Sleep and Health in Pregnancy and the Postpartum

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5th Annual Pennsylvania Sleep Society Conference
May 4, 2013

Physiology in Early Pregnancy

- Immediately following conception pregnancy-related proteins secreted by mother, placenta or fetus are detectable:
  - Chorionic gonadotropin (hCG)
  - Cortisol from decidua confers immunologic protection
- Maternal hormonal milieu is critical in modulation of metabolic and immunologic changes
  - Primary source of estrogen
  - They dramatically change over the course of pregnancy
- Placenta
  - HPA-like end organ with stimulatory and inhibitory feedback mechanisms
  - Intense steroid production, esp progesterone
- Fetus
  - Fetal hypothalamus is active by 12 weeks producing many hormones
  - Feldt-Rasmussen et al 2011

Vascular Changes are Essential for a Successful Pregnancy

- Inadequate or incomplete remodeling of spiral arteries: problematic
  - Characterized by shallow trophoblast invasion
  - Decreased population of invasive trophoblast and narrow bore arteries retaining muscular walls
  - Second trimester miscarriage, preeclampsia, preterm birth and fetal growth restriction
- Cardiac output rises ~40% in response to the fall in systemic vascular resistance and expansion of blood volume
- Endothelial dysfunction is associated with hypertension and preeclampsia
Pregnancy shifts a woman towards increased risk for morbidity

- Glucose tolerance is generally normal in early pregnancy
- Insulin sensitivity is dependent on her pre-pregnancy metabolic status, but insulin resistance increases across pregnancy
- Lipid metabolism also changes
  - Increase in triglycerides, fatty acids, cholesterol and lipoproteins

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Sleep and Adverse Pregnancy Outcomes: A Model

Conceptual Model of How the Interrelationships between Disturbed Sleep and Inflammation in the first 20 weeks Gestation May Increase the Risk for Adverse Pregnancy Outcomes

- Poor Health Behaviors
- Sleep Disturbance
- Neuroendocrine alterations
- ↑ Inflammation
- Disrupt normal placental bed vascular remodeling
- ↑ Adverse Pregnancy Outcomes

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Early Pregnancy and Sleep

- ~25% report disturbed sleep in 1st trimester
- Causes
  - Increased urination
  - Increased fatigue
  - Nausea
  - Mood swings
  - Physical changes
Potential Consequences of Disturbed Sleep in Early Gestation

- Inflammation
- Metabolic dysregulation
- Endothelial dysfunction
- Increased weight/BMI
- Increased blood pressure

Pregnant women with poor sleep have increased IL-6 concentrations

![Graph showing relationship between total sleep time and IL-6 concentrations]

Okun & Coussons-Read, J Repro Imm 2007; Okun, Hall & Coussons-Read, Repro Sci 2007

Moderate to severe SDB is associated with Adverse Pregnancy Outcomes

<table>
<thead>
<tr>
<th>Table 3</th>
<th>SDB stratified by SDB category</th>
</tr>
</thead>
<tbody>
<tr>
<td>No SDB (n= 113)</td>
<td>Moderate to Severe SDB (n= 36)</td>
</tr>
<tr>
<td>NSR composite (%)</td>
<td>16.0</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>23.5</td>
</tr>
<tr>
<td>GOM (n= 0)</td>
<td>0.0</td>
</tr>
<tr>
<td>PI (n= 47)</td>
<td>5.3</td>
</tr>
</tbody>
</table>

MG, adverse pregnancy outcome; GOM, gestational diabetes; PI, preeclampsia/episiotomies; PI, preeclampsia/PE, sleep-disordered breathing

Facco et al, 2012 Am J Perinatol
New-onset snoring during pregnancy is a risk factor for GH and PE

Women with persistent symptoms of insomnia have greater BMI in early pregnancy

Women with persistent symptoms of insomnia have higher blood pressure in early pregnancy
Snoring is a Risk Factor for Adverse Pregnancy Outcomes

Owusu et al, 2013 Int J Gyn and Ob

Poor Sleep Quality is Associated with PTB

Sleep quality (PSQI scores) in women who delivered preterm and term

<table>
<thead>
<tr>
<th>Preterm</th>
<th>Term</th>
<th>p-value</th>
<th>OR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>14-16 weeks</td>
<td>7.8 (4.9)</td>
<td>5.0 (2.7)</td>
<td>.026</td>
<td>1.28 (1.07-1.52)</td>
</tr>
<tr>
<td>24-26 weeks</td>
<td>6.2 (4.0)</td>
<td>5.0 (2.6)</td>
<td>.187</td>
<td>NS</td>
</tr>
<tr>
<td>30-32 weeks</td>
<td>7.8 (4.1)</td>
<td>5.3 (2.7)</td>
<td>.007</td>
<td>1.19 (1.0 -1.42)</td>
</tr>
</tbody>
</table>

