Nutritional and Supportive Care

Nutrition During Fetal Life Constant Supply of Nutrients

- Glucose
- Amino acids
- Lipids
- Calcium
- Magnesium
- Fluids

Fetal to Neonate Transition

- Neonate must supply and regulate these substances
- Transiently hypoglycemic
  - Low at 2 to 4 hours old
- Hypocalcemia

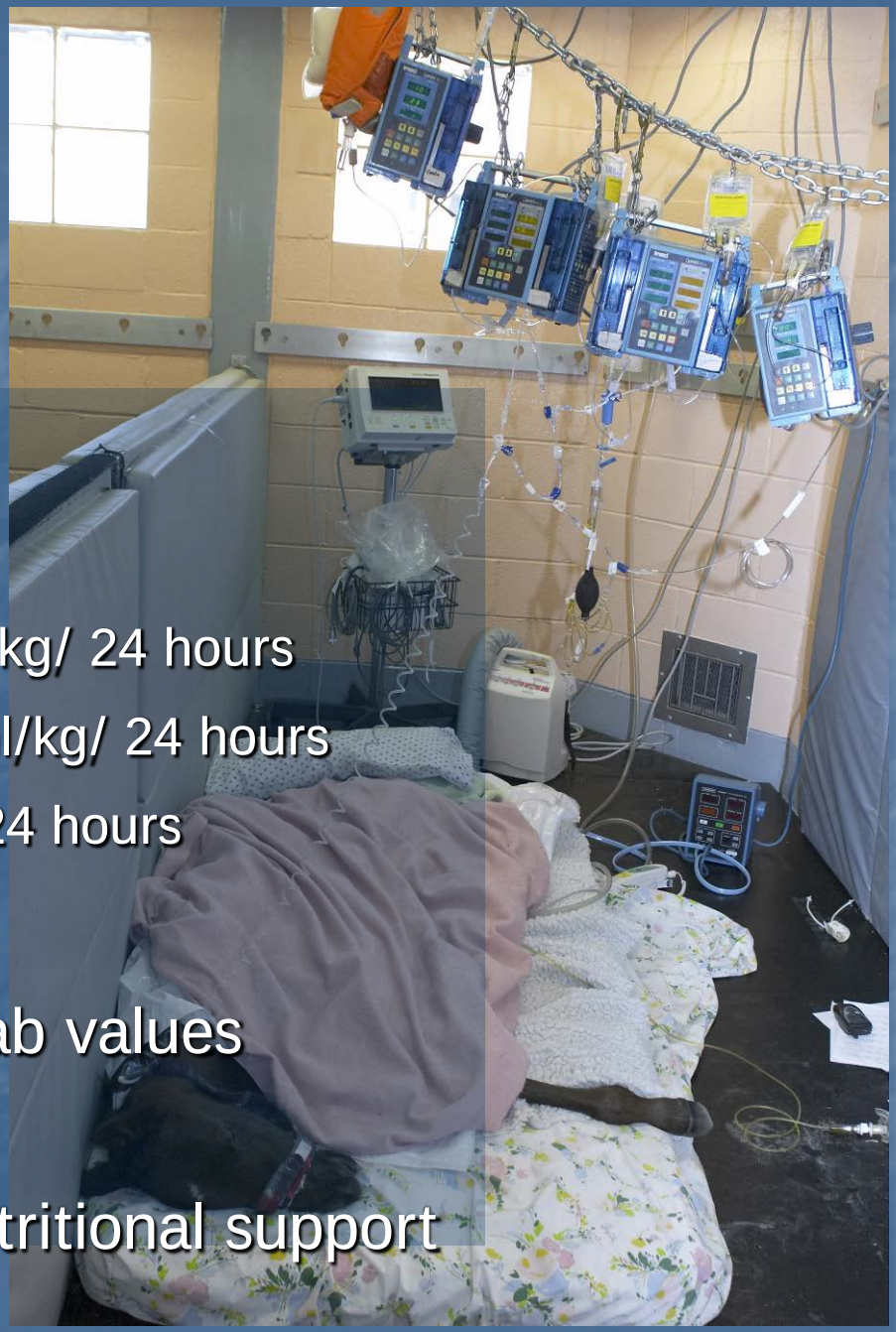
Nutritional Support

- Early Neonatal Period
- Intravenous fluids

  For each Kg up to 10 kg - 100 ml/kg/ 24 hours

  For each Kg from 11-20 kg - 50 ml/kg/ 24 hours

  For each Kg > 20 kg - 25 ml/kg/ 24 hours
- Dextrose - 4 - 8 mg/kg/min
- Electrolyte concentrations - lab values
  - K – 3 mEq/kg/day
- Until enteral or parenteral nutritional support



