Gestational Diabetes Diagnosis and Blood Glucose Targets

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Overview of Metabolism

Non-pregnant Non-diabetic

<table>
<thead>
<tr>
<th>Diet</th>
<th>Fuels (oxid.)</th>
<th>Storage of Excess Fuels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Glucose</td>
<td>Glycogen</td>
</tr>
<tr>
<td>Protein</td>
<td>Amino Acids</td>
<td>Protein</td>
</tr>
<tr>
<td>Fats</td>
<td>Fatty acids</td>
<td>Triglycerides</td>
</tr>
</tbody>
</table>

Effects of Insulin on:

- **Promotes**
  - Liver:
    - Glycogen storage
    - Triglyceride synthesis
  - Muscle:
    - Glycogen storage
    - Oxidation (glycolysis)
    - Protein synthesis
  - Adipose:
    - Glycerol synthesis
    - Triglyceride synthesis

- **Inhibits**
  - Liver:
    - Glycogenolysis
    - Gluconeogenesis
  - Muscle:
    - Glycogenolysis
    - Proteolysis
  - Adipose:
    - Lipolysis
Fed State

- Insulin↑
- Glucose↑
- Glycogenolysis
- Gluconeogenesis
- Fat↑
- Skeletal muscle
- Arteriole
- Vein

Fasting State

- Insulin↓
- Glucagon↑
- Glycogenolysis
- Gluconeogenesis
- Fat↓
- Skeletal muscle
- Arteriole
- Vein

ADIPOSE TISSUE

- FFA↑
- Ketogenesis
- Hyperketonemia
- LIVER
- MUSCLE
- Ketone Utilization

Felig P. Science 1970;107:990
Fasting State in Normal Pregnancy

Rate of Transfer Across Placenta

Hormonal Changes: Early Pregnancy

↑Estrogen, progesterone ➔ Hyperphagia
↑HPL, prolactin ➔ Fat deposition
↑Progesterone, Growth hormone ➔ ↑Insulin secretion
↑HPL (human Placental Lactogen) [accompanied by relatively normal hepatic and peripheral insulin sensitivity, prevents glycogenolysis, proteolysis, and lipolysis, leading to energy storage in early pregnancy]
Daily Glucose Excursions: Late Pregnancy vs Nonpregnant

- Glucose (mg/dl)
- Nonpregnant
- Pregnant


Basal Insulin Concentration

- Pre-Gravid
- Early Pregnancy
- Late Pregnancy


1st Phase Insulin Response

- Control
- GDM


**Insulin Sensitivity**

![Insulin Sensitivity Graph]

<table>
<thead>
<tr>
<th>Control</th>
<th>GDM</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&lt;0.0001</td>
<td>P=0.03</td>
</tr>
</tbody>
</table>

**Insulin Requirement During Pregnancy**

![Insulin Requirement Graph]

**What Happens with High Glucoses and Insulin Levels?**

- **High Glucose levels**
  - Before 8 wks = Birth Defects
  - Excess = Fetal Growth
  - Requirement of O2 increase

- **Insulin Resistance**
  - resets genes and response and function - reprogramming - obesity and diabetes, etc...

- **Stimulates**
  - Fetal insulin secretion
  - Glycogen deposits in placenta
  - Poor placental transfer of O2 and nutrients
  - RBC production

- **Poor Placental Implantation**
  - HTN, PIH
  - Delayed Organ Maturation
  - Hypoxia-tolerance of labor - Deise

- **Polycythemia**
  - Hyperbilirubinemia
  - Increased ammen of blood
  - Vessels
  - Stimulates RBC production
Two GDM Screening Options

- Early A1c
- One step—75 gram OGTT

*Above are the “Sweet Success Guidelines for Care” 2012 Recommendations (7)

Or

- Two Step
  - 50 gram Load if +
  - 100 gram OGTT

Gestational Diabetes Screening and Diagnosis

- Early Screen if:
  - Previous History of:
    - Gestational diabetes
    - Macrosomia history
    - Unexplained still birth
    - Malformed infant
  - History of overt DM in parents, siblings, children (1st+)
  - Body weight with BMI ≥ 25
  - Age > 25
  - Heavy glucoseuria (>2+)
  - Medications that increase glucose intolerance

Age-Adjusted Prevalence of Obesity and Diagnosed Diabetes Among U.S. Adults Aged 18 Years or older (this includes GDM)

Gestational Diabetes Screening and Diagnosis

Early screen if:
- High risk ethnic group:
  - African American
  - American Indian
  - Hispanic/Latina
  - Asian Pacific Islander
  - Southeast Asian
  - Indigenous Australian
- All women at 24-28 weeks gestation

Diagnosis by A1c

<table>
<thead>
<tr>
<th>A1c</th>
<th>Diagnostic Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5.7</td>
<td>No diabetes</td>
</tr>
<tr>
<td>5.7-6.4</td>
<td>Pre-diabetes</td>
</tr>
<tr>
<td>6.5+</td>
<td>Diabetes</td>
</tr>
</tbody>
</table>

