive disorders or the presence of antiphospholipid antibodies (57, 58). For individuals with uncomplicated systemic lupus erythematosus (eg, stable or low-activity disease and no internal organ dysfunction), weekly antenatal fetal surveillance may be considered by 32 0/7 weeks of gestation. For pregnant patients with complicated systemic lupus erythematosus (eg, active lupus nephritis, recent lupus flare, antiphospholipid antibodies with previous fetal loss, anti-Ro/SSA or anti-La/SSB antibodies, or thrombosis), the gestational age at initiation of and frequency of antenatal fetal surveillance should be individualized in consultation with maternal–fetal medicine specialists and may be considered upon diagnosis or at a gestational age when delivery would be considered because of abnormal test results (13, 59).

Antiphospholipid Syndrome

The risk of stillbirth in individuals with antiphospholipid syndrome diagnosed by established criteria (60) is related to the number of positive antibodies, with rates of 217 per 1,000 pregnancies with a single antibody positive result compared with 364 per 1,000 pregnancies with multiple antibody positive results (aOR 2.67; 95% CI, 1.22–2.94) (61). Such risk is independent of treatment with low-dose aspirin and low-molecular-weight heparin. (61). Antenatal fetal surveillance should be individualized and may be performed twice weekly starting by 32 0/7 weeks taking into consideration obstetric history, number of positive antibodies, and current pregnancy complications.

Other Autoimmune Disorders and Mixed Connective Tissue Disorders

For individuals with rheumatoid arthritis or Sjögren syndrome without evidence of hypertension, renal disease, or other systemic involvement, there is insufficient evidence to recommend antenatal fetal surveillance. The stillbirth risk among individuals with rheumatoid arthritis or Sjögren syndrome does not appear elevated over the baseline population risk (62–64). Similarly, there is insufficient evidence to recommend antenatal fetal surveillance for individuals with undifferentiated connective tissue disease.

Sickle Cell Disease and Related Hemoglobinopathies

A recent systematic review and meta-analysis of 19 studies from nine different countries found an increased risk of stillbirth associated with maternal sickle cell disease (81 per 1,000; pooled OR, 4.05; 95% CI, 2.69–6.32; $P<.001$), which was observed both in low-income (OR, 3.59; 95% CI, 2.59–6.32; $P<.001$) and high-income countries (OR, 5.09; 95% CI, 2.38–10.90; $P<.001$) (65). A retrospective statewide cohort study of a contemporary North American cohort (66), however, found no increased rate of stillbirth in pregnancies complicated by sickle cell disease. The authors hypothesized that the low rates of stillbirth may reflect improved antenatal surveillance and management compared with previous studies. They emphasized the importance of fetal surveillance, particularly in the setting of co-existing maternal hypertension, vaso-occlusive crises, placental insufficiency, or fetal growth restriction.

Patients with hemoglobin S-C (Hb SC) disease also are at risk for fetal complications, but to a lesser degree than patients with Hb SS disease (67). The course of pregnancy in individuals with α-thalassemia trait is not significantly different from that of individuals with normal hemoglobin (68). Pregnancy in individuals with Hb H disease has been reported and outcomes have been favorable; however, the number of reports is too few to draw definite conclusion (69). No differences were noted in perinatal outcomes including perinatal mortality in pregnancies complicated by beta-thalassemia minor (70). Until recently, pregnancy in individuals with beta-thalassemia major was extremely rare. In cases in which fetal growth is suboptimal, patients should have antenatal fetal surveillance (68).

For patients with hemoglobinopathies other than Hb SS disease, the decision to perform antenatal fetal surveillance should be individualized and should take into account factors such as fetal growth and disease severity. For pregnant patients with uncomplicated sickle cell disease, once or twice weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks of gestation (66). In the setting of additional complications during the current pregnancy, such as co-existing maternal hypertension, vaso-occlusive crisis, placental insufficiency, and fetal growth restriction, antenatal fetal surveillance should be individualized and may be considered at diagnosis or at a gestational age when delivery would be considered because of abnormal test results.