Early Neonatal Period
Early Hyperglycemia

- Continued glucose production
- Decreased glucose clearance
- Diminished insulin response
- Diminished response to insulin
  - Insulin resistance
- Increased cortisol/epinephrine levels
  - Stress
- Sepsis

Early Neonatal Period
Early Hypoglycemia

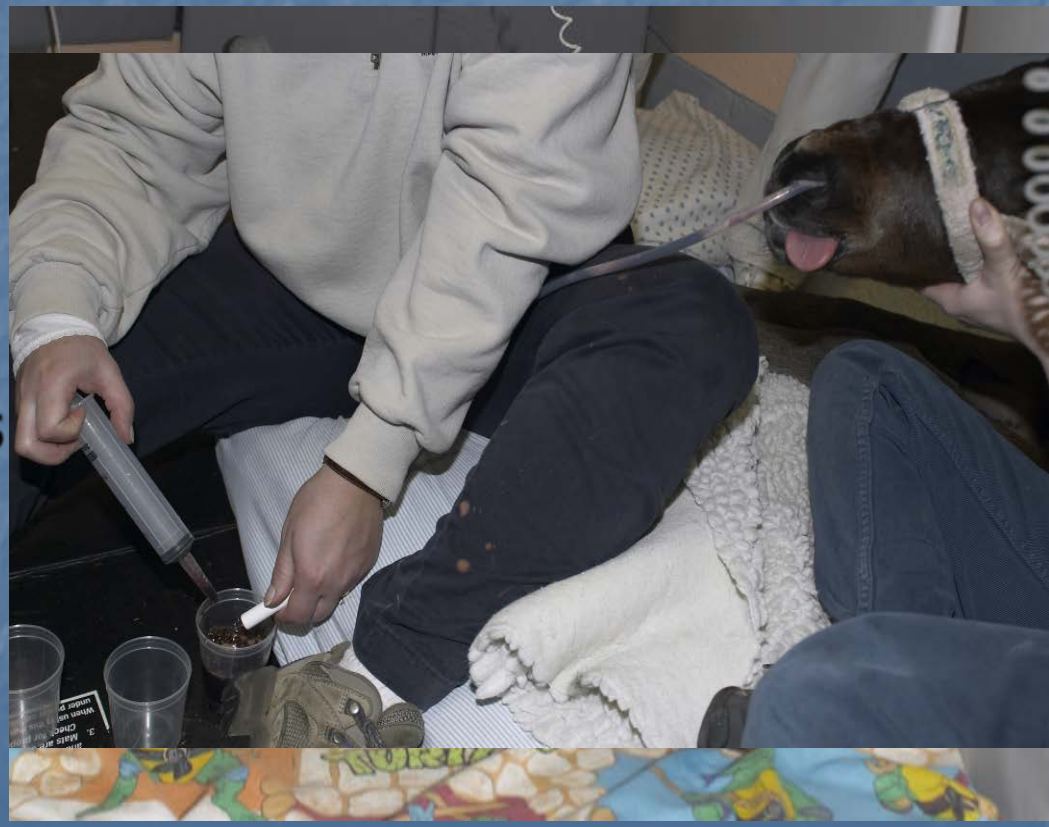
- Limited hepatic glycogen stores
- Inadequate endogenous glucose production
  - Failure of transition to glucogensis
- High glucose utilization – hypermetabolism
- High risk for developing hypoglycemia
  - Perinatal asphyxia
  - Placentitis
    - FIRS
  - Intrauterine growth retardation
    - Placental insufficiency
  - Cold stress
  - Sepsis

Enteral Feeding Advantages

- Physiologic stimulation
- Metabolic regulation
- Gastrointestinal mucosa integrity
- Gastrointestinal mucosa development
- Lower cost

