Pulmonary Problems

During the First Week of Life

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Online Lecture Notes

PDF files of slides

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Lower Respiratory Diseases

- Ventilation/Perfusion Abnormalities
- Pneumonia
- Secondary pulmonary disease
- Therapy

Ventilation/Perfusion Abnormalities

- Mismatching
- Shunting
  - Retention/ reversion to fetal CV physiology
- Alveolar Dead Space Ventilation
- Hypoventilation
- Progressive atelectasis

Ventilation/Perfusion Abnormalities

- Mismatching
  - Uneven perfusion
    - Poor cardiac output
    - Poor vascular reactivity to oxygen?
  - Uneven ventilation
    - Body position
    - Weakness
    - Fatigue
- Hypoventilation
  - Fatigue
  - Central weakness
  - Upper airway disease

V/Q Mismatching

pH	7.436	7.459
Pco_2	54	54
Po_2	37	368
HCO_3	36	38
BE	+11.5	+13.6
O_2 SAT	75%	100%
O_2 content	10.0	12.8
Fio_2	RA	INO_2

Ventilation/Perfusion Abnormalities

- Fetal to neonatal cardiopulmonary physiology
  - Delayed transition
  - Failure transition
  - Reversion
    - Hypoxemia
    - Inflammatory mediators
    - Systemic hypotension

Right-to-Left Shunt

pH	7.377	7.385
Pco_2	29.8	28
Po_2	51.2	71.5
HCO_3	17.7	16.9
BE	-5.7	-6.1
O_2 SAT	81.7	92.9
O_2 cont	15.6	18
Lac	9.8	11.6
Fio_2	RA	INO_2

Right-to-Left Shunt

	ABG	ABG	VBG
pH	7.369	7.356	7.343
Pco_2	38.3	39.2	44.2
Po_2	21.1	31.6	29.6
HCO_3	22.3	22.1	24.2
BE	-2.2	-2.5	-1.1
O_2 SAT	<30	50.4	46.4
O_2 cont	5.7	9.0	7.8
Fio_2	RA	INO_2	INO_2

Progressive Atelectasis

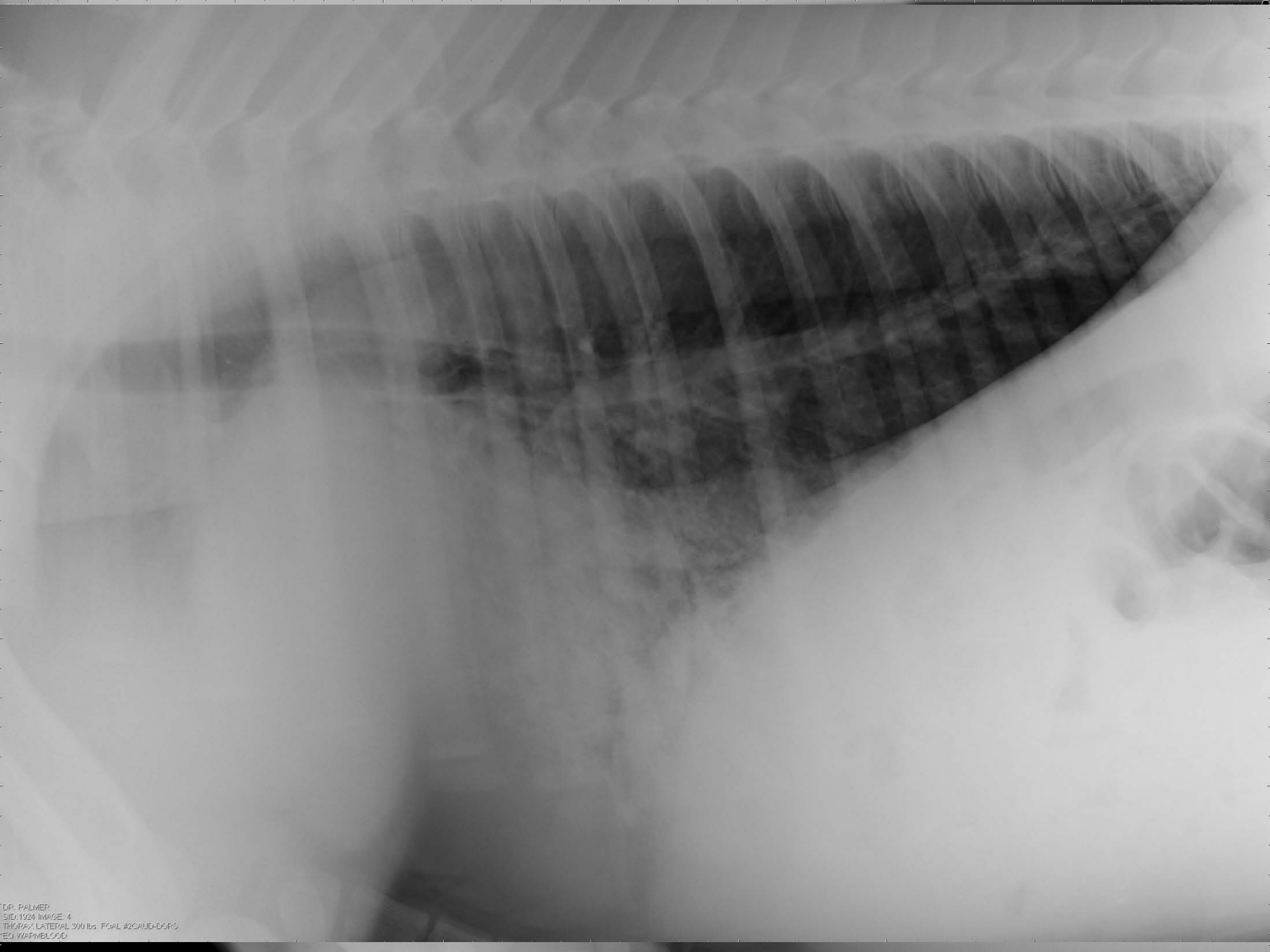
- Unable to maintain FRC
  - Weakness/compliant chest wall
  - Stiff lungs
- Some alveoli collapse on exhalation
  - Repetitive collapse – eject surfactant
  - Some alveoli don't reopen
  - Closed alveoli pull on others
    - More alveoli close
- Decreased compliance
  - As more atelectasis
  - Causes more fatigue
- Self-perpetuating

