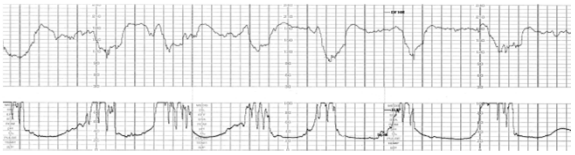
The Tachysystole Myth:

Uterine Activity in Labor

Lisa A. Miller, CNM, JD



Uterine Activity

- Perhaps one of the most important areas of physiology in understanding fetal oxygenation
- Recent studies show a strong correlation between excessive uterine activity and deterioration of fetal acid-base status
- Unfortunately, focus on uterine contraction frequency alone (tachysystole) is not sufficient to provide safe passage

Keys to Successful Induction or Augmentation of Labor

1. Recognition of the differences between terminology, physiology, and management
2. Knowledge in all three areas
3. Knowledge of pharmacology related to oxytocin
4. A team approach that includes a clear plan, with mutual "buy-in", understanding, and patient understanding & accord

How Did You Do?

- Do we have a shared mental model regarding uterine activity?
- What are the implications for patient safety?
- What are the risk management implications?
- Is it time to standardize our approaches to uterine activity and labor management and support?
- Let's begin with a quick review…

Definitions – Montevideo units (MVUs)

The average intensity of contractions in mmHg multiplied by the number of contractions in a ten-minute window. MVUs range from 100 to 250 in the first stage, may rise to 300 to 400 in the second stage.

Contraction intensities of 40 mmHg or more and MVUs of 80 to 120 are generally sufficient to initiate spontaneous labor.

Definitions - Frequency

Number of contractions in a 10 minute period. Contraction frequency overall generally ranges from 2 to 5 per 10 minutes during labor, with lower frequencies seen in the first stage of labor and higher frequencies seen during the second stage of labor.

Definitions - Duration

Time from the onset of a contraction to the offset, measured from the baseline resting tone. Contraction duration remains fairly stable throughout the first and second stages, ranging from 45 to 80 seconds, not generally exceeding 90 seconds.

Definitions - Intensity

The peak of the contraction less the resting tone. Intensity of uterine contractions generally range from 25-50 mm Hg in the first stage of labor and may rise to over 80 mm Hg in second stage.

It is commonly accepted in clinical practice that contractions palpated as "mild" would likely peak at less than 50 mm Hg if measured internally, whereas contractions palpated as "moderate" or greater would likely peak at 50 mm Hg or greater if measured internally.

Definitions – Resting Tone

The intrauterine pressure when the uterus is not contractile. Average resting tone during labor is 10 mm Hg; if using palpation, should palpate as "soft", i.e., easily indented, no palpable resistance. Increased uterine resting tone is called hypertonus and is usually defined as a resting tone exceeding 20-25 mm Hg, or a uterus that does not palpate as soft if using palpation.

Definitions – Relaxation time

Time from the end of one contraction to the beginning of the next. Not to be confused with resting tone. In first stage, relaxation time of 60 seconds is considered normal, relaxation time may decrease in second stage as contraction frequency increases.

NICHD Summary Terms

Contraction frequency is considered ***normal*** when there are $\leq$ 5 contractions in 10 minutes, averaged over a 30 minute window. If there are > 5 contractions in 10 minutes, averaged over a 30 minute window, it is called ***tachysystole***.

Tachysystole includes spontaneous and stimulated uterine contractions, and should be qualified as to the presence or absence of fetal heart rate decelerations.

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OBSTETRICS

Tachysystole in term labor: incidence, risk factors, outcomes, and effect on fetal heart tracings

Cara C. Heuser, MD; Stacey Knight, PhD; M. Sean Esplin, MD; Alexandra G. Eller, MD; Calla M. Holmgren, MD; Douglas Richards, MD; Erick Henry, MPH; G. Marc Jackson, MD

OBJECTIVE: Recent recommendations called for obstetricians to abandon the terms of "hyperstimulation" and "hypercontractility" in favor of the more rigidly defined term, "tachysystole" (TS). The aim of the current study is to describe incidence of and risk factors for TS, describe fetal heart rate (FHR) changes associated with TS, and investigate maternal and neonatal outcomes associated with TS.

