

Hypoglycemia and the Breastfeeding Infant

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Hypoglycemia: The Basics

- Hypoglycemia is a common problem in the Newborn Nursery
 - Low blood sugar levels are common in healthy neonates (about 10%!) by 1-2 hours after birth and are considered to be part of normal adaption to postnatal life.
- Hypoglycemia can cause brain injury
 - There is no specific level or duration of hypoglycemia that is known to produce acute symptoms or brain injury.

Learning Objectives

- Understand who is risk for hypoglycemia and why
- Know strategies that can be implemented for preventing hypoglycemia
- Understand when treatment for hypoglycemia is needed

Roadmap

- Physiology of Hypoglycemia
- Cases
 - The Normal Baby
 - The Big Baby
 - The Little Baby
- Review of important points

Keepin' it Real!



Physiology



Basics of Carbohydrate Metabolism

- Goal of body is to maintain a steady blood glucose level
- Dietary carbohydrates and sugars determine blood sugar levels
- Glucose is stored in body as **GLYCOGEN** and **FAT**
- Pancreatic hormones **INSULIN** and **GLUCAGON** respond to blood sugar levels to maintain the steady state

Insulin

- Produced by beta cells in the pancreas
- Released in response to high blood glucose levels
- Causes absorption of glucose from blood into fat, liver and muscle cells
- Promotes synthesis of proteins in many cells

Glucagon

- Produced by alpha cells of pancreas
- Released in response to low blood sugar levels
- Causes liver to convert stored glycogen to glucose

Feast

- Consumption of carbohydrate/sugar
- Digestion to glucose (fructose and galactose)
- Insulin is released and glucose is taken into cells
- **GLYCOLYSIS** converts glucose to usable energy
- **GLYCOGENESIS** stores extra glucose as glycogen

FAST

4 Systems are involved in maintaining steady glucose concentration in blood for brain metabolism

- Glycogenolysis
- Gluconeogenesis
- Lipolysis
- Ketogenesis

Glycogenolysis

- During fasting state glycogen stores in liver provide most of the glucose needed by the body
- Liver contains enough glycogen to meet metabolic demand for a few hours
- *Stimulated by Glucagon, inhibited by Insulin*

Gluconeogenesis

- Production of glucose using:
 - Amino Acids from muscle
 - Glycerol from fat
 - Lactate from Glycolysis
- Triggered when hepatic glycogen stores are depleted
- *Stimulated by stress hormones. Inhibited by Insulin*

