Uterine contractions during labor result in a decrease in perfusion at the level of the intervillous space, making labor a period of oxidative stress for the fetus. This stress does not pose a challenge for most healthy term fetuses for a variety of reasons, including the increased affinity for oxygen in fetal hemoglobin, the vascular shunts in fetal circulation, fetal cardiac output, and high glycogen store in fetal myocardium [1]. However, even in healthy term fetuses, excessive uterine activity can have an adverse effect on fetal oxygenation and acid–base status [2–8], making the understanding and assessment of uterine activity during labor a crucial patient safety issue. Prompt response and intervention for excessive uterine activity and physiologic support of normal uterine activity in the different phases and stages of labor must be common skills for nurses, physicians, and midwives. The primary focus of this chapter is the evaluation of uterine activity in labor, including defining clinical parameters for both normal and excessive uterine activity. Additionally, a brief review of current parameters for the diagnosis and management of abnormal labor patterns are reviewed, along with specific issues regarding the use of oxytocin for both induction and augmentation of labor.

ASSESSMENT METHODS: PALPATION AND ELECTRONIC MONITORING

Uterine activity may be assessed by manual palpation or by electronic monitoring with an external tocotransducer, an abdominal “patch” using electromyogram (EMG), or an internal intrauterine pressure catheter (IUPC). A complete assessment of uterine activity includes the identification of contraction frequency, duration, strength or intensity, and resting tone. The relative sensitivities of various methods of contraction monitoring are illustrated in Fig. 4.1.
Manual Palpation

Manual palpation is the traditional method of monitoring contractions. This method can measure contraction frequency, duration, and relative strength. Palpation is a learned skill that is best performed with the fingertips to feel the uterus rise upward as the contraction develops. Mild, moderate, and strong are the terms used to describe the strength of uterine contractions as determined by the examiner’s hands during palpation and based on the degree of indentation of the abdomen [9,10]. For learning and for the purpose of comparison, the degree of indentation corresponds to the palpation sensation when feeling the parts of the adult face, as described in the following chart:

**Fig. 4.1** Comparison of relative sensitivities of assessing uterine contractions by internal monitoring (intrauterine pressure catheter), manual palpation, and patient perception. The tocodynamometer and abdominal electromyogram methods are not included as they are variable in sensitivity. (Reprinted from Fetal Heart Rate Monitoring by R.K Freeman, T.J Garite, M.P. Nageotte, and L.A. Miller, 2012, Lippincott Williams & Wilkins, Philadelphia, p.79.)
Palpation of uterine activity is an important clinical skill that is used concomitantly with all modes of contraction monitoring. When using the tocodynamometer (Toco) or abdominal EMG, palpation is the only method to gauge the strength of contractions. When an IUPC is in use, manual palpation is used to confirm the findings both at the time of initial insertion and on an ongoing basis throughout labor.

### Electronic Monitoring of Uterine Activity

*External uterine activity monitoring* is typically achieved using a tocotransducer (to provide information about uterine contraction frequency and duration) combined with manual palpation (to evaluate relative strength). Abdominal fetal electrocardiogram (FECG) and EMG are other methods of external electronic fetal monitoring. Both methods provide continuous data and a permanent record of uterine activity. The electronic display of a contraction, when using a tocodynamometer, depends on the depression of a pressure-sensing device placed on the maternal abdomen. Issues such as placement of the transducer, belt tightness, and maternal adipose tissue result in variations of depression and will affect the graphic representation on the fetal heart rate (FHR) tracing (Fig. 4.2). These factors may result in contractions appearing stronger (or less strong) than they truly are, making it imperative to assess strength of the uterine contraction by manual palpation when uterine activity is externally monitored.

