

Birth Resuscitation



Response to Hypoxia

- Hypoxia in adult
 - CO responsive to tissue O₂ levels
 - Hypoxemia results in
 - Increased CO
 - Increased gas exchange lungs
- Hypoxia in fetus
 - Hypoxemia results in
 - Decreased CO (decrease in HR)
 - Slowing placental perfusion
 - Increase BP
 - Requires intact CNS-adrenergic response

Fetal Adaptation to Hypoxia

- Unlike the lungs, placenta will not deliver more O₂ in response to fetal hypoxemia
- Increase umbilical venous resistance
 - Increases fetal placental surface area
 - Improves maternofetal gas exchange

Fetal Adaptation to Hypoxia

- Fetus/neonate - half of O_2 use is facultative
Growth, anabolic processes, thermoregulation
Not essential for survival
- Lamb
Fetal lamb – 30-40% of O_2 used for growth
Neonatal lamb – 30% of O_2 used for growth
- Induced maternal hypoxemia
Decrease O_2 delivery by 50%
No anaerobic metabolism, no fetal acidosis

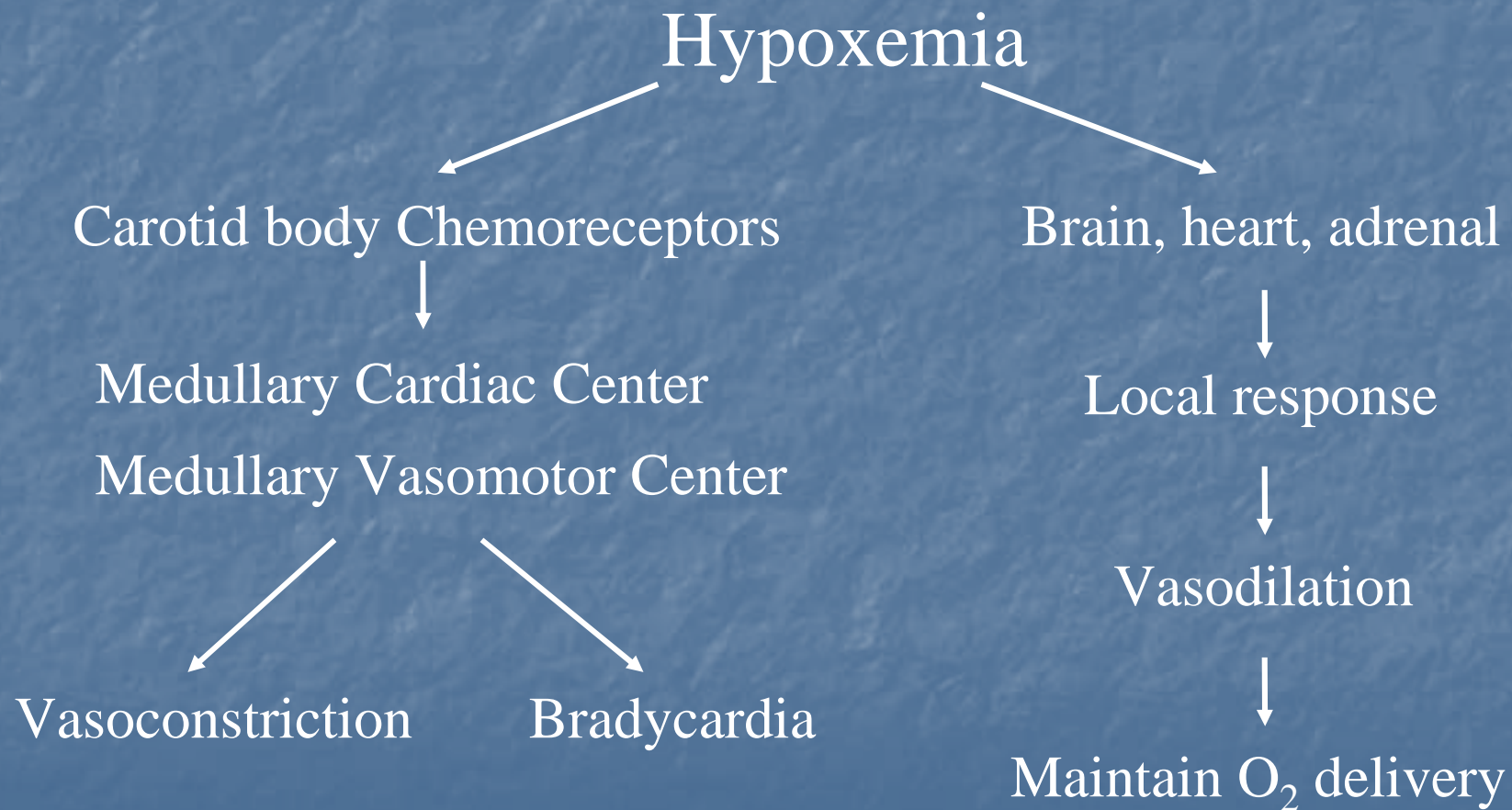
Fetal Adaptation to Hypoxia

- Tolerance to acute hypoxia
 - Turn off growth – how?
 - Decrease unnecessary activity (fetal breathing)
- Tolerance to chronic hypoxia
 - Hypoxia – tolerant cells
 - Postulated to have fewer ion channels
 - Require less energy to prevent Ca leak
- Organs with high metabolic activity
 - Brain, heart
 - Smaller % O₂ used for growth
 - Need to maintain O₂ delivery in face of hypoxemia

Fetal Adaptation to Hypoxia

- Decrease CO (decrease HR)
 - Decrease cardiac O_2 need
 - But increase BP – cardiac work not change
- Redistribution of combined ventricular CO
 - To heart & brain increase from 7% to 25%
 - Increase to adrenal circulation

Fetal Response to Hypoxia



Fetal Response to Hypoxia

Blood Flow Redistribution

- % distribution biventricular cardiac output
 - ↓ Gut, spleen, carcass
 - ↑ Brain, heart, adrenals, placenta
- Fetal lamb \rightarrow ↓ $P_{O_2} = 12-14$ mmHg
