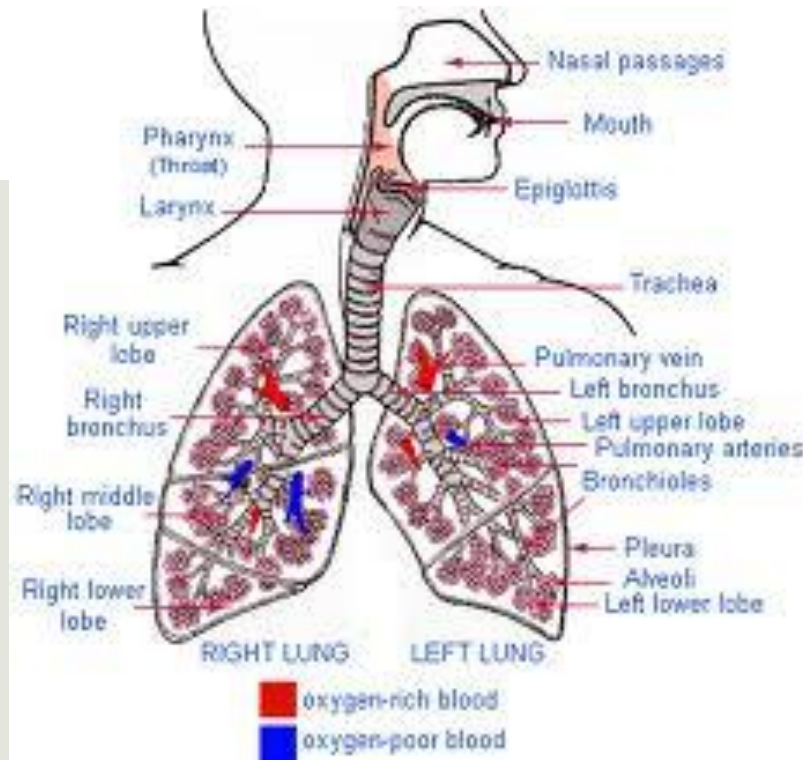


ARDS

▣ <http://youtu.be/SPWAR0bqMkM>

Acute Respiratory Distress Syndrome (ARDS)



Meg, Kelly, Ariel, and Jeannine

Etiology and Pathophysiology

ARDS: definition

- characterized by acute onset of hypoxemia and bilateral pulmonary infiltrates consistent with pulmonary edema but without evidence of left heart failure

ARDS: description

- ARDS often occurs along with the failure of other organ systems, such as the liver or the kidneys. Cigarette smoking and heavy alcohol use may be risk factors
- ARDS leads to a buildup of fluid in the air sacs. This fluid prevents enough oxygen from passing into the bloodstream.
- The fluid buildup also makes the lungs heavy and stiff, and decreases the lungs' ability to expand.
- The level of oxygen in the blood can stay dangerously low, even if the person receives oxygen from a breathing machine (mechanical ventilator) through a breathing tube (endotracheal tube).