*Internal uterine activity monitoring* uses an IUPC that measures actual intrauterine pressure in millimeters of mercury during both contractile and acontractile (resting) periods. As demonstrated in Fig. 4.1, the IUPC allows clinicians to evaluate the frequency, duration, and strength of contractions in millimeters of mercury with improved accuracy. The following chart contrasts the data obtained with these external versus internal modes of monitoring:

<table>
<thead>
<tr>
<th>Contraction Strength</th>
<th>Palpation Sensation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>Tense fundus but easy to indent (feels like touching finger to tip of nose)</td>
</tr>
<tr>
<td>Moderate</td>
<td>Firm fundus, difficult to indent with fingertips (feels like touching finger to chin)</td>
</tr>
<tr>
<td>Strong</td>
<td>Rigid, board-like fundus, almost impossible to indent (feels like touching finger to forehead)</td>
</tr>
</tbody>
</table>
Fig. 4.2 Adjustment of tocotransducer (arrow) to correct displacement after maternal position change. Note the tocotransducer picking up maternal breathing movements on the lower uterine activity panel as evidenced by jagged lines (highlighted). BPM, beats per minute; FHR, fetal heart rate, UA, uterine activity. (Courtesy Lisa A. Miller, CNM, JD.)

**External Mode: Tocotransducer or Abdominal EMG**

<table>
<thead>
<tr>
<th>Frequency of Contractions</th>
<th>Measured from the onset of one contraction to the onset of the next contraction.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of Contractions</strong></td>
<td>Measured from contraction onset to offset.</td>
</tr>
<tr>
<td><strong>Strength/Intensity of Contractions</strong></td>
<td>The abdomen must be palpated to assess the strength of the contraction based on the degree of indentation of the fundus. The more difficult it is to indent the fundus during palpation, the stronger the contraction. Strength of contractions using a toco is usually documented as mild, moderate, or strong to palpation. The tracing produced using external methods will reflect contraction strength relative to other contractions, i.e., stronger contractions will generally produce higher waveforms.</td>
</tr>
</tbody>
</table>

**Internal Mode: IUPC**

<table>
<thead>
<tr>
<th>Frequency of Contractions</th>
<th>Measured from the onset of one contraction to the onset of the next contraction.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of Contractions</strong></td>
<td>Measured from contraction onset to offset.</td>
</tr>
<tr>
<td><strong>Strength/Intensity of Contractions</strong></td>
<td>Intrauterine pressure is measured directly and recorded on the tracing in millimeters of mercury. Strength is usually documented as the numerical value at the peak of the contraction, e.g., 50 mm Hg, 70 mm Hg, etc. Intensity of contractions is technically a term used to identify the peak of the contraction less the resting tone, expressed in millimeters of mercury. In clinical practice, the terms strength and intensity are often used interchangeably; it is important that whichever term is used, it is defined and used consistently.</td>
</tr>
</tbody>
</table>
Resting Tone
The abdomen must be palpated to assess resting tone based on whether the fundus palpates as soft or firm (rigid). During periods of palpated resting tone, the external monitor is generally set/reset to a level of 10 on the uterine activity portion of the fetal monitoring tracing. Resting tone is measured directly and reflected on the tracing based on the intrauterine pressure in millimeters of mercury. Resting tone is recorded as the numerical value when the uterus is completely relaxed (acontractile), e.g., 10 mm Hg, 15 mm Hg, etc.

Electronic Display of Uterine Activity
Uterine activity is monitored and recorded on the lower section of the monitor strip (Fig. 4.3). The range of the scale is from 0 to 100 mm Hg. There are five major vertical divisions of 20 mm Hg each, divided again into minor vertical representations of 10 mm Hg each. Some tracing paper manufactured in North America has four major vertical sections of 25 mm Hg each, with the smaller divisions representing 5 mm Hg of pressure in the uterine activity section. For further information on instrumentation, please refer to Chapter 3.

PARAMETERS FOR NORMAL LABOR
The assessment of normal labor progress has changed, and updated labor curves and consensus guidelines are having an effect on labor support and management [9–13]. Research indicates that current labor patterns are different from those reported by Friedman in the 1950s [14,15]. This has led to the development of partograms (labor progress graphs) that reveal significantly slower curves, and a later onset of active labor, with a median closer to 6 cm of dilation [12,13] (Fig. 4.4). Regardless of these updated parameters, basic definitions for the stages of labor are unchanged. The first stage of labor begins with the onset of contractions and ends with complete dilation of the cervix. It is divided into two phases: latent and active. During the latent phase, irregular and infrequent uterine contractions are associated with gradual cervical softening, dilation, and effacement (thinning). During the active phase of labor, the rate of cervical dilation increases and the fetal presenting part descends. The second stage of labor begins with complete dilation of the cervix and ends with
Fig. 4.3 Frequency of uterine contractions can be measured from the onset of one uterine contraction to the onset of the next. (Courtesy Lisa A. Miller, CNM, JD.)
delivery of the fetus. Although some clinicians may continue to differentiate the second stage into two phases, a passive phase of rest and an active phase of maternal pushing efforts, current research (including a meta-analysis) regarding delayed pushing indicates it has significant disadvantages, including increases in maternal blood loss, chorioamnionitis, and decreased umbilical cord pH [16–18]. Although the practice of delayed pushing may be acceptable in certain select situations, its routine use is no longer recommended. A detailed review of labor management is outside the scope of this textbook, but a discussion of the evaluation of uterine activity and labor abnormalities and oxytocin use is warranted.