 - 4 – 7 X ↑ myocardial flow
 - No ↓ O₂ delivery
 - Myocardial performance sustained
 - ↑ sympathoadrenal activity
 - ↑ coronary blood flow

Fetal Response Hypoxemia

FHR

- Hypoxia stressed fetus with compensation
 - Will have slow FHR
 - Will have fewer FHR accelerations
- Decompensation – hypoxic acidosis
 - Will lose central adrenergic response
 - Develop persistent tachycardia
 - Terminal bradycardia

Fetal Cardiac Response to Hypoxic Stress

- Effect of Hypoxia/Acidosis on Cardiac fn

As long as adrenergic support (CNS)

$P_{O_2} < 15$, pH normal → normal ventricular fn

P_{O_2} normal , pH < 6.8 → normal ventricular fn

$P_{O_2} < 25$, pH < 6.8 → ↓↓↓ ventricular fn

- Basis of hypoxic ischemic disease

Fetal/neonatal myocardium

- Resistant to hypoxic damage
 - Due to high rate of anaerobic glycolysis
 - Greater glycogen stores
 - Resistance of fetal cells to damage from lactic acidosis
- Resistance to combined hypoxia/hypercapnia
- Resistance to ischemia dysfunction
 - After short periods quickly recovers
 - Will work as efficiently as before insult
- Resistant to ischemic myocardium cell death
- More likely to survive cardiopulmonary arrest

Fetal Response to Maternal Oxygen Therapy

- Positive response

 - Increase in FHR base line

 - More FHR accelerations

- But

 - Most fetal foals have low FHR base lines

 - Probably reflects efficiency of CV system

 - Utilize oxygen for growth

Birth



Birth Transition



Transition begins weeks before birth



Transition days before birth



Transition continues through neonatal period



Vital Transitions



Initiation of Breathing



Triggering the First Breath



APGAR Score

Current Researches in Anesthesia and Analgesia—July-August, 1953

A Proposal for a New Method of Evaluation of the Newborn Infant.*

Virginia Apgar, M.D., New York, N. Y.