Renal Disease

Risk of fetal death among individuals with chronic renal disease has been estimated to occur in 15–200 per 1,000 pregnancies (13, 71). The degree of impairment of renal function appears to be the major determinant of pregnancy outcome, with a particularly high risk seen among individuals who require dialysis for end stage renal disease (72). However, there are few data to guide

differences in testing approaches based on severity of the disease. Still, antenatal fetal surveillance should be offered given the elevation in risk of stillbirth among individuals with renal disease. Mild, moderate, and severe renal insufficiency can be defined as serum creatinine 0.9–1.4 mg/dL, greater than 1.4 but less than or equal to 2.5 mg/dL, and greater than 2.5 mg/dL, respectively (73). Individuals with mild renal disease have a lower risk of adverse pregnancy outcomes and do not appear to be at increased risk for stillbirth (74). For pregnant patients with moderate to severe renal disease (serum creatinine greater than 1.4 mg/dL), once or twice weekly antenatal fetal surveillance may be considered beginning at 32 0/7 weeks of gestation. Patients undergoing dialysis require individualized surveillance involving more intensive monitoring.

Thyroid Disorders

Early reports from small uncontrolled series of individuals with uncontrolled hyperthyroidism (n=60) or hypothyroidism (n=26) raised the concern about the associated risks of stillbirth (10% and 12%, respectively) (75, 76). In light of these as well as other small uncontrolled series, thyroid dysfunction was listed among the risk factors for stillbirth, with hyperthyroidism listed among the possible indications for antenatal fetal testing (77, 78). However, large epidemiologic studies have found similar stillbirth rates in pregnancies complicated by maternal hyperthyroidism as in the general obstetric population (79–81). Similarly, many studies have shown no increased risk of stillbirth in pregnancies complicated by maternal hypothyroidism as compared with the general obstetric population (82–84). There is insufficient evidence to recommend antenatal fetal surveillance for individuals with well controlled hyperthyroidism or hypothyroidism. Antenatal fetal surveillance should be individualized for patients with poorly controlled thyroid disease.

In Vitro Fertilization

Pregnancies achieved by in vitro fertilization have an elevated risk (twofold to threefold increase) of stillbirth even after controlling for maternal age, parity, and multifetal gestations (85–88). One meta-analysis (85) cited in the workshop on assisted reproductive technology and adverse pregnancy outcomes sponsored by the National Institute of Child Health and Human Development (89) found a stillbirth rate of 11.8 per 1,000 with an OR of 2.6 (95% CI, 1.8–3.6) in pregnancies achieved by in vitro fertilization. Using gestational age-specific Cox regression, in vitro fertilization/intracytoplasmic sperm injection is associated with an increased hazard of stillbirth from gestational week 37 0/7 (hazard ratio [HR], 2.4; 95% CI, 1.6–3.6), from gestational week 38 0/7 (HR, 2.3; 95% CI, 1.5–3.6), from gestational week 39 0/7 (HR, 2.5; 95% CI, 1.5–4.1), and from gestational week 40 0/7 (HR, 3.0; 95% CI, 1.7–5.2) compared with spontaneous pregnancies (88). For pregnancies achieved using in vitro fertilization, weekly antenatal fetal surveillance may be considered beginning by 36 0/7 weeks of gestation.

Substance Use

Tobacco

A meta-analysis of maternal smoking and risk of stillbirth found smoking 1–9 cigarettes per day to be associated with 9% increased odds of having a stillbirth compared with individuals who do not smoke in pregnancy (OR, 1.09; 95% CI, 1.09–1.24; $P=.55$), and smoking 10 or more cigarettes per day to be associated with a 52% increase in odds of stillbirth (OR, 1.52; 95% CI, 1.30–1.78; $P<.0001$) (90). Cessation of smoking between pregnancies has been shown to be protective. Specifically, individuals who smoked during a first pregnancy but not during the next did not have an increased risk of recurrent stillbirth (OR, 1.02; 95% CI, 0.79–1.30), compared with individuals who did not smoke in either pregnancy. In contrast, the stillbirth risk among individuals who smoked during serial pregnancies was increased 35% (RR, 1.35; 95% CI, 1.15–1.58) (91).