**DEFINING ADEQUATE UTERINE ACTIVITY**

Uterine contractions during labor result in the progressive dilation and effacement of the cervix and descent of the fetal presenting part, culminating in spontaneous vaginal delivery. Much of the data defining the “normal” range of uterine activity was derived from the research of Caldeyro-Barcia and colleagues in the late 1950s and 1960s [19–23]. Using intraamniotic pressure catheters,
Caldeyro-Barcia and Poseiro [20] evaluated uterine activity and coined the term Montevideo units (MVUs) as a method of measuring uterine activity. The original formula was calculated by multiplying the average intensity in millimeters of mercury (peak of contraction less resting tone) times the frequency of uterine contractions in a 10-minute period. Thus, if there are four contractions in 10 minutes with an average intensity of 40 mm Hg, the MVUs for that period would be $4 \times 40$, or 160 MVUs. Over time, it became obvious that the simple addition of the individual contraction intensities over 10 minutes resulted in essentially similar numbers to the multiplication method; since then the addition method has become common practice [9].

Early research showed that spontaneous labor began clinically when MVUs rose to between 80 and 120, with contraction strength needing to reach at least 40 mm Hg [20,21]. This would equate to two to three contractions with intensities of 40 mm Hg or more every 10 minutes for the initiation of labor. In normal labor, contractions increase in intensity and frequency as labor progresses through the first stage and into the second stage. Caldeyro-Barcia and colleagues [20–22] found that uterine activity in the first stage of normal labors generally ranged between 100 and 250 MVUs, with contractions increasing in intensity from 25 to 50 mm Hg and in frequency from three to five over 10 minutes. In the second stage, MVUs can rise to 300 to 400 [3,19–23] as contraction intensities may increase to 80 mm Hg or more and five or six contractions may be seen every 10 minutes.

Baseline uterine tone, also known as resting tone, averages 10 mm Hg during labor, rising from 8 to 12 mm Hg from the beginning of the first stage to the onset of the second stage. Resting tone is assessed during the time between contractions, known as relaxation time. Relaxation times are generally longer (60 seconds or more) in first-stage labor and tend to shorten (45–60 seconds) during the second stage. Contraction duration of 60 to 80 seconds remains relatively stable from active phase labor through the second stage [24]. These findings provide a basis for logical definitions of “adequate” uterine activity when using internal pressure catheters for assessment of uterine contractions.

Caldeyro-Barcia and Poseiro also provided crucial information related to contraction assessment when using palpation, or palpation and a tocotransducer. They found that until the intensity (peak less baseline tonus) reaches 40 mm Hg, the wall of the uterus is easily indented by palpation [21]. This correlates well with the premise that uterine contractions that palpate as moderate or stronger are likely to have peaks of 50 mm Hg or greater if they are measured by internal means, whereas palpated contractions identified as mild are likely
to have peaks of less than 50 mm Hg if measured internally. These findings offer guidance for clinicians in identifying reasonable definitions of “adequate” uterine activity when using palpation (with or without a tocotransducer) for assessment of uterine contractions.

Box 4.1 provides a summary of normal parameters of uterine activity in labor, and Fig. 4.5 illustrates a variety of common uterine contraction patterns in normal labor.