Department of Anesthesiology, Columbia University, College of Physicians and Surgeons and the Anesthesia Service, The Presbyterian Hospital

RESUSCITATION OF INFANTS at birth has been the subject of many articles. Seldom have there been such imaginative ideas, such enthusiasms, and dislikes, and such unscientific observations and study about one clinical picture. There are outstanding exceptions to these statements, but the poor quality and lack of precise data of the majority of papers concerned with infant resuscitation are interesting.

There are several excellent review articles^{1 2} but the main emphasis in the past has been on treatment of the asphyxiated or apneic newborn infant. The purpose of this paper is the reestablishment of simple, clear classification or "grading" of newborn infants which can be used as a basis for discussion and comparison of the results of obstetric practices, types of maternal pain relief and the effects of resuscitation.

The principle of giving a "score" to a patient as a sum total of several objective findings is not new and has been used recently in judging the treatment of drug addiction.³ The endpoints which have

Equine APGAR Score

Score	0	1	2
<i>Heart Rate</i>	Absent	< 60 irregular	> 60 regular
<i>Respiratory Rate</i>	Absent	irregular	regular
<i>Muscle Tone</i>	Limp Lateral	Some Flexion	Active Sternal
<i>Reflex Nasal Stimulation Ear Tickle</i>	No Response	Grimace Weak Ear Flick	Sneeze/Cough Ear Flick/Head Shake

Preparation for Resuscitation

- Anticipation
- High risk situations
 - Obvious from history
 - Intrapartum course
- Unexpected
 - 50% of neonates requiring birth resuscitation
- Must always be prepared
 - Well thought out plan
 - Readily available equipment