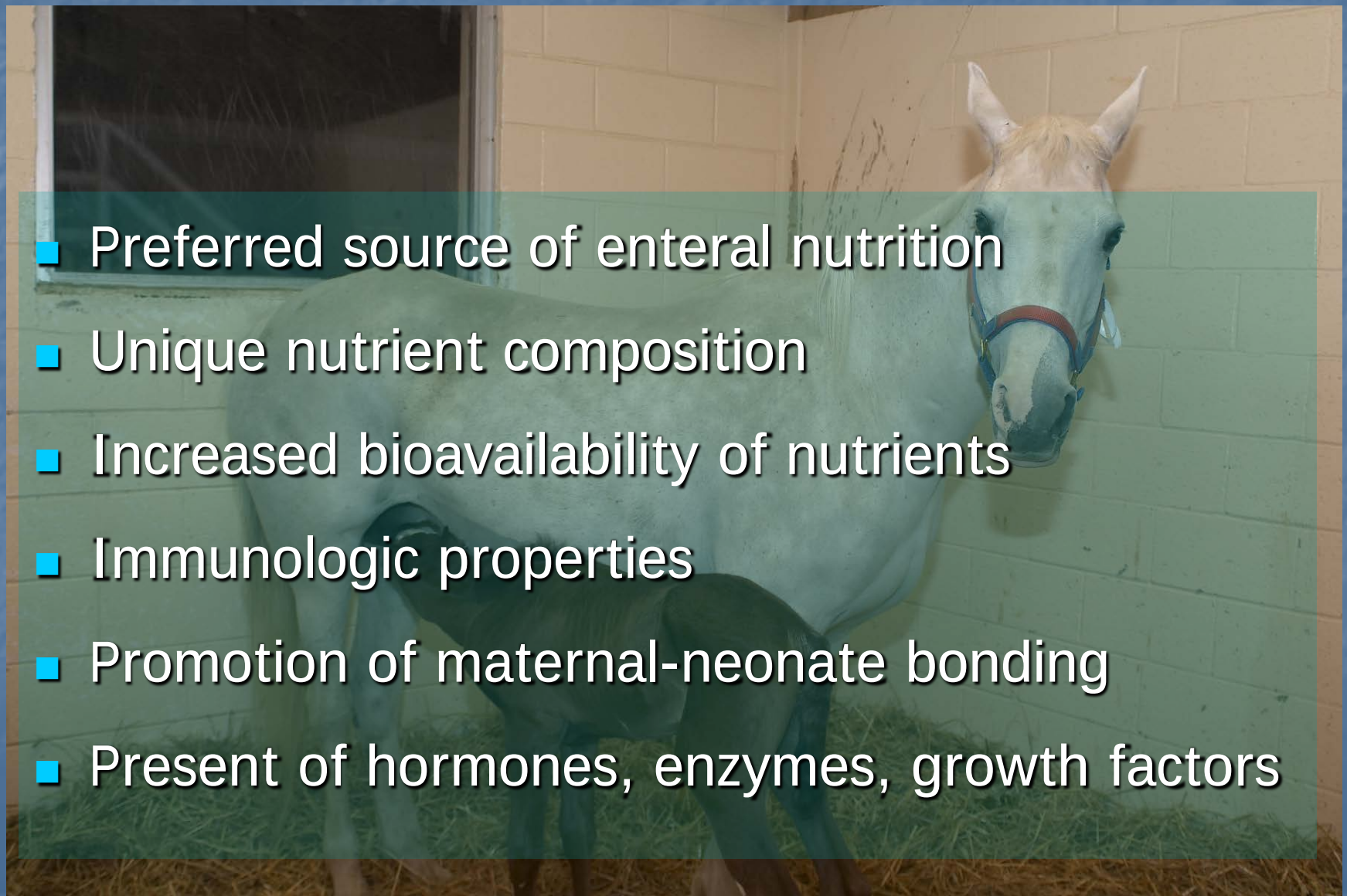
Enteral Feeding
Requirements for initiating enteral feeding

- No abdominal distension
- No gastric reflux
- Passage of meconium
- Active bowel sounds
- If severe perinatal distress
  - Stable blood pressure
  - Temperatures near 100 F
  - Normal Pao_2
  - Stable blood glucose




CRITIKON
DINAMAP™
VETERINARY BLOOD PRESSURE MONITOR 8300
MAP mmHg
45
SYSTOLIC mmHg
73
PULSE bpm
97
DIASTOLIC mmHg
35
AUTO MANUAL
START
CYCLE
MINUTES
CUFF
POWER
BATTERY
OFF

Enteral Feeding
Fresh mare's milk



- Preferred source of enteral nutrition
- Unique nutrient composition
- Increased bioavailability of nutrients
- Immunologic properties
- Promotion of maternal-neonate bonding
- Present of hormones, enzymes, growth factors

Enteral Feeding
Other choices

- Frozen mare's milk
- High quality powdered milk replacer
- Goat's milk

Enteral Feeding

- Initially feed 5% of body weight / 24 hours

  Divided into 12 feedings

- If foal tolerates this volume
- Increase to 10% during the first day
- Normal foal
  - Target of 20-25% of his body weight / day