In summary, applying what is known about parameters of uterine activity during normal labor:

1. Allows clinicians to promote and support adequate and effective uterine activity during the different phases and stages of labor, influencing management decisions when abnormal labor progress or dystocia is diagnosed;
2. Forms a basis for the safe and proper use of labor stimulants; and
3. Provides a foundation on which to define excessive uterine activity by professional consensus.
Fig. 4.5 Examples of normal uterine activity (UA) during labor. (A) Normal contraction pattern in latent phase labor. (B) Normal contraction pattern in active phase labor; note that contractions are more frequent, but there is still adequate relaxation time.
Fig. 4.5—cont’d (C) Normal contraction pattern in second-stage labor; note maternal pushing efforts. (Courtesy Lisa A. Miller, CNM, JD.)
DEFINING EXCESSIVE UTERINE ACTIVITY

Summary terms related to uterine activity were first published in 2008, when the National Institute of Child Health and Human Development (NICHD) issued a workshop report on fetal monitoring [25]. Prior to this report, the lack of sound, standardized definitions for uterine activity hindered both effective communication and the development of consensus-based multidisciplinary guidelines. The summary terms suggested by the NICHD are for the classification of uterine activity using frequency of contractions averaged over a 30-minute period [25, 26]:

Normal: less than or equal to five contractions in 10 minutes
Tachysystole: greater than five contractions in 10 minutes

Tachysystole is to be further qualified by the presence or absence of FHR decelerations and applies to spontaneous and stimulated labors. The workshop report stressed the importance of other parameters such as duration, intensity, and relaxation time in the evaluation of uterine activity, specifically stating that “frequency alone is a partial assessment of uterine activity” [25]. The report also suggested abandonment of previously used summary terms hyperstimulation and hypercontractility. Although the NICHD workshop report is clearly important progress toward the standardization of terminology, standardized terminology alone does not provide clinicians with sufficient guidance for the safe and effective management of uterine activity in labor. Tachysystole is a fairly common event and has been linked to an increase in composite neonatal morbidity [5]. Clinicians must be familiar with the normal physiology of uterine activity (described previously) and the relationship between excessive uterine activity and fetal acid–base status.

The link between excessive uterine activity and untoward effects on FHR is well established [4, 27]. Peebles and colleagues [6] noted decreased fetal cerebral oxygen saturation with shorter contraction intervals. Bakker and colleagues [3] found that fetal acidemia (umbilical artery pH ≤7.11) of all types (respiratory, metabolic, and mixed) was more prevalent in patients with excessive uterine activity during labor, both first and second stages. Specifically, a first-stage average MVU value of 261 and relaxation time of 51 seconds was noted in the acidemic group, versus average MVU value of 236 and relaxation time of 63 seconds in the nonacidemic group. In the second stage, an average MVU value of 442 and relaxation time of 36 seconds were noted in the acidemic group versus average MVU value of 402 and relaxation time of 47 seconds in the nonacidemic group [3]. Logic
would therefore dictate that avoiding MVUs exceeding the previously discussed norm of 250 in the first stage of labor and 300 to 400 in the second stage could decrease the incidence of significant fetal acidemia at birth. Furthermore, in cases of external monitoring or any situation in which MVU evaluation is not feasible, ensuring adequate relaxation times of 60 seconds or more in the first stage and 45 seconds or more in the second stage also could prevent fetal acidemia at birth. Clinicians using frequency of contractions alone (“counting bumps”), without ensuring adequate relaxation time, may be unwittingly creating a negative effect on fetal acid–base status (Fig. 4.6).

In addition to evaluating frequency, strength, and relaxation time, it is important to understand that for the fetus to be able to maintain oxygenation, resting tone also must be normal. Hypertonus, or elevated resting tone, is most commonly defined as uterine resting tone greater than 20 to 25 mm Hg, or a uterus that does not return to soft if using palpation. The information in Box 4.2 can be used by clinicians and multidisciplinary committees to reach consensus on definitions for terms related to uterine activity and evidence-based guidelines for management of all types of excessive uterine activity. This information should serve as the starting point for the development of clear, physiologically sound, and clinically useful approaches to excessive uterine activity that include all parameters of uterine activity versus focusing on frequency (tachysystole) alone.