Okun, Dunkel Schetter & Glynn, 2011 SLEEP

Short sleep duration in late pregnancy associated with PTB

Micheli et al., 2011 Epidemiology
OSA is an independent contributor to adverse pregnancy outcomes

<table>
<thead>
<tr>
<th>Table 1: Multivariate Analysis of Risk for Adverse Outcomes</th>
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</thead>
<tbody>
<tr>
<td>Predictor</td>
</tr>
<tr>
<td>Birth weight (kg)</td>
</tr>
<tr>
<td>Birth length (cm)</td>
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<tr>
<td>Gestational age at birth (d)</td>
</tr>
<tr>
<td>P-value</td>
</tr>
</tbody>
</table>

(1) adjusted for gestational age; (2) adjusted for maternal age; (3) adjusted for maternal age and race.

Olivarez et al., 2011 Amer J Perinatol

Short sleep duration is associated with glucose intolerance

<table>
<thead>
<tr>
<th>Table 2: One-Hour Oral Glucose Tolerance Test (OGTT) Results</th>
</tr>
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<tbody>
<tr>
<td>Test</td>
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<tr>
<td>------------------</td>
</tr>
<tr>
<td>Baseline</td>
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<tr>
<td>Value at 1 hour</td>
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<tr>
<td>Value at 2 hours</td>
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</tbody>
</table>

Facco et al., 2010 AJOG

Summary

- Sleep is a modifiable risk factor
- About 25% of women have significant sleep disturbance in early pregnancy
- Appreciating this and inquiring about sleep during this critical time period could lead to interventions and improvements in sleep. With this the hope is to reduce cardiometabolic risk and risk for adverse outcomes.
Physiological Changes in Postpartum

- Reproductive: Uterus
  - Involution: is the return of the uterus to a nonpregnant state after childbirth
  - Begins immediately after expulsion of the placenta with contraction of uterine smooth muscles

- Cardiac
  - Cardiac output decreases rapidly and returns to normal by 2 to 3 weeks postpartum.
  - Hematocrit increases and increased red blood cell (RBC) production stops.
  - Small transient increase in both systolic and diastolic blood pressure lasting about 4 days after birth

- Respiratory
  - Respiratory function returns to nonpregnant state by 6-8 weeks after birth.

- Endocrine
  - The placental enzyme insulinase causes the diabetogenic effects of pregnancy to be reversed, resulting in significantly lower blood sugar levels in the immediate postpartum period
  - Estrogen and progesterone levels decrease markedly after expulsion of the placenta, reaching their lowest levels 1 week into the postpartum period
  - PP Blues common feature resultant of dramatic hormone drop

- Immune
  - No significant changes occur during postpartum period
  - Leukocytosis with increased white blood cells (WBCs) common during the first postpartum week.
Sleep in 1st year postpartum is associated with higher markers of inflammation 3 years later.

Taveras et al., 2011 Metabolism

Short sleep duration is associated with higher adiposity measures 3 years PP

Taveras et al., 2011 Obesity
Women with More Sleep Complaints During Pregnancy Experience Higher Rates of Postpartum Depression

Women with 36-week PSQI > 8 had higher rate of recurrence than women with PSQI < 8


Future Directions

- Sleep is modifiable
- Behavioral-educational intervention on sleep for postpartum women
  - Goal to promote sleep, not cure problems
  - In hospital, 45-60 min intervention introduction, including 20-page booklet
  - Phone calls at 1, 2 and 4 weeks after hospital discharge
  - Unfortunately, no effect was found
- Could this be implemented in pregnancy to foster long term improvements in sleep?

The idea and dissemination of basic sleep hygiene is lacking in OB/Gyn settings...

Could this benefit mother and child (and father) if implemented earlier?

Table 1: Topics covered by sleep intervention group

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
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| Sleep hygiene for mothers                  | Maintain sleep in privacy
| - Make sure the baby is not awake
| - Make sure the baby is not crying
| - Make sure the baby is not hungry
| - Make sure the baby is not hot
| - Make sure the baby is not cold
| - Make sure the baby is not wet
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Acknowledgements

Staffing and Statistical Support:
University of Pittsburgh Sleep Medicine Institute
CTSI

Funding:
The Anthony Marchionne Foundation
NINR K99/R00 010813
The Amy Roberts Health Promotion award

Thank you!

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