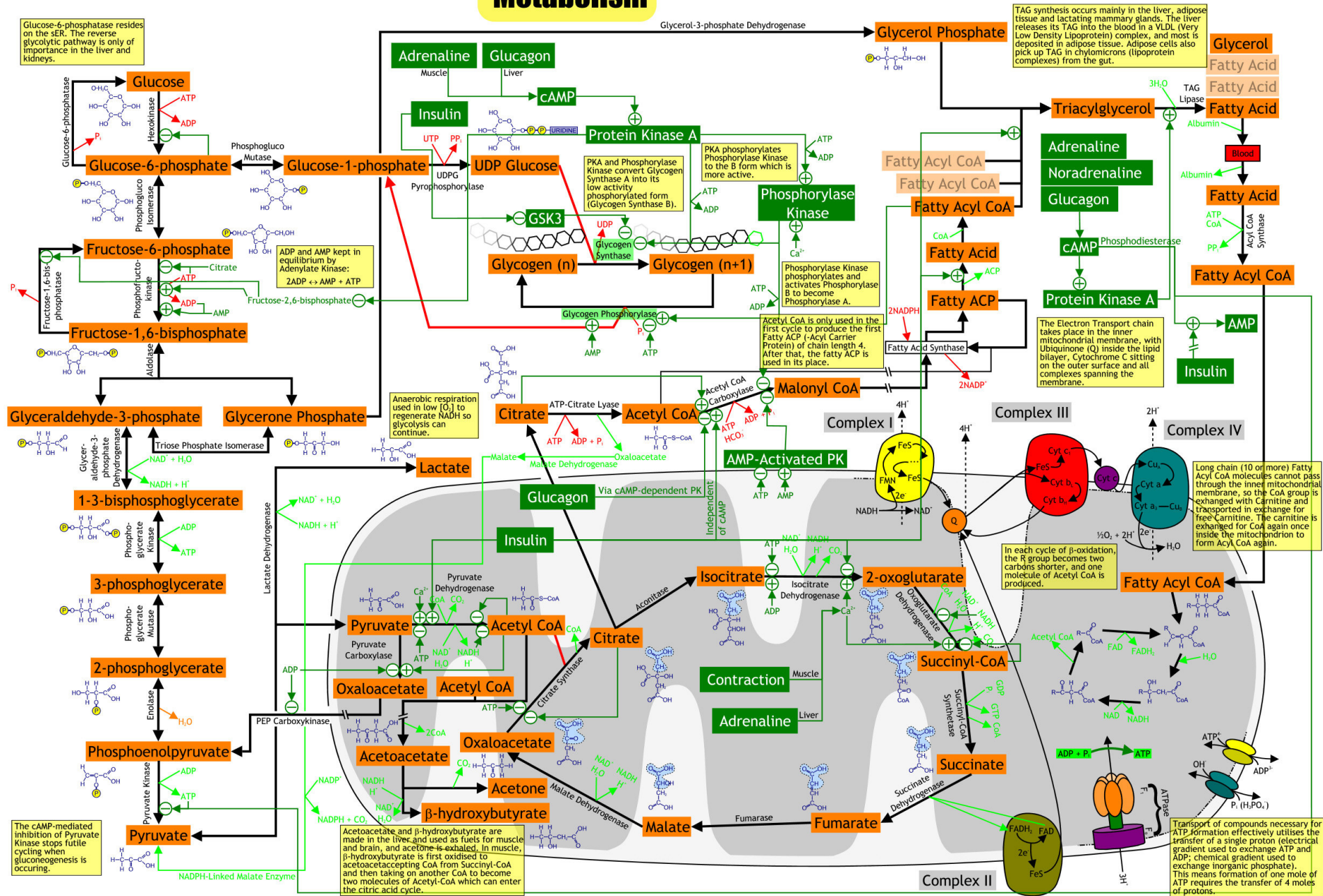
Lipolysis

- Release of Free Fatty Acids (FFAs) from fat
 - FFAs used in fatty acid oxidation in many organs to produce energy
 - FFAs used in ketogenesis
- Lipolysis also releases glycerol which can be used for gluconeogenesis
- *Stimulated by growth hormone and epinephrine.
Inhibited by insulin*