Pregnancy risks specifically attributable to e-cigarette use in pregnancy are not available, but the amount of nicotine consumed through both vaping and smoking seem at least comparable (92). Exposure to second-hand smoke also increases risk. Individuals with exposure to second-hand smoke were also at higher risk of stillbirth than never-smokers with lower or no second-hand exposure and had comparable risks to some active smokers (93). For pregnant patients who smoke cigarettes and e-cigarettes, there is insufficient evidence to recommend routine antenatal fetal surveillance.

Alcohol

A prospective study in Denmark of individuals who consumed alcohol during pregnancy estimated a stillbirth risk of 12.37 per 1,000 pregnancies, but only among those individuals who consumed five or more drinks per week (94). This study found that the risk ratio for stillbirth at or beyond 28 weeks of gestation among individuals who consumed five or more drinks per week during pregnancy was 2.96 (95% CI, 1.37–6.41) compared with individuals who consumed fewer than one drink per week even after adjustment for other risk factors. Multivariate logistic regression analysis, which included maternal smoking habits, caffeine intake, age, prepregnancy body mass index, marital status, occupational status, education, parity, and sex of the child, yielded comparable results. Stratification by birth weight and preterm delivery (dichotomized) did not change the conclusions, nor did inclusion of these variables in the regression model (the odds ratio for individuals who consumed five or more drinks per week was 2.69 [95% CI, 1.14–6.31]). For pregnant individuals who consume five or more alcoholic drinks per week, weekly antenatal fetal surveillance may be considered beginning at 36 0/7 weeks of gestation.

Other Substance Use

Individuals with stillbirth are twice as likely as those with live birth to report addiction to an illicit drug (OR, 2.30; 95% CI, 1.37–3.86) (95). When toxicology testing for morphine, hydromorphone, codeine, hydrocodone, pethidine/meperidine, tetrahydrocannabinolic acid, cocaine, and amphetamines/methamphetamines was performed on umbilical cord homogenates, a positive test for any drug was associated with an OR for stillbirth of 1.94 (95% CI, 1.16–3.27) (95). Tetrahydrocannabinolic acid was the most common individual drug found in 3.9% of stillbirths and 1.7% of controls (OR for stillbirth, 2.34; 95% CI, 1.13–4.81); however, the effect was partially confounded by tobacco smoking.

A multiyear population-based study found an increasing prevalence of opioid use among pregnant individuals in the United States, although the study was not specific as to type or indication for opioid use (96). Even after adjusting for sociodemographic, behavioral, and chronic prepregnancy conditions, opioid use was associated with a modest, increased odds of stillbirth (OR, 1.3; 95% CI, 1.2–1.5). Another study using the U.S. Nationwide Inpatient Sample and using discharge codes specific for opioid use disorder or dependence found a similar temporal trend in opioid use disorder among pregnant individuals, an elevated risk of stillbirth (aOR, 1.5; 95% CI, 1.3–1.8) compared with individuals without drug dependence, but no difference in stillbirth risk when compared with individuals who used other drugs (97).

An association has been identified between benzodiazepine use and preterm delivery and low birth weight (98), but no data are available that suggests an increased risk of stillbirth. Although cocaine and methamphetamine use are associated with an increased risk of stillbirth, much of this risk may be attributable to increased risk of acute placental abruption (99, 100), which is unlikely to be predicted by antenatal fetal surveillance. Absolute risks of stillbirth among cocaine users are not reliably reported in the literature.

For pregnant individuals who use marijuana, opioids, benzodiazepines, cocaine, or methamphetamines, there is insufficient evidence to recommend routine antenatal fetal surveillance. It is unclear whether there is increased risk of stillbirth with polysubstance use. In these cases, it may be appropriate to consider antenatal fetal surveillance on an individual basis, or based on perinatal morbidities (such as fetal growth restriction) that may coexist with substance use.

Additional Considerations

There are additional considerations when assessing the need for antenatal fetal surveillance. Rates of stillbirth are higher in pregnant people with increasing maternal age and with a higher prepregnancy body mass index (BMI).