Some clinicians erroneously contend that the management of excessive uterine activity should be based on the presence or absence of FHR changes. This approach is directly in conflict with what limited evidence exists regarding uterine activity and fetal oxygenation. Bakker and colleagues [3] found no difference in the occurrence of late decelerations between the acidemic and nonacidemic fetuses, suggesting that the key to avoiding acidemia is not dependent on the appearance of FHR changes but on the presence of excessive uterine activity itself. Simpson and James [7] found that in the first stage of labor, even five uterine contractions in 10 minutes (“normal” uterine activity by definition) over a 30-minute period resulted in a 20% decrease in fetal oxygen saturation as measured by fetal pulse oximetry. Both of these studies make it clear that premising the management of uterine activity on frequency alone or basing the management of excessive uterine activity on FHR changes may lead to less than optimal fetal oxygenation and potentially the deterioration of fetal acid–base. Waiting to respond to excessive uterine activity until there are significant changes in FHR is not appropriate. Rather, to
Fig. 4.6 Normal frequency of uterine contractions but inadequate relaxation time between contractions for first-stage labor. Recommended relaxation time in first stage is 60 seconds; note possible fetal heart rate (FHR) decelerations. IUP, intrauterine pressure; UA, uterine activity; US, ultrasound. (Courtesy Lisa A. Miller, CNM, JD.)
BOX 4.2 Evaluation of Uterine Activity During Labor

**Preliminary Assumptions**

- Normal uterine activity in first-stage labor generally does not exceed 250 MVUs.
- Normal uterine activity in second-stage labor should not exceed 400 MVUs.
- Normal contraction duration generally ranges from 45 to 90 seconds.
- Normal contraction intensity (peak less resting tone) generally ranges from 25 to 80 mm Hg, with higher intensities common as labor progresses.
- Normal uterine resting tone ranges from 8 to 12 mm Hg and is generally not greater than 20 to 25 mm Hg.
- Fetal acid–base status can be affected by excessive uterine activity before as evidenced by fetal heart rate changes.

**Excessive Uterine Activity**

All definitions for excessive uterine activity apply to both spontaneous and/or stimulated labor; management of excessive uterine activity should be based on clinical context.

- **Tachysystole**
  Contraction frequency of greater than 5 in 10 minutes, averaged over 30 minutes; applies to spontaneous or stimulated labor.

- **Hypertonus**
  Uterine resting tone exceeding 20 to 25 mm Hg with an intrauterine pressure catheter or a uterus that does not return to soft by palpation during relaxation time.

- **Inadequate relaxation time**
  Less than 60 seconds’ uterine relaxation between contractions during the first stage of labor; less than 45 to 50 seconds’ uterine relaxation between contractions in second stage.

- **Excessive contraction duration** (also known as tetanic contractions or uterine tetany)
  A series of single contractions lasting 2 minutes or more.

Data from references 3, 4, 6, 8, 9, 19–24, and 28–32.

Prevent fetal acidemia at birth, clinicians should focus on identifying and promoting normal (adequate) uterine activity and correcting underlying causes of any type of excessive uterine activity.

**Common Underlying Causes of Excessive Uterine Activity**

- Use of pharmacologic cervical ripening agents
- Use of synthetic oxytocin for augmentation or induction (more common with high-dose, high-frequency administration protocols)
Abruptio placentae
- Uterine overdistention, whether iatrogenic from amnioinfusion or as a result of multiple gestation, hydramnios, or macrosomia

Corrective Measures to Decrease Excessive Uterine Activity

1. Change maternal position to lateral side-lying.
2. Administer a bolus of intravenous (IV) fluids and/or increase the maintenance IV rate.
3. Remove cervical ripening agents or, in the case of oxytocin usage, decrease or discontinue the infusion.
4. If excessive uterine activity related to the use of cervical ripening agents or oxytocin administration is noted in association with FHR changes indicative of interrupted oxygenation, clinicians may consider the use of a tocolytic [33].

These interventions are specific to excessive uterine activity. Note that the management of FHR patterns is addressed in detail in Chapter 6. It is imperative that clinicians respond appropriately to FHR changes regardless of the nature of uterine activity because uterine activity is only one of several causes of interrupted fetal oxygenation. However, FHR changes are not a prerequisite for clinical response to excessive uterine activity. It cannot be overemphasized: Excessive uterine activity should trigger clinician response whether or not FHR changes are observed.

