LEADING THE QUEST FOR HEALTH™
Cedars-Sinai
TACHYSYSTOLE...

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Disclosures

- I have no financial disclosures
- No off label use of drugs

Objectives

- At the completion of this lecture, participants will be able to …
  - Describe (and be able to recognize) the different types of tachysystole
  - Describe the maternal and neonatal clinical implications of tachysystole
  - Describe various treatment options for tachysystole
  - Describe components of QI program to “cease and desist”
    - No more “pitting through it”
    - No more “pit to distress”

What is tachysystole?

- 2008 NICHD Workshop Report on Electronic Fetal Monitoring
  — Macones et al; Obstet Gynecol 2008; 112:661-6
- A full description of EFM tracing requires a qualitative and quantitative description of
  1. Uterine Contractions
  2. Baseline fetal heart rate (FHR)
  3. Baseline FHR variability
  4. Presence of accelerations
  5. Periodic or episodic decelerations
  6. Changes or trends of FHR patterns over time
What is Tachysystole?

- 2008 NICHD Workshop Report on Electronic Fetal Monitoring
  — Macones et al; Obstet Gynecol 2008; 112:661-6
- Uterine Contractions
  — Number of contractions present in 10 minute window, averaged over 30 minutes
  — NORMAL: ≤5 contractions in 10 min window
  — TACHYSYSTOLE: >5 contractions in 10 minutes
    - TS can be spontaneous or associated with stimulated labor
    - TS no decelerations vs TS + decelerations

What is Tachysystole?

- Kunz et al JOGNN, 2013;42:12-18
  — NICHD, ACOG, SMFM, AWHONN
- Tachysystole is identified when one or more criteria are present (30 min increments)
  1. More than 5 contractions in a 10 min window, averaged over 30 min
  2. A series of single contractions lasting 2 min or more
  3. Contractions of normal duration occurring within one minute of each other (ACOG 2003, Simpson & Creehan 2008)
  4. Insufficient return of uterine resting tone between contractions via palpation or intrauterine amniotic pressure above 25 mmHg between contractions via IUPC (Simpson & Creehan)
- Gregory take home point: TS is... TOO MANY CONTRACTIONS!!!
What does Tachysystole look like?

TS + FHR changes

Google images, uterine hyperstimulation

Why Should We be Concerned About Tachysystole?

- During contraction, myometrial pressure exceeds the arterial pressure
- Uterine blood flow stops, oxygen exchange stops
  - If UC >30 mmHg spiral arteries are compressed
  - Labor mean uterine pressure 85-90mmHg, higher with pushing
- Duration, strength of contraction determines length of time spiral arteries are compressed
  - Too long, too strong can cause fetal hypoxemia

Why Should We be Concerned About Tachysystole?

- NICHD 2008 Research Recommendations
  - “…studies include work that evaluates contraction frequency, strength, and duration on FHR and clinical outcomes.”

What’s the Evidence? Is it Much Ado about Nothing?
What’s the Evidence? Is it Much Ado about Nothing?

- Bakker et al, AJOG 2007; 196:313.e1-313.e6
- *Elevated uterine activity increases the risk of fetal acidosis at birth*
- Amsterdam, June 1993-July 2004
- N=2886 (all cases with IUPC); tracings analyzed via computer and 2 independent reviewers for each 10 min window for last hour of first stage and all second stage
- Evaluated: relaxation time, duration, amplitude, surface, Mv units, active planimeter units, and contraction frequency
- Routinely collected blood gases; acidosis defined as pH ≤ 7.11

Conclude: increased uterine activity is significantly associated with higher incidence of umbilical artery pH ≤ 7.11

What’s the Evidence? Is it Much Ado about Nothing?

- Simpson & James AJOG 2008; 199:34.e1-34.e5
- *Effects of oxytocin-induced uterine hyperstimulation during labor on fetal oxygen status and fetal heart rate patterns*
- Retrospective study, 56 women with hyperstimulation >30 min defined as <6 or >=6 UC in 10 min
- Evaluated fetal oxygen saturation and FHR patterns

Conclude: as contraction frequency increased, effect of fetal oxygen saturation is more pronounced
What's the Evidence? Is it Much Ado about Nothing?