Prepregnancy BMI

The risk of stillbirth rises with increasing obesity; after controlling for characteristics including maternal age, nulliparity, and comorbid conditions, the hazard ratio for stillbirth is 1.71 for prepregnancy BMI 30.0–34.9 kg/m^2; 2.00 for BMI 35.0–39.9 kg/m^2; 2.48 for BMI greater than 40; and 3.16 for individuals with BMI equal to or greater than 50 kg/m^2 compared with individuals with BMI less than 30 (101). Interpregnancy BMI increases show a linear association with risk of stillbirth, which rises significantly as the category of weight gain increases (102). An interaction also has been shown to exist between obesity and gestational age: for example, individuals with BMI equal to or greater than 30 kg/m^2 have an adjusted hazard ratio of 3.5 (95% CI, 1.9–6.4) at 37–40 weeks and 4.6 (95% CI, 1.6–13.4) at greater than 40 weeks compared with individuals of normal weight (BMI 18.5–25 kg/m^2) (103). For patients with prepregnancy BMI of 35.0–39.9 kg/m^2, weekly antenatal fetal surveillance may be considered beginning by 37 0/7 weeks of gestation. For patients with prepregnancy BMI equal to or greater than 40 kg/m^2, weekly antenatal fetal surveillance may be considered beginning at 34 0/7 weeks of gestation.

Maternal Age

As with increasing BMI, several studies suggest a progressively increased RR of stillbirth with advancing maternal age; primiparous individuals have a higher risk of stillbirth than multiparous individuals for all maternal age groups, and the risk may increase further with advancing gestational age (9, 104, 105). Individuals 35–39 years old and without medical conditions have a 1.28-fold increased RR (95% CI, 1.17–1.41) of stillbirth at term (37–41 weeks) compared with individuals younger than 35 years. Individuals without medical conditions who are age 40 and older have a 1.79-fold increased RR (95% CI, 1.52–2.10) of stillbirth at term (37–41 weeks) compared with individuals younger than 35 years (105).

Although maternal age is important to acknowledge, it is still—when presented in isolation—a relatively weak risk factor for the actual prediction of stillbirth. Because of the prevalence of pregnancy among individuals 35 years and older in the general population, there also is concern that any recommendation to implement screening based on maternal age alone could create multiple burdens for patients and clinicians and potentially widen disparities in care, particularly if not thoughtfully applied. However, maternal age may lead to a higher cumulative risk when it is present with other factors. In the absence of other risks factors for stillbirth, there is insufficient evidence to recommend routine antenatal fetal surveillance for the isolated indication of maternal age of 35 years or older.

Obstetric Conditions

Previous Stillbirth

Compared with individuals without a history of stillbirth, those with a previous stillborn infant are 4.83 times (95% CI, 3.77–6.18) more likely to have a subsequent stillbirth (106). The risk of recurrent stillbirth may be increased as high as 10-fold depending on maternal race and characteristics of the previous stillbirth, such as etiology, gestational age, and presence of fetal growth restriction (107). Using maternal linked cohort data, stillbirth occurred in 22.7 per 1,000 individuals with a stillbirth in the preceding pregnancy compared with 4.7 per 1,000 for those without such a history (108). The etiology of a previous stillbirth affects the ability of antenatal fetal surveillance to prevent recurrences. However, for many cases of stillbirth, the etiology is unknown (109). For stillbirths associated with specific conditions, such as hypertension or diabetes, antenatal fetal surveillance should be part of the recommended management guidelines for such conditions. For patients with a previous stillbirth at or after 32 0/7 weeks, once or twice weekly antenatal fetal surveillance is recommended at 32 0/7 weeks (1) or starting at 1–2 weeks before the gestational age of the previous stillbirth. For previous stillbirth that occurred before 32 0/7 weeks of gestation, individualized timing of antenatal fetal surveillance may be considered.