CURRENT TRENDS IN LABOR SUPPORT AND MANAGEMENT

Recognizing the differences in contemporary patterns of labor progression, professional organizations are working collaboratively to enhance the clinician’s knowledge regarding normal labor and to provide new parameters for the approach to labor management, including emphasizing the importance of individualization and shared decision-making [11]. Labor abnormalities have been described historically using a variety of expressions, such as slow progress in labor, failure to progress, dystocia, dysfunctional labor, or cephalopelvic disproportion [34]. Up to 68% of unanticipated cesarean deliveries in patients with vertex presentation are reported to be caused by dystocia, and given the number of repeat cesarean deliveries that follow a primary cesarean for dystocia, the diagnosis of dystocia may account for as many as 60% of all cesarean births [34].
Because fetal monitoring includes the evaluation of the adequacy of uterine activity and the progress of labor, a brief overview of different labor abnormalities and possible management strategies is warranted. A clear understanding of labor progress can be helpful when interdisciplinary discussions arise regarding management of uterine activity, especially discussions regarding the utilization of oxytocin, the most common treatment for dystocia.

**Latent Phase Abnormalities**

Labor onset is defined as effacement and dilation of the cervix caused by regular uterine contractions. The latent phase of labor begins with the onset of labor (regular contractions, cervical change) and ends at the beginning of the active phase of first stage. Latent phase is considered prolonged if it is >20 hours in nulliparous patients and >14 hours in multiparous patients [34]. Contrary to what may be seen in clinical practice, both the American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine (SMFM) do not recommend cesarean delivery for either slow progress in latent phase or a prolonged latent phase, noting that most women will enter active phase with expectant management [11]. Research now also provides specific management strategies for management of the latent phase in nulliparous women being induced at term [35]. Considerations for the management of prolonged latent phase labor are listed next.

**Management Strategies for Latent Phase Disorders***

1. For women in spontaneous labor, avoid admission to the labor unit in early latent phase labor. Unless otherwise indicated, admit only if the cervix is >3 cm dilated or 100% effaced. Educate patients antenatally about the benefits of this approach, and provide instructions for comfort measures while laboring at home.
2. Assess the woman’s level of fatigue, and provide appropriate labor support.
3. Encourage adequate fluid intake and small, frequent meals while the mother is at home.
4. Set specific intervals to reevaluate status, even if symptoms remain unchanged.
5. Encourage ambulation to provide comfort and increase tolerance to latent phase labor.

*Adapted from references 11, and 34–38.*
6. Provide adequate time for latent phase labor to progress during induction of labor. This may mean up to 18 to 20 hours of adequate uterine activity in nulliparous women.

7. Diagnose prolonged latent phase only after the presence of adequate uterine activity for >20 hours in nulliparas and >14 hours in multiparas. Use of oxytocin and/or amniotomy should be considered as opposed to cesarean delivery.

8. For nulliparous women at term undergoing induction, do not consider cesarean delivery for failed induction until at least 15 hours after both rupture of membranes and oxytocin initiation.


**Active Phase Abnormalities**

There are three main categories of active phase labor abnormalities:

1. *Protraction disorders:* a slow rate of cervical dilation, defined as less than the fifth percentile statistically

2. *Arrest disorders:* where labor progresses normally initially in active phase, then stops, for a period of at least 2 hours

3. *Combined disorders:* where slow progress precedes arrest [34]

ACOG recommends that oxytocin augmentation be considered for these disorders [11]. Although traditionally the diagnosis of an arrest disorder required 2 hours without cervical change in the presence of a uterine contraction pattern that exceeded 200 MVUs, studies [39–41] now suggest that 4 hours of uterine activity exceeding 200 MVUs (or 6 hours if the average uterine activity pattern was <200 MVUs) will result in up to a 92% vaginal delivery rate with no increased risk to the newborn. The suggested management approaches for active phase disorders are listed next.

**Management Strategies for Active Phase Disorders**

*Adapted from references 11, 12, 27, 28, 32, 38–45, and 53.
5. Consider amniotomy if membranes are intact.
6. Limit active management of labor to nulliparous patients with singleton, cephalic presentations.
7. Require a diagnosis of active phase arrest as follows: no cervical change after at least 4 hours of adequate uterine activity or 6 hours of oxytocin administration with inadequate uterine activity.
8. Provide continuous labor support.