Wave Chest Fatigue

- No longer be able to hold the chest open
- Inspiration
  - Diaphragm contracts
  - Chest wall pulled towards the lungs
  - Abdomen expands
- Expiration
  - Diaphragm relaxes
  - Chest wall moves out
  - Abdomen moves in
- Significant fatigue
  - Respiratory failure
  - Respiratory/cardiac arrest
- Sleeping neonate

Aspiration Pneumonia

- May or may not be symptomatic
- Lung changes caudal heart base
  - Except lateral recumbent foals
- Signs
  - Respiratory effort and rate are increased
  - Pneumonic sounds
    - Referred upper airway sounds
  - Apneustic breathing pattern
  - Radiographs or ultrasound examination
  - Hematology and blood fibrinogen
- Mixed bacterial flora expected
- Prognosis
  - Most important factor - stopping aspiration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THORAX LATERAL 200 lbs FOAL #2CAUD-DORS
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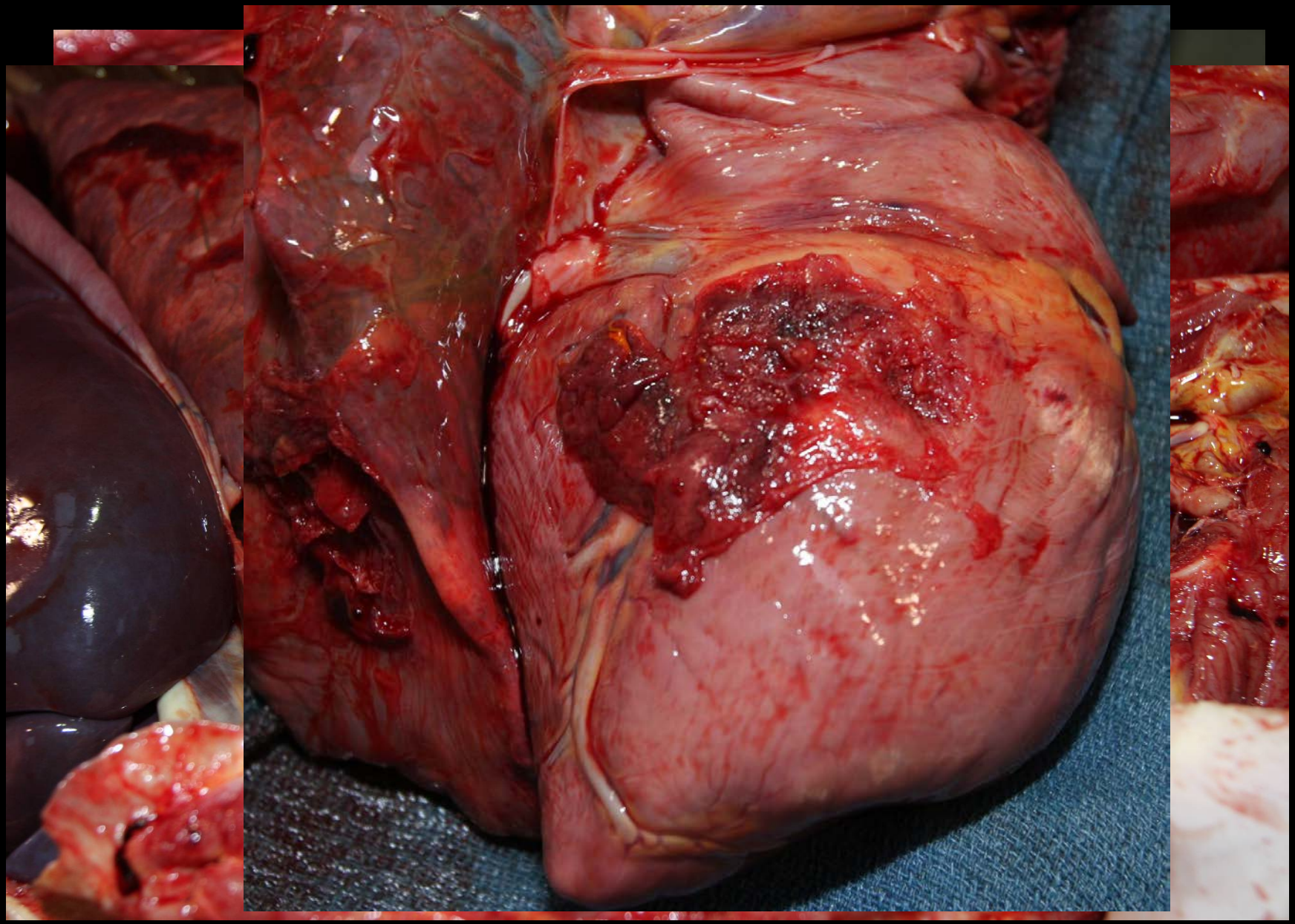