STUDY DESIGN: For this retrospective cohort study, we reviewed and analyzed the intrapartum FHR and tocometric characteristics of all patients with a singleton, nonanomalous fetus in term labor in a single hospital system over a 28-month period. Univariate association testing was done using χ^2 and *t* tests, comparing demographics, pregnancy characteristics, outcomes, and TS events. Multivariable association testing between risk factors and TS events were tested using generalized estimating equations, adjusting for multiple pregnancies during the study period for the same woman.

RESULTS: There were a total of 50,335 deliveries from 48,529 women during the 28-month period. Of these, there were a total of 7567 TS events in 5363 deliveries among 5332 women. Use of oxytocin or misoprostol, an epidural, hypertension, and induction of labor were associated with an increased risk of TS. We found a doubling of TS events with any oxytocin, a dose-response correlation between oxytocin and TS, FHR changes occurring in a quarter of TS events and, finally, that presence of TS increases the chance of composite neonatal morbidity.

CONCLUSION: TS is associated with specific risk factors and impacts FHR and neonatal morbidity.

Key words: contractions, fetal heart tracing, hyperstimulation, labor, tachysystole

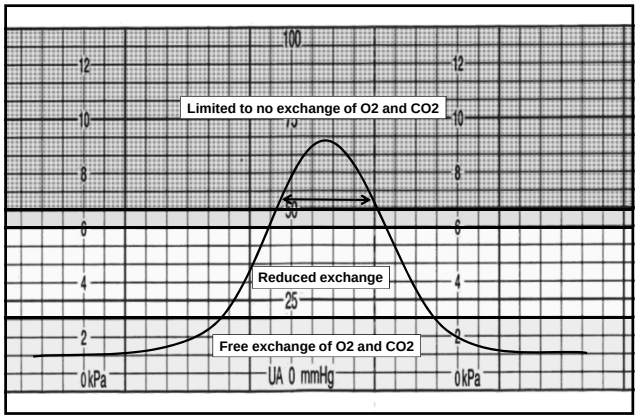
Cite this article as: Heuser CC, Knight S, Esplin MS, et al. Tachysystole in term labor: incidence, risk factors, outcomes, and effect on fetal heart tracings. Am J Obstet Gynecol 2013;209:xx.e1-xx.e.

Uteroplacental physiology

- The term placenta weighs about 500 gm, with a diameter of about 20 cm and is approx. 3 cm in thickness
- 700-800 ml of blood (10-15% of maternal cardiac output) perfuses the uterus each minute, 70-90% of this passes through the intervillous space
- Dependent upon maternal blood pressure

Factors that affect uterine blood flow

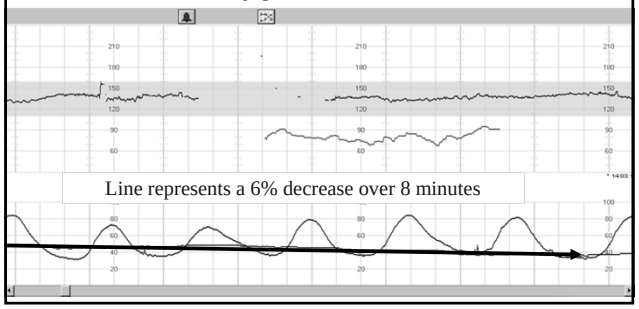
- Uterine contractions
- Hypertonus (abruption, tetany, pitocin)
- Hypotension (epidural block, supine position, hypovolemic shock)
- Hypertension (chronic, PIH)
- Vasoconstriction, endogenous (sympathetic discharge)
- Vasoconstrictors, exogenous



Montevideo Units

- "adequate" defined by Schifrin as greater than 200 Montevideo units (MVUs)
- According to Caldyro-Barcia's work, normal labor that is spontaneous is generally less than 280 MVUs, although there is wide variation among women.
- In second stage, MVUs may naturally rise to over 300

How Quickly Does Hyperstimulation* Affect Fetal Oxygenation?