    21% provides the ideal 120 kcal/kg/day

Enteral Feeding
Ill Foal

- Enteral feeding is questionable
  - Trophic feelings
  - 1-2% body wt divided every 4-6 hrs
  - Provide calories / protein using parenteral route
- Permissive underfeeding
  - Over-nutrition associated with sepsis
  - Ill foals are confined
  - Target – enough to maintain anabolism
    - 1-2% weight gain per day
  - Usually 12-14% body weight

Enteral Feeding

- Example 20% - 114 kcal/kg/day
- 110 lb Foal

  110 lb X 20% = 22 lb

  22 lb X 16 oz/lb = 352 oz/day

  352 oz / 12 feedings = 29 oz/feeding
- 50 kg Foal

  50 kg X 20% = 10 kg = 10 liters

  10 liters / 12 feedings = 833 ml/feeding

Enteral Feeding Route

- Suckling
- Small Diameter

  Indwelling Nasogastric Tube

Enteral Feeding
Suckling

- Best route - physiologic stimulation
- Abnormal suckling behavior

  Desperately want to suck

  Ineffective

  High risk for aspiration

  - Healthy neonate - few consequences
  - Critical neonate - pulmonary disease
- Feed on demand - at least Q2H

Enteral Feeding
Small Diameter Indwelling Nasogastric Tube

- Feed every two hours
- Bolus feeding
- Rhinitis
- Pharyngitis

Parenteral Nutrition Intravenous delivery of

- Calories
  - Glucose
  - Lipids
- Protein
  - Amino Acids
- Vitamins
- Trace minerals

Parenteral Nutrition
Glucose requirements

- Primary source of energy developing fetus
- Term net umbilical uptake

  5 to 8 mg/kg/min (7.2-11.5 gm/kg/day)

- Fetus unable to carry out gluconeogenesis

Glucose Support

- All compromise neonates
  - Will benefit from exogenous glucose support
  - Decrease catabolic state
  - Support their recovery
- Blood glucose interpretation
  - Not relate directly to adequate glucose stores
  - Summation of glucose mobilization/utilization
  - Hypoglycemia
  - Normoglycemia
  - Hyperglycemia