EXIT

Ex-utero
Intrapartum
Treatment

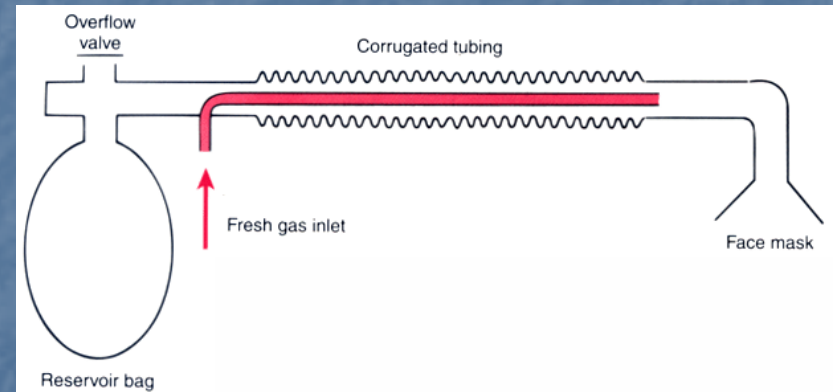


Development of EXIT



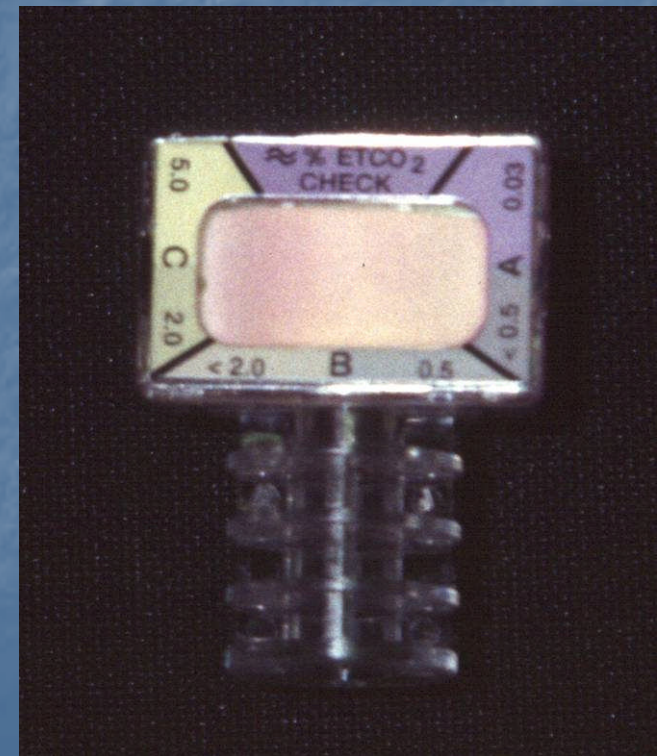
EXIT Technique

- During a dystocia
 - If nares are external
 - If nose in the pelvic canal, palpable
- Intubation attempted
 - Placement checked
 - Bain Circuit
- Ventilation initiated
 - Self inflating bag



EXIT Technique

- Carbon dioxide detector
 - Capnograph
 - Easy Cap II



EXIT Capnography

- Monitor cardiac output
 - ETCO₂ correlates with cardiac output
- Ventilation
 - Transition - placental to pulmonary circulation
- Initially ETCO₂ low (4 – 8 torr)
 - Residual tissue levels
- ETCO₂ levels predict viability
 - Dead fetus
 - Initially 4 – 8 torr
 - Quickly becomes 0
 - Compromised foal
 - 8 to 20 torr
 - Responding to resuscitation
 - 40 to 60 torr



EXIT Technique

- Drug therapy
 - Catheter through endotracheal tube
 - Epinephrine
 - Vasopressin
 - Naloxone
- Pulse/ECG
- Arterial blood gas
 - Lingual artery





EXIT

- General anesthesia in mare
- Redirection of placental blood flow to the lungs
- Decrease in placental blood flow
 - Associated with rise in fetal PO₂
 - O₂ Rx
 - Controversial
 - Role in redirection of placental blood flow
 - Favor of its use during EXIT
 - Decrease transfer of anesthetic agents/other drugs
 - Reduction in neonatal depression after delivery



EXIT

Summary

- Luxury of time to correct the dystocia
- Assess fetal viability
- Rescue foals during dystocia
- Increase successful referral radius