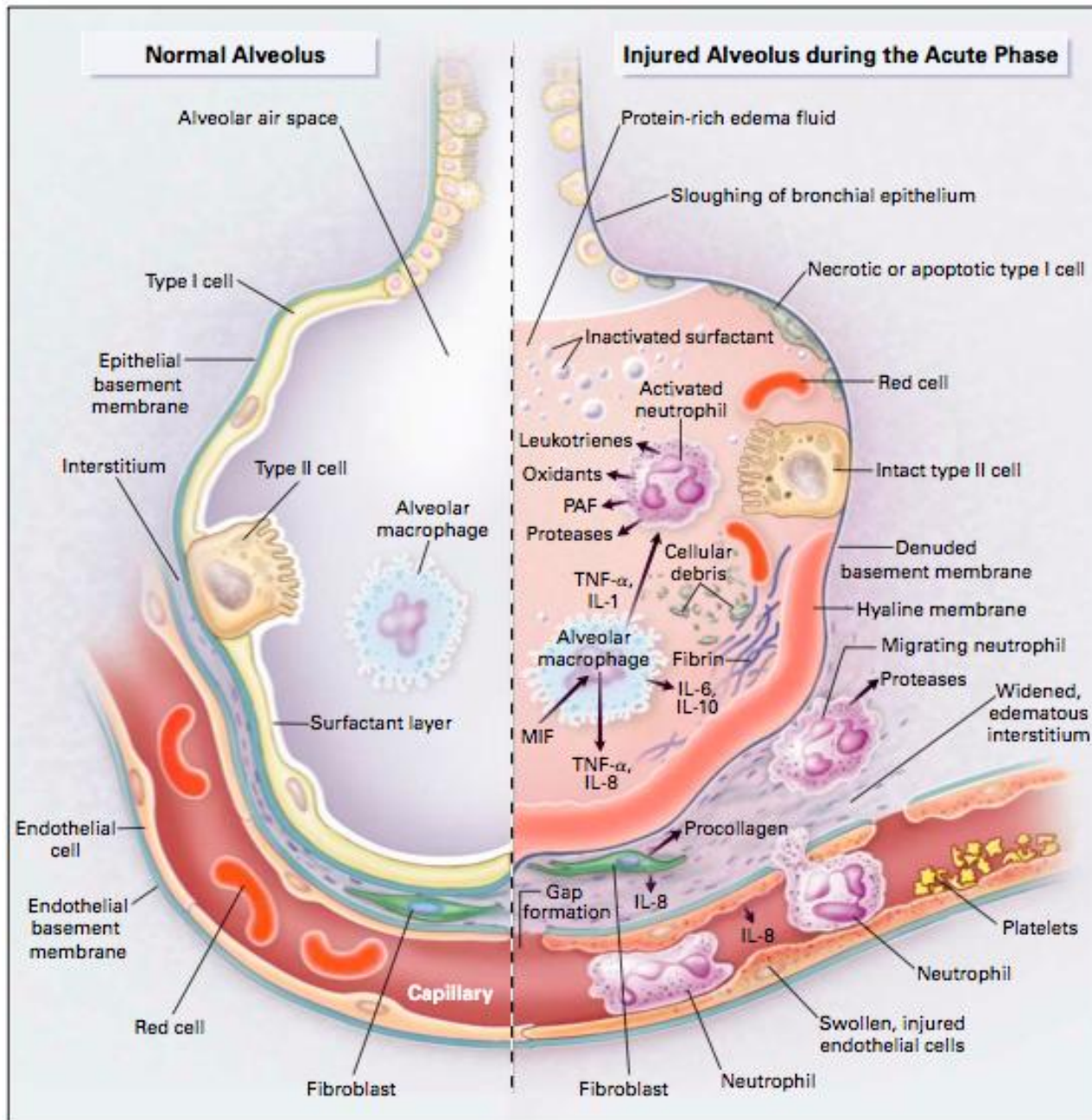
Etiology

- Respiratory failure proceeds; ARDS sometimes occurs as a complication of this condition but is not a guaranteed outcome
- Causes for respiratory failure can be direct or indirect

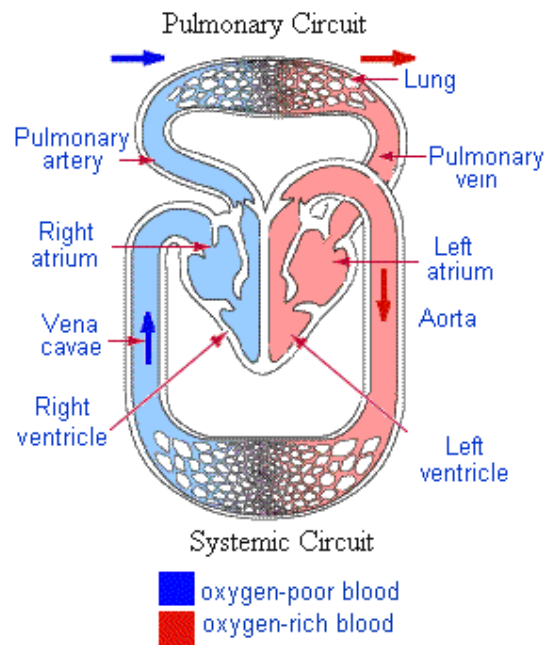
Direct	Indirect
Pneumonia	Severe sepsis
Gastric aspiration	Transfusions
Drowning	Shock
Fat and amniotic-fluid embolism	Salicylate or narcotic overdose
Pulmonary confusion	Pancreatitis
Alveolar hemorrhage	
Smoke and toxic gas inhalation	
Reperfusion (pleural effusion drainage, embolectomy)	
Unilateral lung re-implantation	