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OBSTETRICS

Effects of oxytocin-induced uterine hyperstimulation during labor on fetal oxygen status and fetal heart rate patterns

Kathleen Rice Simpson, PhD, RNC; Dotti C. James, PhD, RNC

OBJECTIVE: The objective of the study was to evaluate effects of oxytocin-induced hyperstimulation on fetal oxygen saturation and fetal heart rate patterns.

STUDY DESIGN: Uterine activity of 56 women was evaluated retrospectively for hyperstimulation lasting 30 minutes using 2 definitions: group 1: 5 or more but less than 6 contractions in 10 minutes (n = 102, 30-minute periods); group 2: 6 or more contractions in 10 minutes (n = 56, 30-minute periods). Fetal oxygen saturation and heart rate patterns during each period and the preceding 30 minutes of less than 5 contractions in 10 minutes were compared.

RESULTS: Hyperstimulation was associated with significant oxygen desaturation: (group 1 = 10.68 [20%] decrease from 52.14 to 41.46; $P < .001$); group 2 = 15.34 [29%] decrease from 52.02 to 36.68; $P < .001$) and significantly more nonreassuring fetal heart rate characteristics, compared with normal uterine activity.

CONCLUSION: Hyperstimulation is associated with negative effects on fetal status. The more contractions in 30 minutes, the more pronounced the effect.

Key words: electronic fetal monitoring, fetal oxygen saturation/fetal pulse oximetry, fetal safety, labor induction, oxytocin-induced uterine hyperstimulation

Cite this article as: Simpson KR, James DC. Effects of oxytocin-induced uterine hyperstimulation during labor on fetal oxygen status and fetal heart rate patterns. Am J Obstet Gynecol 2008;199:34.e1-34.e5.

OBSTETRICS

★EDITORS' CHOICE★

Elevated uterine activity increases the risk of fetal acidosis at birth

P. C. A. M. Bakker, MD; P. H. J. Kurver, MSc; D. J. Kuik, MSc; H. P. Van Geijn, MD, PhD

OBJECTIVE: The objective of the study was to assess the role of uterine activity on fetal outcome.

STUDY DESIGN: Intrauterine pressure (IUP) recordings from consecutive term singleton, vaginal deliveries collected between June 1, 1993, and July 1, 2004, were analyzed. One thousand four hundred thirty-three recordings were included. IUP data were obtained using HP 8040A and HP M1350 cardiotocographs. For each recording the uterine contraction curve was analyzed, and the following contraction parameters were determined: relaxation time; contraction duration, frequency, amplitude, and surface; Montevideo units; and active planimeter units and contraction frequency. IUP recordings and contraction parameters from deliveries ending with an umbilical artery pH of 7.11 or less were compared with those ending with an umbilical artery pH of 7.12 or greater. Statistical analyses were performed using Student's *t* test and logistic regression.

RESULTS: An umbilical artery pH 7.11 or less at birth is associated with significant more uterine activity during the first and second stage of labor.

CONCLUSION: Increased uterine activity is significantly associated with a higher incidence of an umbilical artery pH of 7.11 or less.

Key words: intrauterine pressure recording, umbilical artery pH, uterine activity

Cite this article as: Bakker PCAM, Kurver PHJ, Kuik DJ, et al. Elevated uterine activity increases the risk of fetal acidosis at birth. Am J Obstet Gynecol 2007; 196;313.e1-313.e6.

So, what can we do?

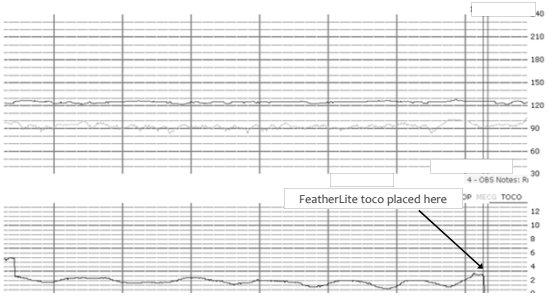
- Shift focus to attaining adequate uterine activity vs. avoiding tachysystole
- Agree on physiologically sound guidelines for appropriate uterine activity (recall differences in labor)
- Be vigilant about FHR changes and look for early signs of disrupted oxygenation

What about labor disorders?