Second-Stage Abnormalities

Failure of the fetus to rotate and descend is called arrest of descent, and it is the labor abnormality associated with the second stage. ACOG and SMFM now state that before confirming an arrest diagnosis in the second stage, there should be at least 2 hours of active pushing in multiparous women and at least 3 hours of active pushing in the nullipara [11]. They also note that longer durations may be appropriate based on individual clinical factors. Contrary to some clinicians’ practices, these are not mandates for cesarean delivery but rather parameters for guiding assessment and intervention. Prolonged second stage should trigger clinical reevaluation of the three Ps: powers, passenger, and passage. Evaluation of adequacy of uterine contractions, fetal position, and pelvic diameters may provide direction regarding interventions to facilitate rotation and descent. Although it may be considered appropriate in certain cases, delaying active pushing once complete dilation has been reached should no longer be a routine practice because of the increased risks [16,17].

Uterine Activity and Oxytocin Use

Disagreements related to oxytocin management are a frequent source of conflict between nurses, midwives, and physicians, and allegations regarding oxytocin management are common in obstetric litigation. Designated as a high-alert medication [46], oxytocin remains the most common treatment choice for labor abnormalities, making its use a daily issue in most labor and delivery suites in the United States. There are many sound, evidence-based protocols for the administration of oxytocin, ranging from high-dose, high-frequency to low-dose, low-frequency and hybrids that combine aspects of both regimens. Closely and accurately monitoring uterine activity is important during the care of all laboring women, but especially in labors being either induced or augmented with oxytocin, because oxytocin usage can result in excessive uterine activity even at low dosages.
Studies [43–45,47] regarding the pharmacologic characteristics of oxytocin use in relation to dysfunctional labor and dystocia show that 40 minutes are needed to achieve the maximum dose level. Regarding oxytocin pharmacokinetics, reviews by Arias [48] and Sanchez-Ramos [42] concluded that lower doses and less frequent increases of oxytocin are preferable as they allow time for a more physiologic approach and decrease the risk of tachysystole that is associated with higher doses and shorter dosing intervals. Simpson and Creehan [31,32] suggested starting doses of 0.5 to 2 mU/min with increases every 30 to 60 minutes of 1 to 2 mU/min. This approach is in keeping with one of the primary tenets of pharmacology, which is use the lowest amount of drug needed to achieve the desired effect. A systematic review of high-dose versus low-dose oxytocin for labor induction at term [49] found no benefit and noted an increase in tachysystole in the high-dose group. A randomized controlled trial comparing high-dose to low-dose for labor augmentation in nulliparous women at term [50] showed no difference in cesarean section between the two groups, and although the high-dose group did have slightly shorter labors, they had more tachysystole and more instrumental vaginal births for fetal indications. Couple this information with the liability aspects related to uterine activity and oxytocin, a low-dose approach is the preferred approach from both an evidence-based viewpoint and for risk management considerations. Clinicians should carefully consider all the data, and the differences in use of oxytocin for induction versus augmentation, when deciding on oxytocin management schemes. Suggestions for the safe and effective use of oxytocin in labor are summarized in Box 4.3.

Oxytocin dosage should be titrated to uterine activity, with a goal of attaining adequate or normal uterine activity. Coupling or tripling of uterine contractions (Fig. 4.7) is a phenomenon that may be seen during oxytocin administration. Suggested treatment for this pattern is temporary discontinuation of oxytocin, lateral positioning of the mother, initiation of a fluid bolus, and a restart of oxytocin after 30 minutes or more [32]. Oxytocin rest has also been shown to be a safe and effective way to decrease the cesarean rate in term nulliparas experiencing a prolonged latent phase; rest periods of 8 hours or longer reduced cesarean delivery without any increase in maternal or neonatal morbidity [52].