Meconium aspiration

- Rare
  - Before birth
    - Associated with asphyxia
    - Fetal gasping
  - During delivery
    - Liquid meconium - upper airways
- Diagnosis
  - Stained nasal discharge
  - Radiographic changes
- Signs
  - Persistent tachypnea
  - Inflammatory hemogram
  - No bacterial infection
    - Persist up to a week or longer
    - Tachypnea and hyperfibrinogenemia
    - No radiographic/US changes
  - Secondary bacterial infections

Secondary Pulmonary Disease
Traumatic Pulmonary Disease

- Fractured ribs
  - Pulmonary contusions
  - Pulmonary/Plural hemorrhage
  - Lacerations of major arteries
  - Pneumothorax
  - Traumatic diaphragmatic hernia
- Pleuritis and pleural effusion



Secondary Pulmonary Disease Abdominal Hypertension

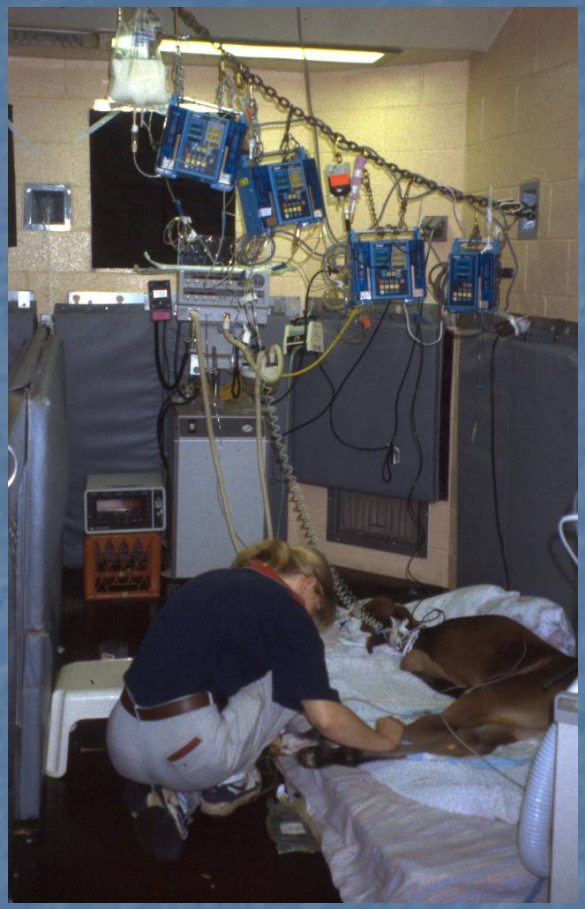
- Abdominal hypertension
  - Ruptured bladder
  - Intestinal distension
    - Acute enteritis
    - Ileus