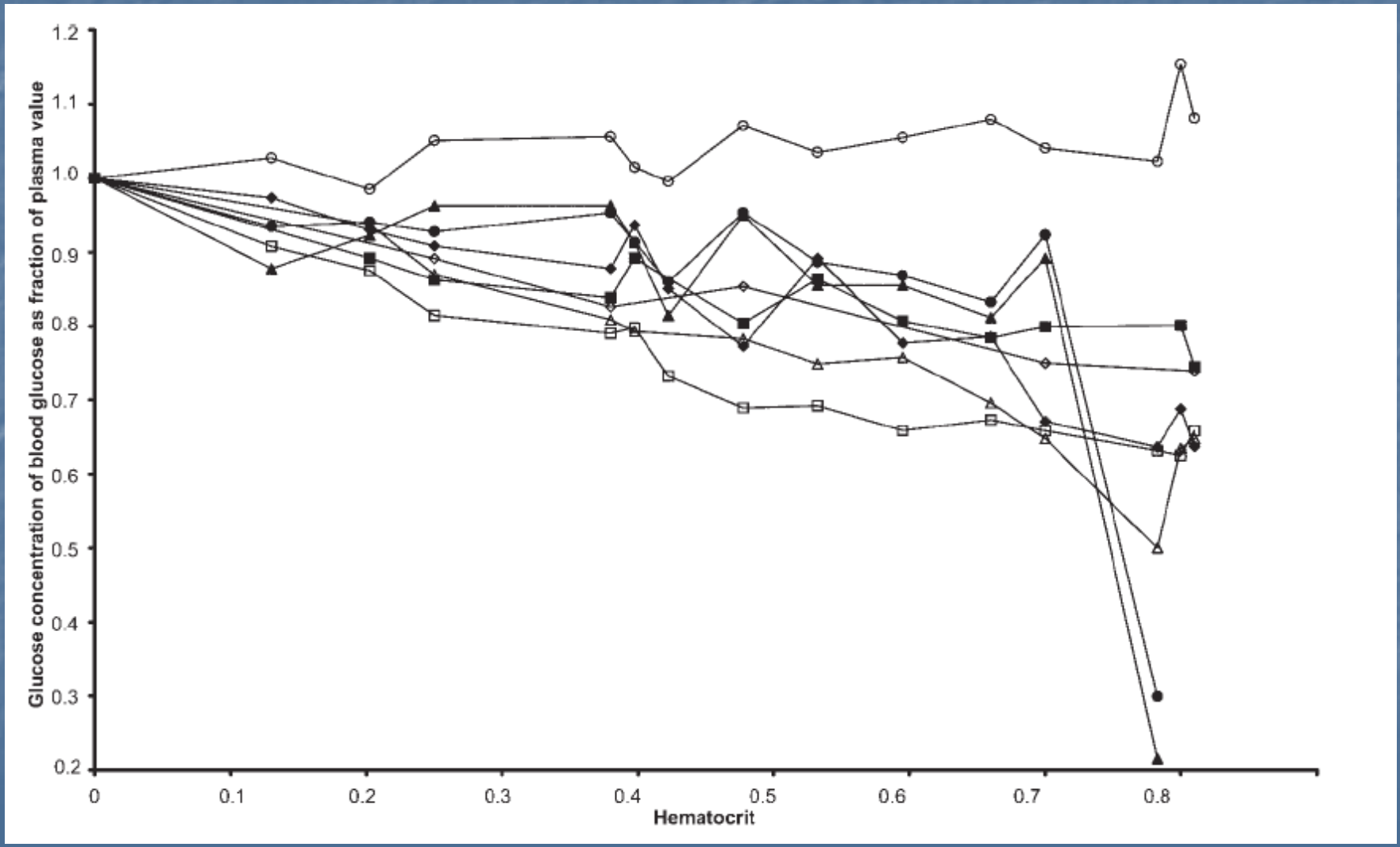
Glucose Measurement

- Bedside monitoring – Glucometers
- Whole blood measurement
  - Electrochemical biosensor
  - Plasma from whole blood
    - Diffuses into, solvates the reagent layer
  - Electrons produced, current generated
  - Photometric test strips
    - Produces a blue color

Glucose Measurement Variation

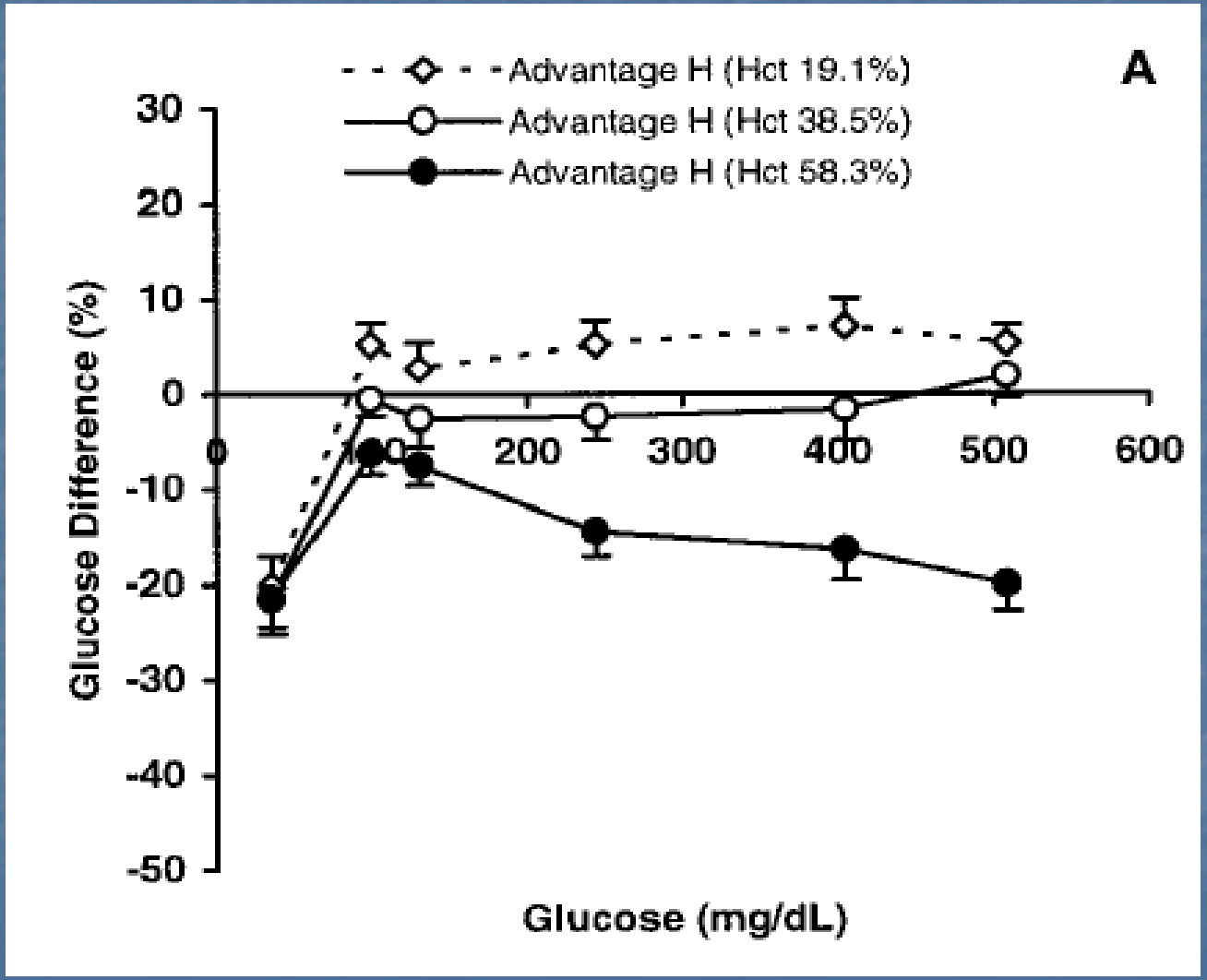
- PCV
- Total protein
- P_{O_2}
- pH
- Model/Instrument
- Reagent strip
  - Handling
  - Age
  - Lot