History of Other Adverse Pregnancy Outcomes in Immediately Preceding Pregnancy

History of Preeclampsia

A history of adverse obstetric outcomes other than stillbirth, such as preeclampsia and growth restriction, is associated with an increased risk of stillbirth in the next pregnancy (110, 111). The risk of stillbirth is inversely related to the gestational age at delivery in the previous pregnancy with the adverse obstetric outcome. In a large nationwide study (110), the odds ratio for stillbirth in a second pregnancy was 2.3 (95% CI, 1.5–3.6; rate: 11 per 1,000) if the first pregnancy was complicated by preeclampsia with delivery at 32–36 weeks; 3.8 (95% CI, 1.8–7.8; rate: 18 per 1,000) if the preeclampsia occurred with delivery at 28–32 weeks; and 5.6 (95% CI, 1.3–23.2; rate: 23 per 1,000) if preeclampsia occurred with delivery at 20–27 weeks. The authors did not control for fetal growth restriction because this may be a secondary event that is the result of the preeclampsia and, thus, a marker of disease severity (110). Other investigators have reported a greater than doubling in risk of stillbirth in the pregnancy after one with preterm preeclampsia, even without recurrent preeclampsia (111).

History of Small for Gestational Age Neonate

Similarly, a history of an otherwise nonanomalous neonate who was small for gestational age (defined as birth weight 2 standard deviations or more below the mean for gestational age) in the first pregnancy is associated with increased risk of stillbirth in the subsequent pregnancy after adjusting for covariables associated with risk of stillbirth (112). The risk is inversely related to the gestational age at the first small-for-gestational-age birth: aOR was 2.1 (95% CI, 1.6–2.8) for term deliveries; 3.4 (95% CI, 2.1–5.6) for gestational ages between 32 and 36 weeks; and 5.0 (95% CI, 2.5–9.8) for gestational ages less than 32 weeks (112). The corresponding rates were 4.8 per 1,000, 9.5 per 1,000, and 19 per 1,000, respectively. Similar findings were reported by other investigators (113), with severity of growth restriction in the antecedent pregnancy related to risk of stillbirth in the second pregnancy (110). The increased risk of stillbirth persists even if the second pregnancy is the appropriate size for gestational age (112).

It would seem prudent to institute antenatal fetal surveillance in a pregnancy after one complicated by fetal growth restriction or preeclampsia that required preterm delivery, even in the absence of growth abnormalities or preeclampsia in a subsequent pregnancy. Previous adverse pregnancy outcomes are primarily associated with an increased risk in preterm stillbirth in a subsequent pregnancy (112). Therefore, for patients with a history of fetal growth restriction or preeclampsia requiring preterm delivery, even in the absence of growth abnormalities, antenatal fetal surveillance may be considered at 32 0/7 weeks and can be individualized and considered at an earlier gestational age.

Intrahepatic Cholestasis of Pregnancy

Protocols for intrahepatic cholestasis of pregnancy include antenatal fetal surveillance, although this is based on expert opinion alone because this testing has not been shown to reduce the risk of fetal demise. The risk of stillbirth associated with intrahepatic cholestasis of pregnancy has been estimated at 12–30 deaths per 1,000 births (13), although most studies in the published literature do not include sufficient numbers of individuals to be able to estimate a rate with adequate confidence. There appears to be a positive correlation between maternal levels of bile acids and the risk of stillbirth, particularly with total bile acid levels greater than 40 mmol/L (114, 115) or, in more recent studies, greater than 100 mmol/L (116, 117). For singleton pregnancies with intrahepatic cholestasis, the prevalence of stillbirth was 1.3 per 1,000 births with total bile acids less than 40 micromole/L; 2.8 per 1,000 births with total bile acids of 40–99 micromole/L; and 34.4 per 1,000 births with total bile acids of 100 micromole/L or greater (117). The mechanism of fetal death in individuals with intrahepatic cholestasis of pregnancy has been hypothesized in some cases to be related to sudden fetal cardiac arrhythmia, a phenomenon that would not be expected to be predicted by traditional methods of antenatal fetal surveillance and, indeed, there are reports of stillbirths quite proximal to a normal test result. A prospective study (118) found that active management including twice weekly fetal

monitoring starting at diagnosis of cholestasis or viability (if cholestasis was diagnosed before viability) significantly reduced the risk of stillbirth (0 per 218 versus 14 per 888; $P=.045$). For individuals with intrahepatic cholestasis of pregnancy, once or twice weekly antenatal fetal surveillance may be considered beginning at diagnosis or at the gestational age when delivery would be considered because of abnormal test results (119).