- Decreased pulmonary blood flow
- Increased atelectasis
- Decreased compliance
- Increased mismatching/shunt fraction

Sepsis

- Septicemia
  - Systemic localize in lungs
  - Primary pulmonary infection
- Bacterial
  - Hematogenous colonization
  - Aspiration
- Viral pathogens
  - Herpes Virus
  - Equine Viral Arteritis virus
  - Equine Influenza virus

ARDS



- Absence of pathogens
- Inflammatory response
  - Profound disruption of the lungs
  - Inflammatory mediators
    - Inducers of pulmonary hypertension
    - Significant right-to-left shunting
    - Face of systemic hypotension
- Acute lung injury (ALI)
- Acute Respiratory Distress Syndrome (ARDS)

Supportive Respiratory Therapy

- Respiratory failure
  - Supportive therapies
  - Helpful
  - Harmful

Supportive Respiratory Therapy

- Positional therapy
- Intranasal oxygen insufflation
- Increasing cardiac output
- Inhaled nitric oxide (NO)
- Other supportive care
  - Nutrition, fluids, etc
- Stenting the airway
- Respiratory stimulants
- Positive pressure ventilation

Hypoxemia
Positional Therapy

- Help with V/Q matching
  - Aid oxygen loading
- Helpful if
  - Weak
  - Poor inspiratory excursions
  - Marginal perfusion
- Difference is not seen in all foals
  - Fighting the position
  - Arterial blood gas samples “worst case scenario”

Hypoxemia
Intranasal Oxygen Insufflation

- Oxygen is
  - Most useful/ Most dangerous drug
- INO_2 will correct mismatching
- Should not be universally applied
  - Based on careful monitoring
  - Stall side blood gas analyzers
  - More realistic goal
- Complications
  - Oxygen toxicity
  - Nasal irritation
  - Rhinitis
  - Airway drying
    - Tracheal and nasal discharge
    - Increased upper airway resistance

Hypoxemia
Increasing Cardiac Output

- Remain hypoxemic despite INO_2
- Alveolar dead space ventilation
- Shunt fraction
  - Pulmonary hypertension
  - Increasing CO - decrease shunt Fraction?
- Dobutamine
  - Euovolemic hypoxemic
  - Dramatic improvement in oxygenation

Hypoxemia
Inhaled Nitric Oxide (NO)

- Pulmonary hypertension
  - 5-10 ppm NO
- Uneven ventilation and perfusion
  - Vasodilatation to ventilated alveoli
- Clinical improvement
  - Septic shock
  - ARDS
  - Transient – reverse early pathology

Hypoventilation

- Achieve a normal blood pH
  - Not “normal $Paco_2$”
  - Appropriate hypoventilation
- Permissive hypercapnia
- Therapeutic hypercapnia
- Therapeutic hypoxemia

Respiratory Acidosis

- Upper airway collapse
  - Endotracheal tube stent
- Neonatal Encephalopathy
  - Blunted central sensitivity
  - Chemical stimulants
    - Caffeine
    - Doxapram

Positive Pressure Ventilation

- Manipulation of pulmonary gas exchange
- Increase lung volume returning normal FRC
- Decrease the work of breathing
  - Relieve fatigue
  - Decrease respiratory oxygen and energy utilization
  - Redirect perfusion away from respiratory muscles
- Modern ventilators
  - Normal lungs – easily ventilated
  - Severe pulmonary damage – possible to be successful
    - Septic pneumonia
    - ARDS