When administering oxytocin and using internal monitoring during labor induction or augmentation, the titration of oxytocin to establish uterine activity patterns reaching MVUs of 200 to 240 is an appropriate goal. When external monitoring and palpation are
used, palpable contractions of normal duration every 2.5 to 3 minutes should correlate well with adequate MVUs (Fig. 4.8). If labor progress is not occurring with what seems to be adequate uterine activity by palpation, the proper clinical response is not to increase the oxytocin, but rather to consider internal monitoring to assess uterine activity more accurately. Once accurate evaluation of uterine activity is achieved via IUPC, then oxytocin can be safely increased. Even using a low-dose, low-frequency approach with oxytocin, contraction frequency of less than every 2 minutes during the course of labor is a common occurrence; if it persists over a 30-minute period, it is considered tachysystole. Management must be based on clinical context and institutional protocol but should be geared toward returning uterine activity to adequate and appropriate for the stage of labor. In other words, clinicians should not try to achieve second-stage labor patterns in the latent or active phase of first-stage labor because this may interfere with fetal gas exchange. Continuous and ongoing evaluation of fetal status using a systematic approach can prevent fetal acidemia, improve outcomes, and reduce medicolegal

**BOX 4.3 Suggestions for Safe and Effective Oxytocin Usage**

1. Use isotonic intravenous fluids during oxytocin administration to avoid dilutional hyponatremia.
2. Administer oxytocin for both induction and augmentation of labor using a low-dose, low-frequency protocol to maximize pharmacologic dose response and avoid tachysystole.
3. Use standardized definitions for adequate and excessive uterine activity; ensure that all team members are in accord.
4. Resolve any episodes of excessive uterine activity, regardless of whether fetal heart rate changes are present. Note that the goal of oxytocin use is *adequate* but not *excessive* uterine activity.
5. To promote optimal fetal oxygenation in first-stage labor, train team members to decrease oxytocin *before* tachysystole occurs by responding to contraction frequencies less than every 2 minutes before 30 minutes have elapsed.
6. Attempt to maintain average relaxation times of 60 seconds between contractions in first stage and 45 seconds during second stage.
7. Once an adequate pattern of uterine activity has been established, wean the oxytocin to the lowest amount necessary to maintain adequate contractions.
8. If coupling and tripling of uterine contractions occur, discontinue oxytocin for 30–60 minutes, administer an intravenous fluid bolus (isotonic), and encourage the woman to a side-lying position.

Data from references 3, 6–8, 24, 27, 28, 31, 32, 34, 36, 37, 40–45, and 49–51.
Fig. 4.7 Oxytocin administration may result in coupling and tripling of uterine contractions. Treatment consists of discontinuation of oxytocin, maternal position change, and intravenous hydration. (Courtesy Lisa A. Miller, CNM, JD.)
risk. Safety related to oxytocin use is achieved by avoidance of the injudicious use of oxytocin, adherence to evidence-based multidisciplinary guidelines regarding oxytocin administration, and appropriate and consistent team management of excessive uterine activity.

**SUMMARY**

Uterine activity during labor results in normal oxidative stress for the fetus, and fetal gas exchange and acid–base status are directly affected by uterine activity during labor. Excessive uterine activity is related to fetal acidemia at birth and should be avoided by careful monitoring and cautious use of labor stimulants. Parameters for normal, or adequate, uterine activity are easily defined on the basis of normal labor physiology. Clinicians must reach consensus on definitions related to excessive uterine activity and recognize that the term *tachysystole* addresses only one aspect of uterine activity, that of frequency. Recognition of the importance of other parameters of uterine activity, such as strength, duration, resting tone, and relaxation time
are equally important components of the evaluation of uterine activity during labor.

Crucial to the promotion of improved outcomes for mother and fetus is clinician understanding of both the normal progress of labor and labor abnormalities. The availability of continuous labor support, patient education regarding appropriate admission criteria, and adequate hydration play key roles in minimizing labor abnormalities. Familiarity with various labor curves, individualization of labor management, and incorporation of shared decision-making regarding induction or augmentation are crucial to ensuring safe passage. An understanding of the pharmacologic characteristics of oxytocin, combined with a goal to attain adequate uterine activity, will lead to safe and effective use of this high-alert medication.

As Bakker [3] so aptly states, “contraction monitoring deserves full attention.” The evaluation of uterine activity and FHR patterns is inextricably intertwined in the care and support of the laboring mother. Historically, focus on uterine activity assessment and management has been inconsistent in clinical practice. Nurses, midwives, and physicians must have the requisite knowledge and skills to give uterine activity evaluation and management the same attention and care given to FHR pattern assessment.

References