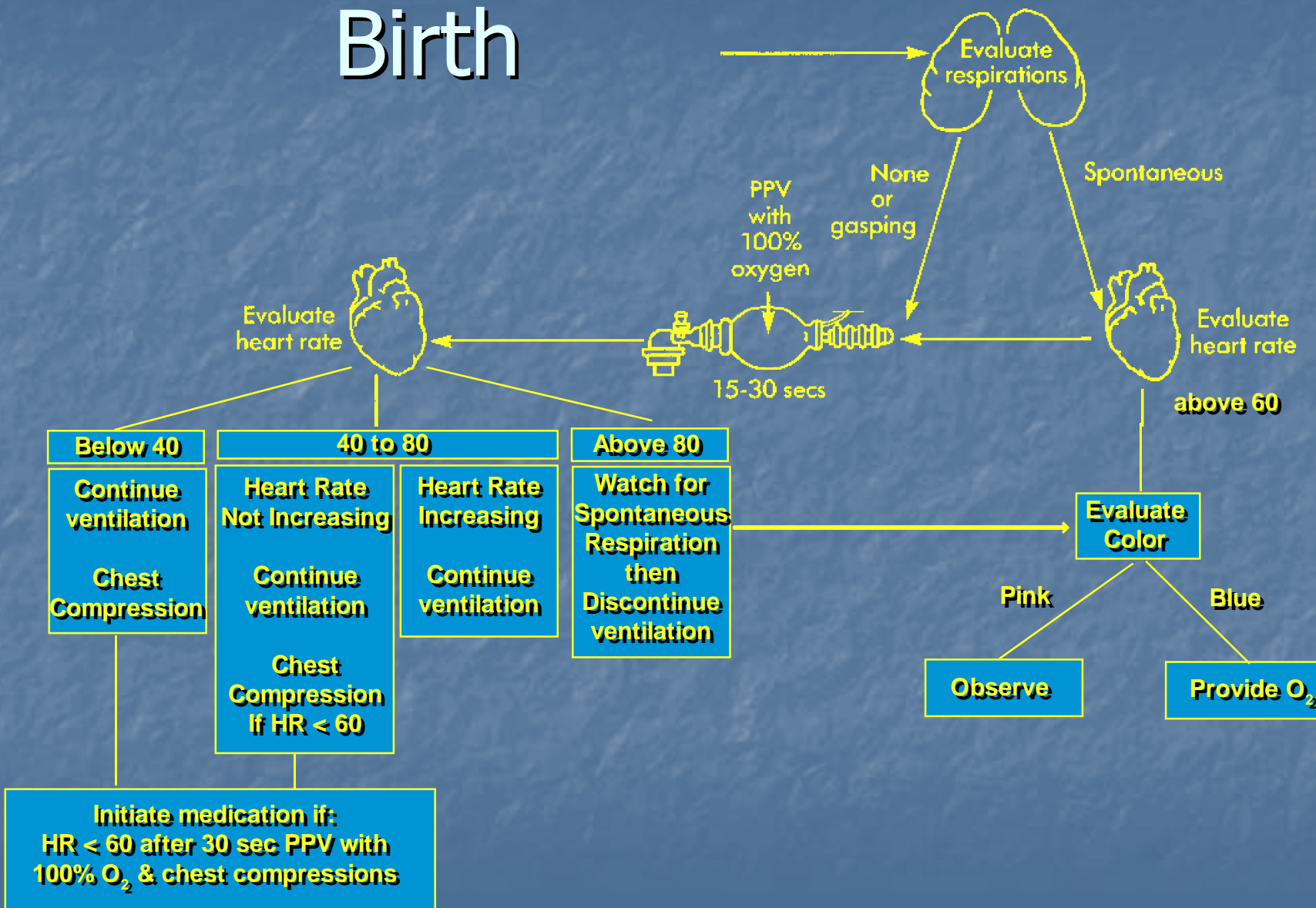




Elements of Resuscitation

- *Initial Quick Overview*
- *Apgar score*
- *Clearing the Airway*
- *Tactile Stimulation*
- *Thermal management*
- *Free Flow Oxygen*
- *Ventilation*
- *CPR*
- *Post resuscitation care*

Birth



Initial Quick Overview



Apgar Score *1, 5, 10 minutes*



Clear Airway



Meconium Aspiration



Tactile stimulation



Thermal management

A photograph of a brown horse lying in a hospital bed. The horse is covered with a white blanket and has a white bandage around its neck. Medical equipment, including a metal stand and a black chair, is visible in the background. The scene is dimly lit, suggesting an indoor clinical setting.