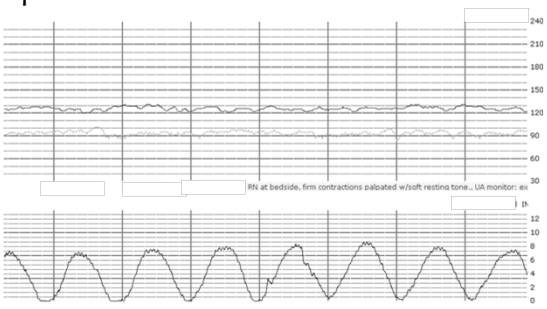
Latent phase: Considered "prolonged" after 20 hours or more of ***adequate uterine activity*** in the nulliparous woman, 14 hours or more in the multip

Strategies for management include avoiding admission, strict criteria for diagnosis, fluids, and use of cervical ripeners when induction is ***medically*** indicated.

High Frequency, Low Amplitude?



Or equipment limitation? Here's the same patient with use of the FeatherLite toco



Management of Active Phase

- **Active phase disorders**
  - **Protraction disorders** - a slow rate of cervical dilation
  - **Arrest disorders** - initial normal progress, then stops, for at least two hours
  - **Combined disorders** - slow progress followed by arrest
- Traditionally, clinicians used 2 hours of greater than 200 MVUs to diagnose an arrest, but newer research shows that using a guideline of 4 hours of uterine activity greater than 200 MVUs (or 6 hours if the average MVUs were less than 200) will result in up to a 92% vaginal delivery rate with no increased risk to the neonate.

Second-stage disorders

Prolonged second stage: 2-3 hours in nullips, 1-2 hours in multips, longer parameters used with epidurals in place

Arrest of descent: failure of rotation & descent

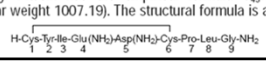
Strategy is basically a re-evaluation of the "Three P's", using an IUPC in some cases, as well as reviewing EFW, pelvic diameters, and prior labor progress.

Pitocin drug insert

Pitocin®
(Oxytocin Injection, USP) Synthetic

DESCRIPTION

Pitocin (oxytocin injection, USP) is a sterile, clear, colorless aqueous solution of synthetic oxytocin, for intravenous infusion or intramuscular injection. Pitocin is a nonapeptide found in pituitary extracts from mammals. It is standardized to contain 10 units of oxytocic hormone/mL and contains 0.5% Chlorobutanol, a chloroform derivative as a preservative, with the pH adjusted with acetic acid. Pitocin may contain up to 16% of total impurities. The hormone is prepared synthetically to avoid possible contamination with vasopressin (ADH) and other small polypeptides with biologic activity. Pitocin has the empirical formula $C_{43}H_{66}N_{12}O_{12}S_2$ (molecular weight 1007.19). The structural formula is as follows:



Product labeling or…?

INDICATIONS AND USAGE

IMPORTANT NOTICE

Elective induction of labor is defined as the initiation of labor in a pregnant individual who has no medical indications for induction. Since the available data are inadequate to evaluate the benefits-to-risks considerations, Pitocin is not indicated for elective induction of labor.

Oxytocin Pharmacology & Dosage

Half-life of 10-12 minutes (in-vivo!), with steady-state plasma concentration achieved in 3-4 half-lives (approx. 30-45 minutes)

Uterine response is within 3-5 minutes of IV administration

Prolonged use may result in downregulation (receptor desensitization) *and can actually result in ineffective* uterine contractions

Oxytocin Dosage & Frequency of Increases

- Various concentrations, use isotonic IV to avoid hyponatremia
- Starting doses of 0.5-6 mu are supported in the literature, with timing of increases ranging from 15-40 minutes
- No sign. variations in outcomes, but > incidence tachysystole with higher doses and more frequent increases have led most experts to agree on a low-dose, low-frequency approach as the safest