A1c drops approximately 0.5% in pregnancy

Critical Periods of Development

<table>
<thead>
<tr>
<th>Weeks gestation from LMP</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most susceptible time for major malformation</td>
<td>Heart</td>
<td>Central Nervous System</td>
<td>Ear</td>
<td>Teeth</td>
<td>Palate</td>
<td>External genitalia</td>
<td>Leg</td>
<td>Eye</td>
<td>Arm</td>
</tr>
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California Diabetes and Pregnancy: Prenatal Guidelines for Care 1986
Screening in Unusual Cases

- Bariatric surgery clients - Most will not tolerate a glucose load
- Hyperemesis
  - SO
  - Fasting and 1 hour postprandial blood glucose level checked at 22-24, 28-32, and 34 weeks gestation
  - Obtain fasting and 1 hour post-meal blood glucose for 1 week with a blood glucose meter while she continues her usual diet.

75 Gram OGTT
ONE STEP TEST

- Fasting test
  - FBS 1 hour 2 hour
    - > 92 > 180 > 153
  - 1 value = positive screen

What do we TEACH?

- What is GDM?
- What does it do to a pregnancy?
- What can be done?
  - Self Blood Glucose Testing
  - Medical Nutrition Therapy (MNT)
  - Monitoring - Maternal and Fetal
  - Antepartum/Intrapartum/Postpartum care
  - Newborn care
  - Long-term prevention

Diabetes is:

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting in defects in insulin secretion, insulin action or both. ADA. Diagnosis and classification of diabetes Mellitus. Diabetes Care 2010;33(Suppl 1):S62- S69.

 Either don’t make enough insulin or
 Can’t effectively use what is made

Diabetes is:

Overt or pre-existing:
  (0.1-0.3% all pregnancies)

Type 1-Insulin dependent, Ketone prone
Type 2-Non-insulin dependent
  Accounts for 90% of all Diabetics 80% are obese

IGT or Pre-Diabetes
Polycystic Ovary Syndrome/Metabolic Syndrome
GDM: (~90%)
  Diagnosed during pregnancy
  ~1-14% of all pregnancies
Blood Glucose Testing

- All clients start with a minimum testing schedule of FBS and 1 (or 2) hours after meals
- Premeal blood glucoses if suspected elevations between meals or if utilizing algorithm
- HS and overnight blood sugars are used if suspected overnight hypoglycemia

Blood Glucose Monitoring

- Additional testing as needed for suspected hypo or hyperglycemia
- Decrease testing if well controlled with diet only clients
- Recommend testing meter accuracy once a trimester
- Recommend using memory meters
  *Clients with meters that do not match record should have blood glucoses done during office visits
What is Normal?
Pregnancy and CGMS

Ben-Haroush et al. in 2004 and Yogev et al. in 2007 (12) looked at non-diabetic pregnancies with the CGMS—>

• Average was 83.7 ± 18
• Fasting 75 ± 12
• Pre-meal 78 ± 11
• 1 hour Post meal was 110 ± 16
• 2 hour 97 ± 11
• Peak post meal time was 70-90 minutes
• The mean over night Glucose was 68 ± 10

Blood Glucose Targets

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<tr>
<th>Time</th>
<th>Plasma Glucose mg/dl California (7)</th>
<th>Plasma Glucose mg/dl ACE (8)</th>
<th>Plasma Glucose mg/dl ACOG (9)</th>
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<tbody>
<tr>
<td>Fasting and pre-meal</td>
<td>65 - &lt; 90</td>
<td>60-90 &lt; 100</td>
<td>&lt; 95</td>
</tr>
<tr>
<td>Post-meal 1 hour</td>
<td>100 - &lt; 130</td>
<td>&lt; 120</td>
<td>&lt; 130 to 140</td>
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<tr>
<td>Post-meal 2 hour</td>
<td>&lt; 120</td>
<td></td>
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</tr>
<tr>
<td>2-6AM</td>
<td>65-120</td>
<td></td>
<td></td>
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Blood Glucose Monitors

- I counted 32 different home blood glucose meters at just one pharmacy
- Of these 25 had the capacity to download
- Memory varied from none to 1000
- Hematocrit ranges were from 0-70%
- Time for testing ran from 5 to 50 seconds
- Blood glucose range from 20-600 mg/dl
- Temperature readings
- Sizes, colors, and cases varied significantly

SO What should we be looking for?

So what do we want in a Meter?

- Accuracy
  - Hematocrit range
  - Ease of use
  - Blood glucose range
  - Temperature ranges
- Memory
  - Ability to download
  - Ability to reapply more blood
  - Alternate testing capacity
  - Size of displays
  - Battery required
  - Alarms...

Computer Downloading

- Every company has their own programs
- All require some data port and computer access
- All have print outs
- All have the ability to program desired ranges
- All the companies I have encountered will give free software and often the data cables too
What Affects Blood Glucose

- Pregnancy
- Food choices
- Exercise and Activity
- Stress
- Medications
- Timing
- Other…
References


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