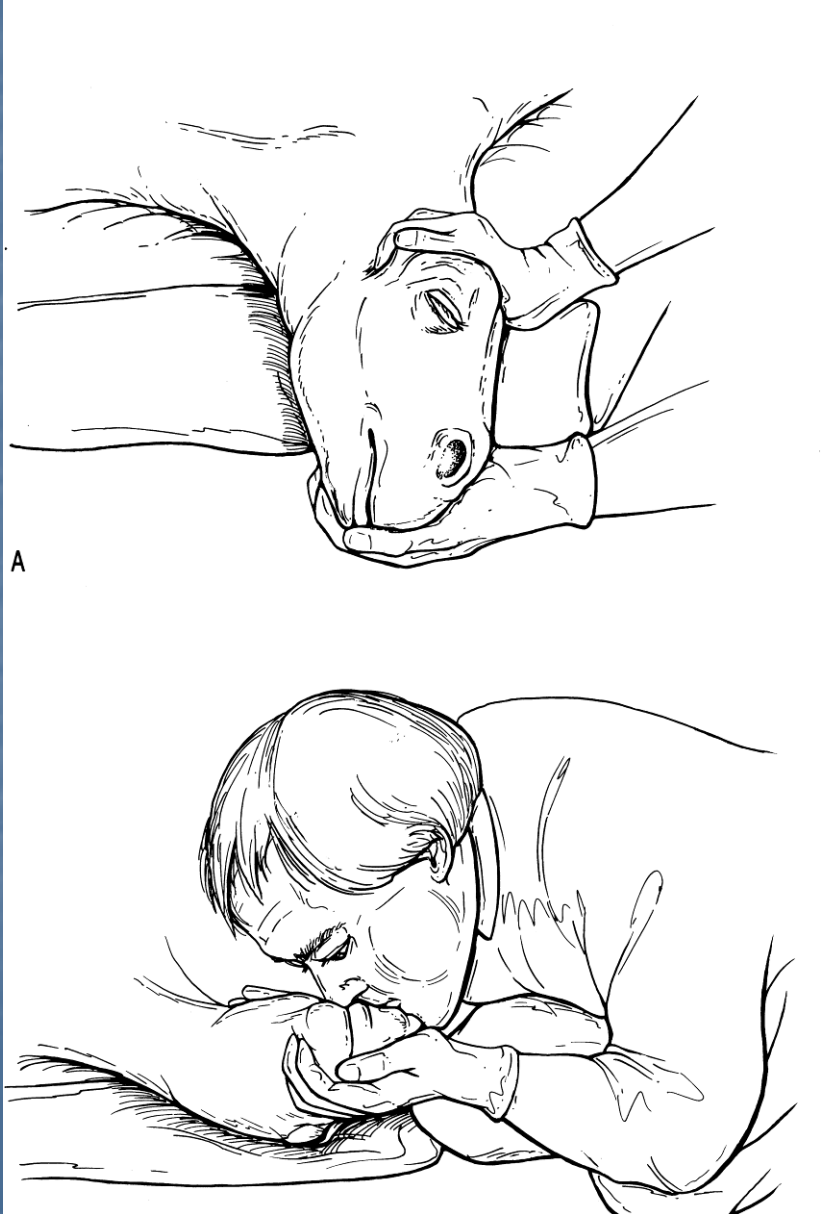
- Dry with towels
- Move to warm area
- Radiant heat
- Hot water pads
- Hot air blanket