Glucose Measurement
PCV



Püntmann et al Clin Chem Lab Med 2003; 41(6):809–820

Glucose Measurement
PCV and Glucose Level



Tang et al Arch Pathol Lab Med. 2000;124:1135–1140

Glucose Measurement PCV

- Whole blood vs plasma
- Reagent strip sieve plasma
  - Increased hematocrit may mechanically obstruct diffusion
  - Block the “holes” in the mesh membrane
  - Decrease the volume of plasma available to diffuse
  - Alter blood viscosity, decreasing fluid permeability
  - Rouleau formation

Glucose Measurement PCV

- Critically ill neonatal foals
  - Microclot formation
  - Sample hemolysis
  - Protein deposition
  - High fibrinogen levels
  - Fibrin aggregation
  - Platelet/other cellular aggregation
  - Other inflammatory phenomena

Parenteral Nutrition Glucose requirements

- At birth glucose

  Gluconeogenesis (catecholamine secretions)

  Hepatic glycogenolysis

  Umbilical cord rupture - release Glucagon

- At birth the stimulated fetal liver

  4 to 8 mg glucose/kg/minute

Parenteral Nutrition Protein Requirements

- Estimate amino acid utilization late term fetus
- Intrauterine nitrogen delivering - lambs
  - 2.7 to 3.5 gm/kg/day
  - When total energy is > 70 kcal/kg/day
- Increased requirements
  - Stress
  - Infection
  - SIRS

Parenteral Nutrition
Lipid requirements

- Lipids are not utilized by fetus as energy
- Periods of stress - very important
- Neonatal foals utilize lipids as an energy source

  40 - 50% of total caloric intake can come from fat

Parenteral Nutrition Starting Formula
Example - 50 kg foal

- Dextrose - 10 gm/kg/day - 34 kcal/kg
- Amino acids - 2 gm/kg/day - 8 kcal/kg
- Lipids - 1 gm/kg/day - 11 kcal/kg
- Plus vitamins and trace minerals
- Total - 53 kcal/kg
- Nonprotein kcal - 24% lipid
- Nonprotein kcals:gram nitrogen = 139.5

Foal Nutrition Numbers to Know

- Glucose - 3.4 kcal/gm
- Amino acids - 4.0 kcal/gm
- Lipid - 9.0 kcal/gm
- 6.25 gm amino acids = 1 gm nitrogen
- 1 oz = 30 ml
- 16 oz milk = 1 lb
- Mare's milk - 0.57 kcal/ml

Maternal Bonding Behavioral therapy

- Mares need contact with foals
  - Sight
  - Smell
  - Touch
  - Hear
- Stimulus for lactation
  - Establish milk flow
  - Maintain milk flow

Nurse Mare Bonding

- Environment
  - Quiet
  - No distractions
  - "Foal's Stall"
- Foal's behavior
  - Vigorous nursing
  - Aggressive nursing
- Foal's Smell
- Foal's physical appearance