Etiology

- Examples of common causes of ARDS include:
 - Septic shock or sepsis
 - Trauma
 - Breathing vomit into the lungs (aspiration)
 - Inhaling toxic chemicals
 - Pneumonia



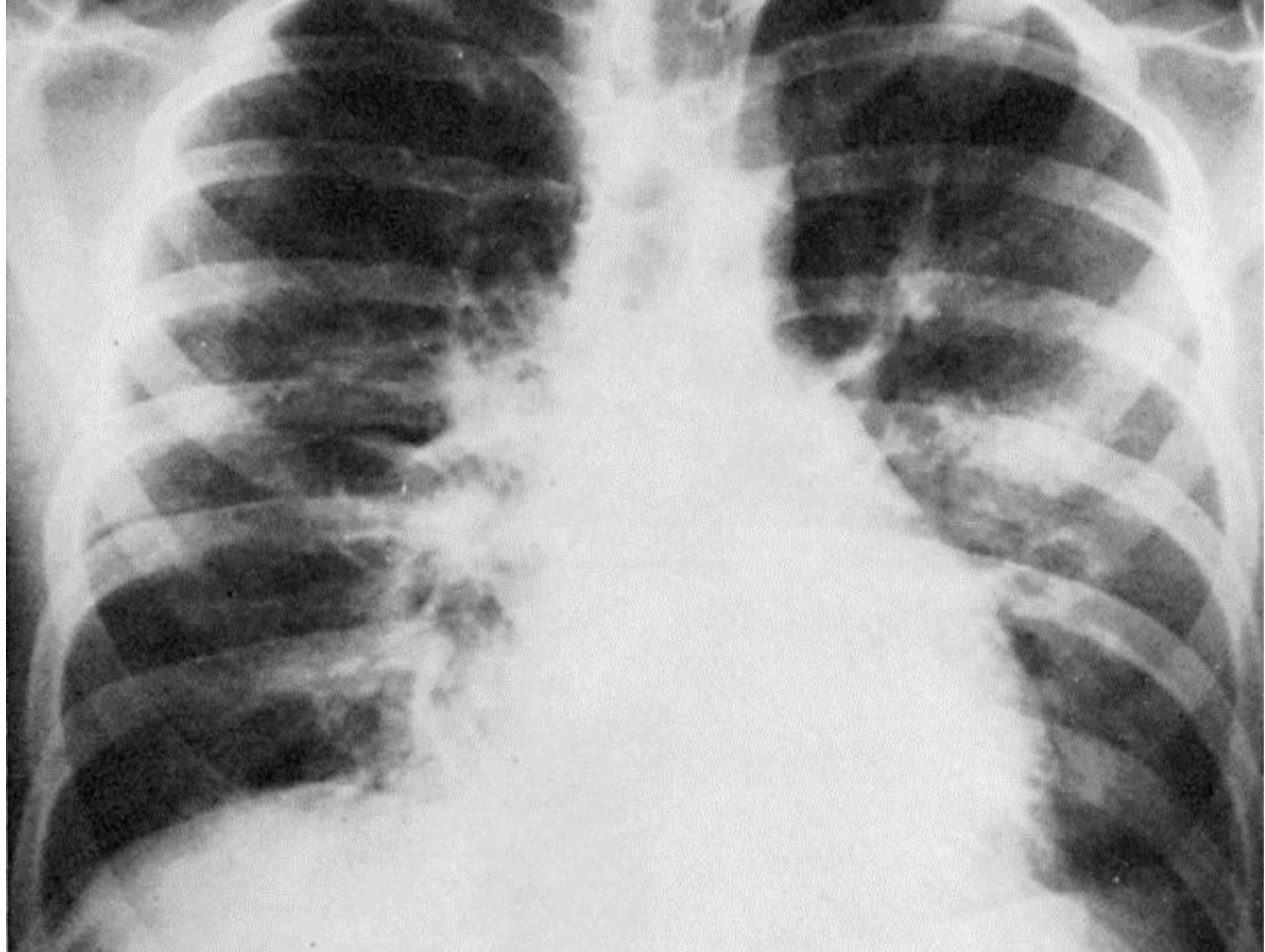
Normal Lung Function



Pathophysiology

■ Three stages to ARDS

1. Exudative Stage
2. Fibroproliferative Stage
3. Resolution and Recovery Stage



High Risk

- Cystic Fibrosis
- Malnourished
- Geriatric patients
- Emphysema = high risk for smokers

Prevalence

- Depends on which criteria is used, some are more stringent than others
- Estimate 150,000 cases in the US per year.

Comorbidities, Prognosis, Diagnostic Procedures

Comorbidities

- Sepsis
- Multiple Organ Failure
- Pneumothorax
 - Incidence is only 10-13%

Signs and Symptoms

- Symptoms can vary, depending on the cause
- Most common
 - Shortness of breath/ often labored breathing
 - Cough with white/pink expectoration
 - Fatigue
 - Pulmonary edema
- A few examples of others:
 - Pancreatitis: abdominal pain
 - Pneumonia: fever, cough, breathlessness
 - Initial and severe infections: chills and lightheadedness

Signs and Symptoms

- Auscultation
 - reveals abnormal breath sounds (crackling): suggest fluid in the lungs
- Often blood pressure is low
- Cyanosis
- Symptoms usually develop within 24 to 48 hours of the original injury or illness. Often, people with ARDS are so sick they are unable to complain of symptoms.

Progression

- Some patients can progress to have Fibrosing Alveolitis
 - Persistent hypoxemia
 - Increased alveolar “dead space”
 - Further decrease in ability of gas exchange

Radiology: Progression

Normal Lungs



Day 1-Admidtance



Radiology: Progression

Day 2



Day 3



Prognosis

- Same APACHE II scores as those with other respiratory disorders