- Simpson & James AJOG 2008; 199:34.e1-34.e5

<table>
<thead>
<tr>
<th>FSpO2 &amp; FHR</th>
<th>Normal UC &lt;5 UC /10 min N=158</th>
<th>=5 UC /10 min N=102</th>
<th>&gt;= 6 UC /10 min N=56</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSpO2</td>
<td>No change 20% dec 29% dec</td>
<td>29% dec 32% dec</td>
<td>32% dec</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Oxytocin mean mU</td>
<td>6.08 9.64 12.03</td>
<td>&lt;0.001</td>
<td></td>
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<tr>
<td>Absent variability (%)</td>
<td>0 1.9 3.6</td>
<td>0.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimal variability (%)</td>
<td>7.6 10.8 16.1</td>
<td>0.011</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accelerations (%)</td>
<td>86.0 77.5 62.5</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
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<tr>
<td>Variables (%)</td>
<td>17.7 29.4 25.0</td>
<td>0.451</td>
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<td>Late decelerations (%)</td>
<td>8.9 15.7 26.8</td>
<td>0.032</td>
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<tr>
<td>Prolonged decels (%)</td>
<td>0 3.9 3.6</td>
<td>0.085</td>
<td></td>
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<tr>
<td>Recurrent decels (%)</td>
<td>9.5 21.6 37.5</td>
<td>0.002</td>
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</tbody>
</table>


Defining uterine tachysystole: how much is too much?

- Prospective cohort study, 584 women undergoing induction of labor with oral misoprostol (100ug)
- Tachysystole >=6 UC in 10 min during first four hours of induction
- Uterine hypertonus—contraction > 120 sec
- Evaluated infant condition at birth
  - Composite measure: 5 min Apgar<3, pH<7.1, intubation in DR, neonatal seizures, NICU admission or death

Limitation—elapsed time; conclude self-limited episodes remote from delivery are not harmful

Kunz et al JOGNN 2013;42:12-18

Incidence of Uterine Tachysystole in Women Induced with Oxytocin

- Retrospective study, 55 women undergoing induction of labor with oxytocin
- Tachysystole >5 UC in 10 min averaged over 30 min
- Series of single contractions 2 min or more
- UC’s within one min of each other
- Insufficient return to baseline (palpation or IUPOC >25 mmHg between contractions

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What's the Evidence? Is it Much Ado about Nothing?

Kunz et al JOGNN 2013;42:12-18

Mean oxytocin infusion was 9.2 mU/min; median 8 mU/min

Range (0.5-30)

Duration 4-33.5 hours; mean 13.7 hours

798.5 hours of strip evaluated/1,597 30-min segments

661 TS events (41%)

- Most common was fewer than 60 sec between contractions (98%)
- Second most common was >5 in 10 min/30 min (33%)
- Series of contractions >120 sec (11%)
- Insufficient return to baseline tone (1%)

Higher incidence because they used four criteria

Suggest tachysystole is under recognized if limited to single definition; FHR changes associated with all four definitions

Rates using >5 in 10 min/30 min comparable to prior studies

Heuser et , AJOG 2013; 209:32e.e1-6.

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

Retrospective cohort study, 10 hospitals March 2007-June 2009; 50,335 term singleton deliveries (spontaneous/induced)

Tachysystole:
- TS in nursing note; UC <=2 min apart; >5 UC in 10 min/30
- 100 charts randomly reviewed by authors to validate

Cesarean delivery

Neonatal complications

50,335 deliveries; 5363 (10.7%) had at least one TS event

Average duration was approximately 60 min

3.7% had TS-FHR changes

4.3% had TS-Interventions

1.5% had TS-Delivery expedited (CS or OVD)

Not mutually exclusive
- 8% had 1 event; 2% had 2 events; 1% had 3 or more
What's the Evidence? Is it Much Ado about Nothing?

- Heuser et al., AJOG 2013; 209:32e.e1-6.
- Oxytocin for induction/augmentation in 37,020 labors (75%); 4591 (12.4%) had at least one TS event
- 4.0% had TS-FHR changes
- 4.9% had TS-Interventions
- 1.5% had TS-Delivery expedited (CS or OVD)
- Comparable to entire population
- For every 5 mU/min increase in dose, increase RR
  - TS 1.12 (1.06-1.13)
  - TS-F 1.12 (1.09-1.14)
  - TS-I 1.16 (1.14-1.18)
  - TS-D 1.06 (1.02-1.10)

So what can we do about it?

- Gregory op ed…
- There is evidence to suggest...it is much ado about something!
- TS is associated with decrease in fetal oxygen saturation
- TS is associated with changes in FHR
- TS occurs 10-40% of deliveries
  — Oxytocin associated with TS, pervasive use

Summary of findings
1. 11% of term laboring patients have TS events; 2/3 no change in FHR or interventions
2. 25% of patients with TS had unfavorable change in FHR
   — FHR improved half the time without intervention
   — TS increased risk of OVD, NICU admission, composite adverse neonatal morbidity by 30%
3. 2-3x TS events with any oxytocin; dose response correlation

At the bedside
- Hydration
- Position change
- Decrease oxytocin/turn oxytocin off
- Tocolytic agent
So what can we do about it?