Free-flow O₂


- Intranasal O₂
- Flow-by O₂



Mouth-to-Nose Ventilation



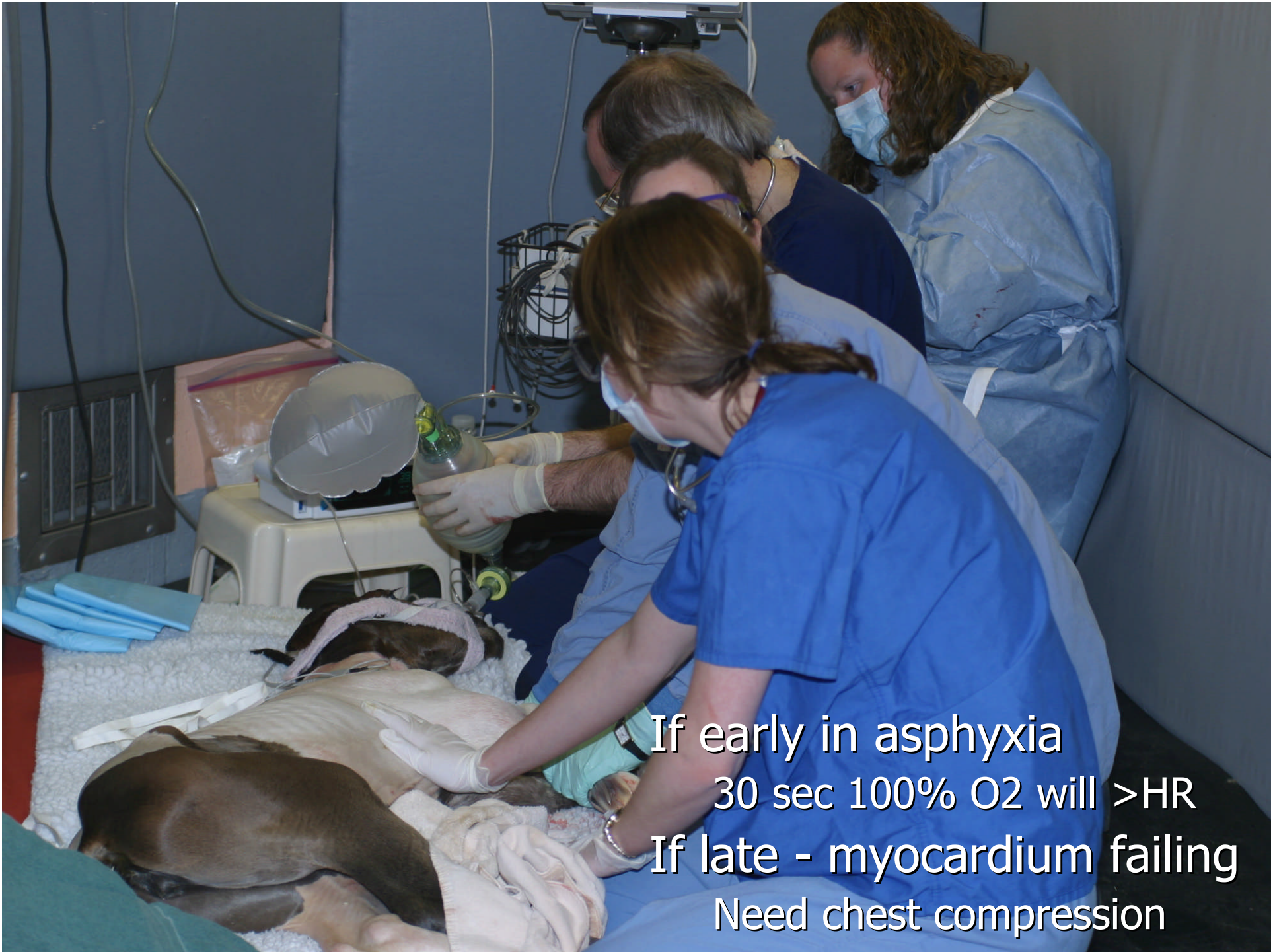
If the neonate
does not breath
spontaneously



Self-inflating
bag valve
device

Drug-depressed Neonate

- Alpha2-adrenoceptor agonists reversal
 - Atipamezule
 - Yohimbine
 - Not tolazoline
- Diazepam reversal - flumazenil
- Opiate reversal – naloxone
- Volatile anesthetic reversal
 - Ventilation



If early in asphyxia

30 sec 100% O₂ will >HR

If late - myocardium failing

Need chest compression

Cardiovascular Support

- Assessment
- Nonperfusing rhythm?
 - Most frequently bradycardia
- Chest compression
 - If not perfusing (bradycardia)
 - If HR not perfusing in 30 sec - use drugs

Advanced Life Saving – CPR

- Epinephrine
 - Low dose 0.02 mg/kg
 - High dose 0.1 mg/kg
 - Repeat every 3 min
- Vasopressin
 - 0.2 – 0.4 U/kg
 - Once