Late-Term and Postterm Pregnancy

Prolonged pregnancy poses a number of risks to the fetus and neonate, including stillbirth. The risk of stillbirth at term increases with gestational age from 0.11 per 1,000 ongoing pregnancies at 37 weeks (95% CI, 0.07–0.15) to 1.78 per 1,000 ongoing pregnancies at 41 weeks (95% CI, 1.52–2.07) and to 3.18 per 1,000 ongoing pregnancies at 42 weeks (95% CI, 1.84–4.35) (120). There is no agreement as to the gestational age at which fetal monitoring should start. Because the rate of fetal, maternal, and neonatal complications is significantly increased beyond 41 weeks, both the American College of Obstetricians and Gynecologists and the World Association of Perinatal Medicine suggest that beginning evaluation at that time may be considered, if the individual remains undelivered (121–123). For otherwise uncomplicated pregnancies, antenatal fetal surveillance is recommended beginning at 41 0/7 weeks of gestation and continued once or twice weekly until 42 0/7 weeks when delivery is indicated, but delivery may also be considered between 39 0/7 and 42 0/7 weeks (122–124).

Abnormal Serum Markers

Pregnancies complicated by first trimester pregnancy-associated plasma protein A (PAPP-A) levels less than or equal to the fifth percentile (0.415 multiples of the median [MoM]) have a 2.15-fold (125) to 9.2-fold (126) increased risk of stillbirth at greater than 24 weeks, with rates of 5.8–20 per 1,000, respectively (125–128). The lower the PAPP-A level, the higher the risk of stillbirth that has been associated with it (125, 127, 128); however, it is unclear if this risk persists in the absence of fetal growth restriction.

Abnormal second trimester analytes also have been associated with increased risk of stillbirth. Unexplained elevated maternal serum alpha-fetoprotein (MSAFP) is associated with increased risk of stillbirth with RR estimates ranging from 3.4 to 21.9 (128–131). The rate of stillbirth is 6.7 per 1,000 for MSAFP equal to or greater than 2.0 MoM (130) and 30 per 1,000 for MSAFP greater than 2.5 MoM (131). Although the relative risk of stillbirth is highest when MSAFP is greater than or equal to 2.5 MoM, one study found that the RR is markedly reduced after adjustment for LBW and the associations first observed were no longer statistically significant (132).

Inhibin A greater than 2.0 MoM also is associated with increased risk of late fetal death (128, 130), with rates of 9.4 per 1,000 and aOR of 2.41. The increased risk of stillbirth after 24 weeks persisted when preeclamptic and low birth weight participants were excluded (130). The association with stillbirth strengthens if elevated inhibin A is associated with other abnormal marker levels (ie, high alpha fetoprotein, high hCG, or both) (128, 130).

If serum screening for aneuploidy is performed, the results may be considered in determining whether serial growth assessments and antenatal fetal surveillance should be performed. For patients with first trimester pregnancy-associated PAPP-A levels less than or equal to the fifth percentile (0.4 MoM) or second trimester inhibin A equal or greater than 2.0 MoM, weekly antenatal fetal surveillance may be considered beginning at 36 0/7 weeks of gestation despite evidence of normal fetal growth. There is insufficient evidence to recommend antenatal fetal surveillance for patients with second trimester MSAFP equal to or greater than 2.0 MoM in the absence of fetal growth restriction.

Placental, Umbilical Cord, and Amniotic Fluid Conditions

Chronic Placental Abruption

Placental abruption has a high-positive association with stillbirth, with estimated risks as high as 4–7% in one population-based study (133), and aOR as high as 8.7 in another (134). For patients with chronic placental abruption who are candidates for outpatient management, once or twice weekly antenatal fetal surveillance may be considered upon diagnosis. For patients diagnosed with chronic placental abruption at an early gestational age, shared decision making between the pregnant individual and the clinician is particularly important.