- Simpson & Dotti AJOG 2008
- TS-I: Interventions identified in 148/158 events
  - 6 decreased oxytocin by ½
    — Mean time to resolution = 23 min
  - 35 stopped oxytocin (d/c oxy)
    — Mean time to resolution = 14.2 min
  - 69 d/c oxy + IVF bolus
    — Mean time to resolution = 9.8 min
  - 38 d/c oxy + IVF bolus + lateral position
    — Mean time to resolution = 6.1 min

QI Program to Eradicate Tachysystole

- Acknowledgements
  - IHI
  - Summa Health System
  - Premier Inc
  - Ascension Health
  - Hospital Corporation of America
  - Centura Health

Components of TS QI Program

1. Rationale
2. Multidisciplinary team
3. Baseline data: Is TS a problem at your institution?
4. Develop consensus on protocol for oxytocin administration
   — Standardize (order sets/guidelines) so everyone doing the same thing
   — Borrow “physiologic dosing” protocol or “low dose” version
   — Safety checklist (aka “hard stop”)
5. Address team communication
6. Develop audit tool to track TS events, and define accountability
   — MD; RN
7. Distribute results
8. Refine processes, educate, repeat

So what can we do about it?

- At the bedside / hospital / health system
- Kunz et al
  — “The objective is to integrate an increased awareness of uterine tachysystole with evidence-based practice in the titration of oxytocin”
- Gregory op ed… invite you to consider a QI project around dosing oxytocin to prevent tachysystole
  — 100% hand washing, perioperative ABx
  — 0 retained objects, surgical site infections
  — 0 tachysystole events… why not?
Components of TS QI Program

- **Rationale**
  - Clinical evidence previously discussed
  - Liability concerns (Simpson & Knox MCN 2009;34:8-14)
    - Inappropriate oxytocin use is one of the top 5 areas of preventable perinatal harm
    - Oxytocin associated with 22% of claims involving neurologically impaired babies and 15% of claims involving stillbirth or neonatal death
    - 50% of paid claims involve allegations of oxytocin misuse
      - Usually TS—fetal hypoxemia, acidemia, asphyxia and subsequent brain damage

Components of TS QI Program

- **Rationale**
  - Clinical evidence previously discussed
  - Liability concerns
    - FDA black box warning, 1998
      - Restrict to medically indicated inductions and augmentations of labor and not used for elective inductions
    - Institute for Safe Medication Practices
      - Oxytocin is a high alert medication, 2007
      - “heightened risk of causing significant harm if used in error”

Components of TS QI Program

- **Rationale**
  - Liability concerns
    - “injudicious use of oxytocin” (increased rate despite nonreassuring FHR, or uterine TS) occurred in 68% of cases
    - Most cases involving neonatal death or neurologically impaired infant, use of oxytocin decreased chance of successful defense

Components of TS QI Program

- **Rationale** (Simpson & Knox MCN 2009;34:8-14)
  - Complications from oxytocin use are commonly dose related
  - Often involve lack of timely recognition and appropriate treatment of TS
  - IVF bolus administration of oxytocin (instead of LR) for FHR changes or maternal hypotension
  - Inappropriate elective delivery <39 weeks
  - Goals of IV oxytocin “affect labor progress by stimulating contractions of normal intensity, duration, and frequency, and to avoid tachysystole and its potential harmful sequelae. As with other high alert medications, the lowest dose possible to achieve the desired clinical effect should be used”.
Components of TS QI Program

- **Rationale** (Simpson & Knox MCN 2009;34:8-14)
- Complications from oxytocin use are not limited to the fetus
- Maternal risks include
  - Pain
  - Abruption
  - Uterine rupture
  - Unnecessary CS for FHR patterns
  - Postpartum hemorrhage
  - Infection
  - hyponatremia

Components of TS QI Program

2. **Multidisciplinary team**
   - Include senior management (administration, QI, nursing and physician leadership)
   - Include key physician opinion leaders
     - Plus recruit MD’s and nurses most likely to be antagonists or known to “push the pit”
     - Include early in process—educate and see the evidence as it unfolds
       - Cooperative management instead of top down or punitive

Components of TS QI Program

3. **Baseline data**: Is TS a problem at your institution?
   - Sample a day or a week
   - Collect data on TS in 30 min increments (whole labor or some specified time to include both active labor and pushing)
   - Collect data on FHR tracing, interventions (especially use of tocolytic)
   - Collect data on maternal and neonatal outcomes
   - Collect data by provider (MD and RN)
   - Compare with normative data sited in literature or…set zero as goal