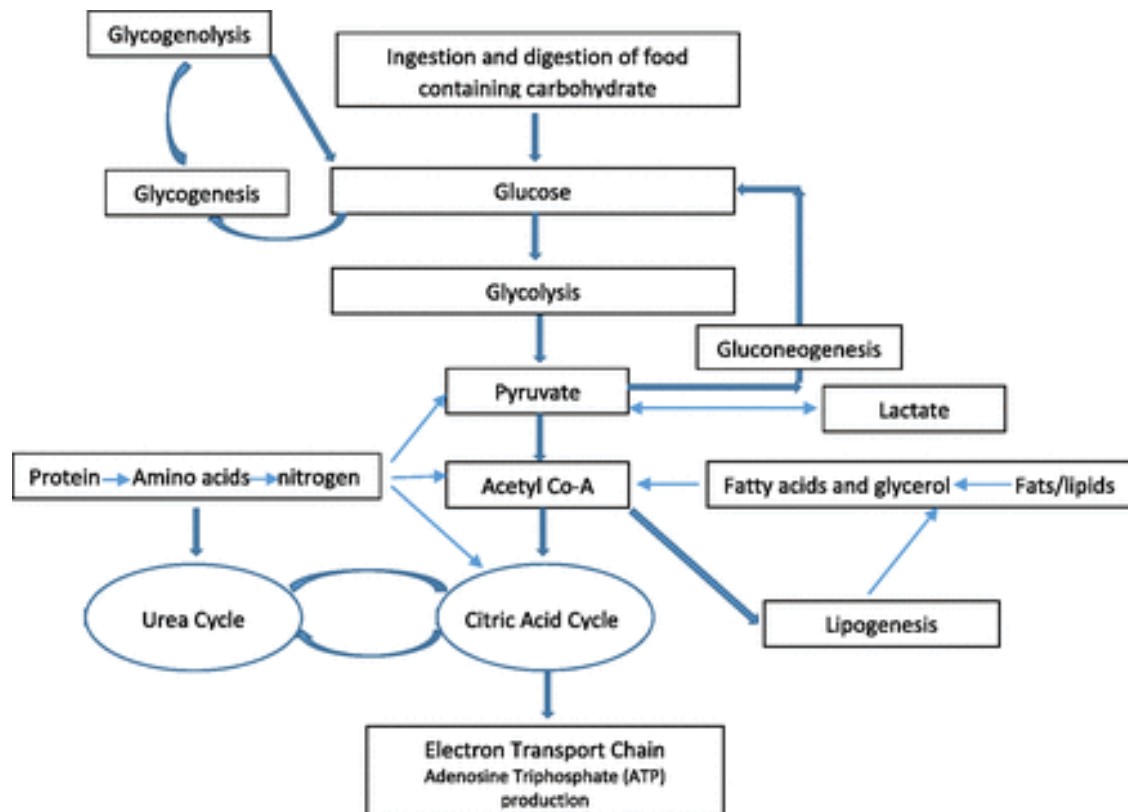
Ketogenesis

- Uses fatty acids produced by Lipolysis
- Fatty acids used by liver to make ketones, B-hydroxybuterate and acetoacetate
- Brain can use these compounds for energy
- *Stimulated by epinephrine, inhibited by insulin*

Metabolism



Easier to look at.....



Fetal Glucose Metabolism

- Fetus receives a steady stream of glucose via diffusion across placenta
- Maternal blood sugar directly related to fetal blood sugar
 - Fetal blood sugar levels usually about 2/3 of maternal blood sugar levels
 - Linear relationship between maternal and fetal blood sugar levels

Fetal Response

- Placenta is impermeable to insulin
- Fetal pancreas functional between 16-24 weeks gestation
- Insulin secretion is upregulated by pulsatile increases in fetal blood glucose concentrations
- *Insulin also acts as a growth factor*

The Big Event

- Baby is born
- Cord is cut
- Transition from **STEADY SUPPLY** of nutrients via umbilical cord to
- **FEAST AND FAST**



Transitional Metabolic State

- High levels of insulin
- Precipitous drop in blood sugar
- Variable glycogen and fat stores
- Delayed activation of enzymes required for ketogenesis and gluconeogenesis?
- **NOW WHAT??????**



Baby Case #1

- A 39 0/7 week first time mom gives birth to a 3500 gm (7#11oz) baby by normal vaginal delivery
- Delivery was uneventful and Apgars were 9 at one minute and 9 at 5 minutes
- On review of mom's medical record she is a healthy 28 year old woman who has had an uncomplicated pregnancy

What is expected?

- Transient hypoglycemia is a normal phenomenon in the first 24 -48 hours of life
 - Blood sugar nadir at 2-3 hours
 - Self-limited
 - No clinical signs
 - Part of adaption to postnatal life
 - Compensated for with gluconeogenesis, glycogenolysis and ketogenesis

Breast or Bottle?

- Breastfed, formula fed and mixed fed infants follow same pattern
 - Fall in blood sugar over first 2-3 hours
 - Gradual increase over next 48-96 hours
- Exclusively Breastfed infants have
 - Slightly lower glucose levels
 - Slightly higher ketone body levels

Risks Factors for Hypoglycemia

Maternal	Newborn History	Newborn Events
Diabetes	Premature Birth	Prolonged fasting
Hypertension	SGA	Cold stress
Eclampsia	LGA	Sepsis/Infection
Dextrose Infusion	CCHD	Asphyxia
Beta Agonists	Midline defects	Polycythemia
Sulfonylureas		