Vasa Previa

Among individuals with vasa previa, stillbirth may result from rupture of submembranous fetal vessels that course across the cervical os (109). Perinatal outcomes improve significantly when prenatal diagnosis allows for management that includes cesarean delivery before the onset of labor (135, 136). Although close inpatient surveillance before delivery at 34 0/7–37 0/7 weeks may be an appropriate management strategy, outpatient fetal surveillance management should be individualized for patients with vasa previa (137).

Abnormalities of the Placenta or Cord

It has been speculated that almost 25% of stillbirths, in a large U.S. cohort, are potentially preventable, and the majority of them (57%) are due to placental abnormalities or insufficiency, with most such deaths occurring after 37 weeks (138). Abnormalities of placental shape, single umbilical artery, and abnormalities of umbilical cord insertion (eg, velamentous cord insertion) are thought to reflect abnormal placental implantation. Not surprisingly, the abnormalities have been associated with

increased risk of stillbirth, but whether the increased risk of stillbirth is independent of fetal growth restriction is unknown (139–141). Examination of the placenta, cord, and membranes is listed among the most important tests in the evaluation of a stillbirth (142). In the population-based case-control study of stillbirth conducted by the National Institute of Child Health and Human Development Stillbirth Collaborative Research Network, the odds ratios for stillbirth were 4.80 (95% CI, 2.67–8.62) for single umbilical artery and 4.50 (95% CI, 2.18–9.27) for velamentous cord insertion (139). In a recent meta-analysis, the stillbirth rate was 34 per 1,000 in the velamentous cord insertion group (aOR 3.96; 95% CI, 3.21–4.89) (143). A stillbirth rate of 12 per 1,000 recently has been reported in a cohort of isolated, single umbilical artery cases (144). In light of these findings, ACOG as well as others (145) advocate for serial antenatal fetal surveillance in the case of velamentous cord insertion or single umbilical artery. For patients with velamentous cord insertion or single umbilical artery, weekly antenatal fetal surveillance may be considered beginning at 36 0/7 weeks of gestation.

Isolated Oligohydramnios

The stillbirth rate in pregnancies complicated by oligohydramnios, defined as a single deepest vertical pocket less than 2 cm, is estimated at 14 per 1,000 (13). Oligohydramnios can be isolated or associated with maternal or fetal conditions. The perinatal outcomes of oligohydramnios associated with other conditions is related to the underlying condition, but the natural history of isolated oligohydramnios is unclear. Isolated oligohydramnios is more frequent at term; this is commonly considered evidence of placental insufficiency and a potentially preventable cause of stillbirth with adequate surveillance (138). For patients with isolated oligohydramnios (single deepest vertical pocket less than 2 cm) who are not being delivered (20), once or twice weekly antenatal fetal surveillance may be considered upon diagnosis.

Polyhydramnios

The degree of polyhydramnios is frequently categorized as mild, moderate, or severe, based on a deepest vertical pocket of 8–11 cm, 12–15 cm, or 16 cm or greater, or an amniotic fluid index of 24.0–29.9 cm, 30.0–34.9 cm, and 35 cm or greater, respectively (146). The increased risk of fetal mortality associated with polyhydramnios has been attributed to higher incidence of fetal anomalies (147). However, a retrospective cohort study of nonanomalous births (148) found that the risk of stillbirth in pregnancies complicated by polyhydramnios is 1.14 per 1,000 at 32 weeks, 1.34 per 1,000 at 34 weeks, 1.64 per 1,000 at 36 weeks, and 2.91 per 1,000 at 39 weeks. When adjusted for multiple confounding variables, polyhydramnios remained associated with increased odds of stillbirth (aOR 5.5; 95% CI, 4.1–7.6). The significance persisted after excluding pregnancies with pregestational or gestational diabetes mellitus. The authors concluded that polyhydramnios may warrant increased antenatal surveillance, particularly in the last weeks of pregnancy. For patients with moderate or severe polyhydramnios (deepest vertical pocket equal to or greater than 12 cm or amniotic fluid index equal to or greater than 30 cm), once or twice weekly antenatal fetal surveillance may be considered beginning at 32 0/7 to 34 0/7 weeks of gestation (146, 149, 150). Absent other indications, antenatal fetal surveillance is not required for mild idiopathic polyhydramnios (146).