Components of TS QI Program

4. **Develop consensus on protocol for oxytocin administration**
   - Standard concentration of oxytocin prepared by the pharmacy
   - Standardize (order sets/guidelines) so everyone doing the same thing
   - Borrow “physiologic dosing” protocol or “low dose” version
     - Start 1-2 mU/min and increase 1-2 mU/min every 30-60 min based on maternal fetal response
Components of TS QI Program

4. Develop consensus on protocol for oxytocin administration

- Recall oxytocin physiology
  - Secreted in pulsatile fashion
  - $\frac{1}{2}$ life of oxytocin 3-12 min; 3-5 $\frac{1}{2}$ lives needed to get to steady state; should see uterine response within 30-60 min after reaching steady state
  - Infusion rate 4-6 mU/min = natural serum levels, spontaneous 1st stage
    - Hayes & Weinstein, AJOG 2008

4. Develop consensus on protocol for oxytocin administration

- Safety checklist (aka “hard stop”)
  - Specify maximum dose (hard stop)
  - Specify contraction frequency goal
    - (eg. goal of 3-4 contractions in 10 min window that is strong per palpation or 60 mmHg with IUPC)
  - Specify: do not increase oxytocin if adequate labor pattern with adequate cervical change (or stop oxytocin if active phase)
    - If no cervical change, continue to increase if category 1 and no TS
  - Specify treatment for TS as protocol/nursing practice
    - Don’t need to call MD to do interventions
    - Intervene for TS, don’t wait for FHR changes

Clark et al AJOG 2008; Krenning et al JPNN, 2011; Doyle et al JOGNN 2011
Components of TS QI Program

5. Address team communication
   - Team collaboration around goal of “zero TS”
   - Nurse at the bedside primarily responsible for oxytocin administration; MD frequently offsite or multitasking
   - Clinical disagreements about how to manage oxytocin is frustrating…Algorithm should defer to bedside clinician!

6. Develop audit tool to track TS events, and define accountability
   - Representative Examples
     - Was tachysystole present
     - How long before intervention
     - Was protocol followed prior to oxytocin dosage change
     - Was appropriate interventions implemented within 30 min
     - If oxytocin stopped, was it restarted per protocol
       — (less than 20 min by ½; >20 min, start over)
     - RN ID
     - MD ID
     - Evidence of appropriate communication between care team
     - Was chain of command used

7. Distribute results
   - Acknowledge success of RN/MD’s with zero TS events
   - Develop threshold for peer review letter/nursing performance review monitoring
     — Look for patterns, recurrent offenders
   - Publish (visibly display) unit statistics
Components of TS QI Program

8. Refine processes, educate, repeat
   - Re-educate outliers
   - Unit stats
     — De-identify outliers

Can TS QI Program Work?

SUCCESSFULLY IMPLEMENTED!

Multiple hospitals & health systems

- Clark et al AJOG 2008; 199:105.e1-105.e7
- Improved outcomes, fewer cesarean deliveries, and reduced litigation: results of a new paradigm in patient safety
- Total quality improvement program
- Team collaboration, communication, standardized protocols, checklists, peer review
- 220,000 deliveries, 120 hospitals, 21 states
- Claims/10,000 births decreased from 10 to 6 from 1996-2006
- CS rate decreased 24% to 21% 2005 to 2006

Can TS QI Program Work?

Krening et al JPNN 2012;26:15-24
- Oxytocin Administration: The transition to safer model of care
- Centura Health, Colorado, 9 hospitals
- Initiated Perinatal Services Quality Review Team x system '07
- Adapted HCA protocols for their institution which included components of IHI induction/augmentation bundles
  — Checklist incorporated into EMR; completed q 30 min
- 2009, timeline for rollout x all hospitals
Objectives Met

- At the completion of this lecture, participants will be able to …
  - Describe (and be able to recognize) the different types of tachysystole
  - Describe the maternal and neonatal clinical implications of tachysystole
  - Describe various treatment options for tachysystole
  - Describe components of QI program to “cease and desist”
    - No more “pitting through it”
    - No more “pit to distress”

Take Home Points...LESS IS MORE

- Standardized protocol for dose adjustment (“low dose regimen”)
- Check lists q ½ hr to confirm FHR ok, no evidence TS
- Hold if FHR changes, TS, cervical change
- Bedside clinician (RN) rules
  - LESS IS MORE
- Labor may be longer…but
  - Less cesareans
  - Less PPH
  - Less overall neonatal morbidity
  - Less Liability
  - LESS IS MORE!

Tachysystole...What’s next?

The horse is already out of the barn…

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Less is more OR enough is enough!

- Educate yourself
- Engage your network
- Offer help, don't wait to be asked
- Build a shared understanding
- Give until it feels good
- Form habits of learning, and pass these on to your kids

https://www.google.com/search?q=enough+is+enough
http://tutormentorconnection.ning.com/profiles/blog/list?user=2771i57rto5

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