Ongoing Oxytocin Dosing

- Dose should be decreased once adequate labor pattern is established
- In second stage, endogenous release and an increase in receptor sites may result in tachysystole if the dosage is not weaned, or if oxytocin was injudiciously begun during transition
- 90% of women at term will have successful inductions with doses of 6mU/min or less, and some authors suggest a limit of 16mU/min

Table 2. Keys to safe and effective oxytocin use[a]

- Use a standardized, multidisciplinary protocol that clearly outlines the role of physicians, midwives, and nurses to reduce error potential and ensure team understanding and compliance.
- Have a physician with cesarean section privileges aware of all patients receiving oxytocin and available to respond to emergencies.
- Ensure that all clinicians are educated regarding the differences in uterine activity in the different phases and stages of labor.
- Make the primary focus of oxytocin use *attaining* adequate uterine activity (versus *avoiding* tachysystole) to promote the goal of stimulating a normal labor pattern.
- Promote uterine muscle function through adequate hydration and use of positioning.
- Adopt a low-dose, low-frequency dosing regimen to maximize pharmacologic dose response and avoid tachysystole.
- To avoid the risk of dilutional hyponatremia, use isotonic intravenous fluids during oxytocin administration.
- Do not exceed a dose of 20 mU/min.
- Following the establishment of an adequate contraction pattern, begin to wean the oxytocin to the lowest amount necessary for maintenance.
- Intervene on any episodes of tachysystole, regardless of whether or not fetal heart rate changes are present.
- During the first stage of labor, attempt to maintain a contraction frequency of greater than 4 but less than 5 and minimum relaxation times of 60 s.
- During the second stage of labor, attempt to maintain a contraction frequency of 5 and minimum relaxation times of 45–50 s.
- Evaluate uterine resting tone during relaxation time and avoid hypertonus.
- If coupling and tripling of uterine contractions occur, discontinue oxytocin for 30–60 min, administer an intravenous fluid bolus (isotonic), and encourage the woman to adopt a side-lying position.
- Consider the use of intrauterine pressure catheters when uterine activity seems adequate to palpation but is not resulting in labor progress, or in cases where it is difficult to evaluate uterine activity with palpation and external monitoring.

Other Considerations

Elective Induction: Yes or no, if yes, what criteria need to be met and what type of informed consent should be obtained?

Response to tachysystole and restart of oxytocin after discontinuation: Should these be included in the protocol or guidelines, and does it mandate provider notification?

Why should we care?

OBSTETRICS

Cesarean section and development of the immune system in the offspring

Clara E. Cho, BSc; Mikael Norman, MD, PhD

The worldwide rate of cesarean section (CS) has quadrupled in <2 decades,[1,2] making CS the most common surgical procedure performed in women of childbearing age today. The World Health Organization recommends that in up to 15% of deliveries, CS may be indicated.[3] However, 37 of 60 developed countries currently exceed this recommendation.[4] The rate of CS is currently

This review examines the relation between the mode of delivery and development of the immune system in the offspring. Recent epidemiological studies provide evidence that elective cesarean section (CS) is associated with aberrant short-term immune responses in the newborn infant, and a greater risk of developing immune diseases such as asthma, allergies, type 1 diabetes, and celiac disease. However, it is still unknown whether CS causes a long-term effect on the immune system of the offspring that contributes to compromised immune health. With the dramatic increase in the rate of CS today, a greater emphasis should be placed on the discussion among both professionals and childbearing women on potential consequences of CS on the health of the offspring.

AJOG April 2013

What should we do?

"To decrease cesarean delivery rate in the United States, reducing primary cesarean delivery is the key. Increasing vaginal birth after previous cesarean rate is urgently needed. Cesarean section for dystocia should be avoided before the active phase is established, particularly in nulliparous women and in induced labor."

Zhang J, Troendle J, Reddy UM, et al, for the Consortium on Safe Labor. Contemporary cesarean delivery practice in the United States.
Am J Obstet Gynecol 2010;203:326.e1-10.