Additional Health Equity Considerations

Although race is not a biologic risk factor for stillbirth, it is likely a proxy for the negative influence of racism on health. Rates of stillbirth are higher in pregnant people who self-identify as Black (10,151). For example, non-Hispanic Black individuals have an unadjusted stillbirth rate that is more than twice the rate of other racial groups (for every 1,000 live births, there are 10.53 stillbirths among non-Hispanic Black individuals versus 4.88 stillbirths among non-Hispanic white individuals) (152). Other investigators (9) have found higher rates of stillbirth, independent of comorbidities, in self-identified Black individuals. Race is a social rather than a biological construct and the effects of racism (structural, institutionalized, and interpersonal) and biases (implicit and explicit) are implicated in many health inequities; these are more likely than race to be related to elevated risk (153–155).

Given the current limited data on the influence of racism on inequitable rates of stillbirth, further insight into the individual effects of racism, race, and clinical comorbidities, as well as the collective effect of these factors are needed. Furthermore, there is a critical need for the health care system to address the upstream and root causes of adverse outcomes associated with racism. Until further data are available on the effects of specific factors resulting from racism, recommendations regarding fetal surveillance cannot reliably be made. The American College of Obstetricians and Gynecologists and the Society for Maternal-Fetal Medicine call on obstetrician–gynecologists and other health care clinicians to help address racism by examining their own prejudices and biases; engaging with diverse groups of advocates; and addressing the ways in which the structure of health care systems, systems processes, and personnel (including physicians and staff) can perpetuate health inequities in communities of color (156–158).

Future Research

There is a paucity of evidence to support the efficacy of antenatal fetal surveillance in preventing stillbirth and to inform evidence-based recommendations on the timing and frequency of such surveillance. This is in part because stillbirth is rare and occurs in association with

a variety of etiologies and risk factors. To adequately demonstrate the benefit of antenatal fetal surveillance in preventing stillbirth would require randomizing tens of thousands of pregnant individuals. Despite these challenges, research is needed to ideally identify individualized risks of stillbirth, taking into account the multiple and independent patient-level risk factors, including the effect of racism, and to develop evidence-based recommendations regarding initiation and frequency of testing. Additionally, research is needed to address the potential for false-positive tests and resultant unnecessary interventions. Furthermore, a better understanding of specific causes of stillbirth, such as underlying placental dysfunction, and better surveillance methodology to detect suspected dysfunction may lead to improved ability to screen for and prevent stillbirth and to identify more specific indications for fetal testing.

Conclusions

The low prevalence of stillbirths in all high-risk conditions and the high rates of false-positive results translate into extremely low positive predictive values for abnormal findings at antenatal fetal surveillance. Clearly, antenatal fetal surveillance started at or near term would minimize the risks of prematurity related to false-positive test results. Antenatal fetal surveillance started at 32 weeks or earlier should be reserved for conditions with a documented high risk of preterm stillbirth and suggestion of benefit from antenatal fetal surveillance. Shared decision making should be employed with the pregnant individual. Moreover, individualization of clinical management is warranted, incorporating the totality of fetal risks, the presence and severity of maternal comorbidities, and practice setting. There is no evidence for the frequency of antenatal fetal surveillance required to reduce the risk of stillbirth for any high-risk condition. Despite this, antenatal fetal surveillance may be considered for all pregnancies complicated by conditions associated with increased risk for stillbirth and in which antenatal fetal surveillance may decrease the risk. However, it is important to emphasize that the guidance offered in this Committee Opinion should be construed only as suggestions; this guidance should not be construed as mandates or as all encompassing. Ultimately, individualization about if and when to offer antenatal fetal surveillance is advised. Further research is needed to better distinguish indications, and optimal frequency and types of antenatal fetal testing.

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