 - Worse gas exchange
 - Better general physiological state
- Proper fluid balance increases survival

Tests and Diagnosis

- Tests used to diagnose ARDS includes:
 - Severe hypoxemia
 - $\text{PaO}_2/\text{F}_1\text{O}_2 = <200$
 - (F_1O_2 is the fraction of inspired oxygen)
 - Arterial blood gas
 - Bronchoscopy
 - CBC and blood chemistries

Tests and Diagnosis cont.

- ▣ Chest x-ray
 - ▣ Can cause confusion
 - ▣ Pneumonia, CHF, and Cardiogenic Pulmonary Edema can present themselves in a similar way
- ▣ Sputum cultures and analysis
- ▣ Test for possible infections

Prognosis

- Mortality rate at 53%
- Exact prognosis is uncertain for those with underlying chronic pulmonary disease
 - Not likely to survive
- Young, previously healthier patients can expect to survive
- Lung transplantation may be an option for some

Prognosis

- Mechanical ventilatory support reduce mortality
- Non-ventilatory adjuncts to gas exchange
 - improve oxygenation
 - do not reduce mortality
- Although death rates are falling, long term debility in survivors is considerable

ARDS survivors

- ▣ Most can receive full lung function
- ▣ May still experience:
 - ▣ Shortness of breath
 - ▣ Fatigue
 - ▣ Muscle wasting and weakness
 - ▣ Continued cough
 - ▣ Continued need for oxygen support
 - ▣ Usually go away after a year
- ▣ Dr must follow-up to monitor lungs

Medications, Treatments, and Instruments

Treatment for ARDS

- Ventilation
 - Mechanical ventilator
 - ECMO
 - Endotracheal tube

Ventilators

- Get oxygen into the lungs.
- Remove carbon dioxide from the body. (Carbon dioxide is a waste gas that can be toxic.)
- Help people breathe easier.
- Breathe for people who have lost all ability to breathe on their own.



Endotracheal tube goes through patient's mouth and into the windpipe

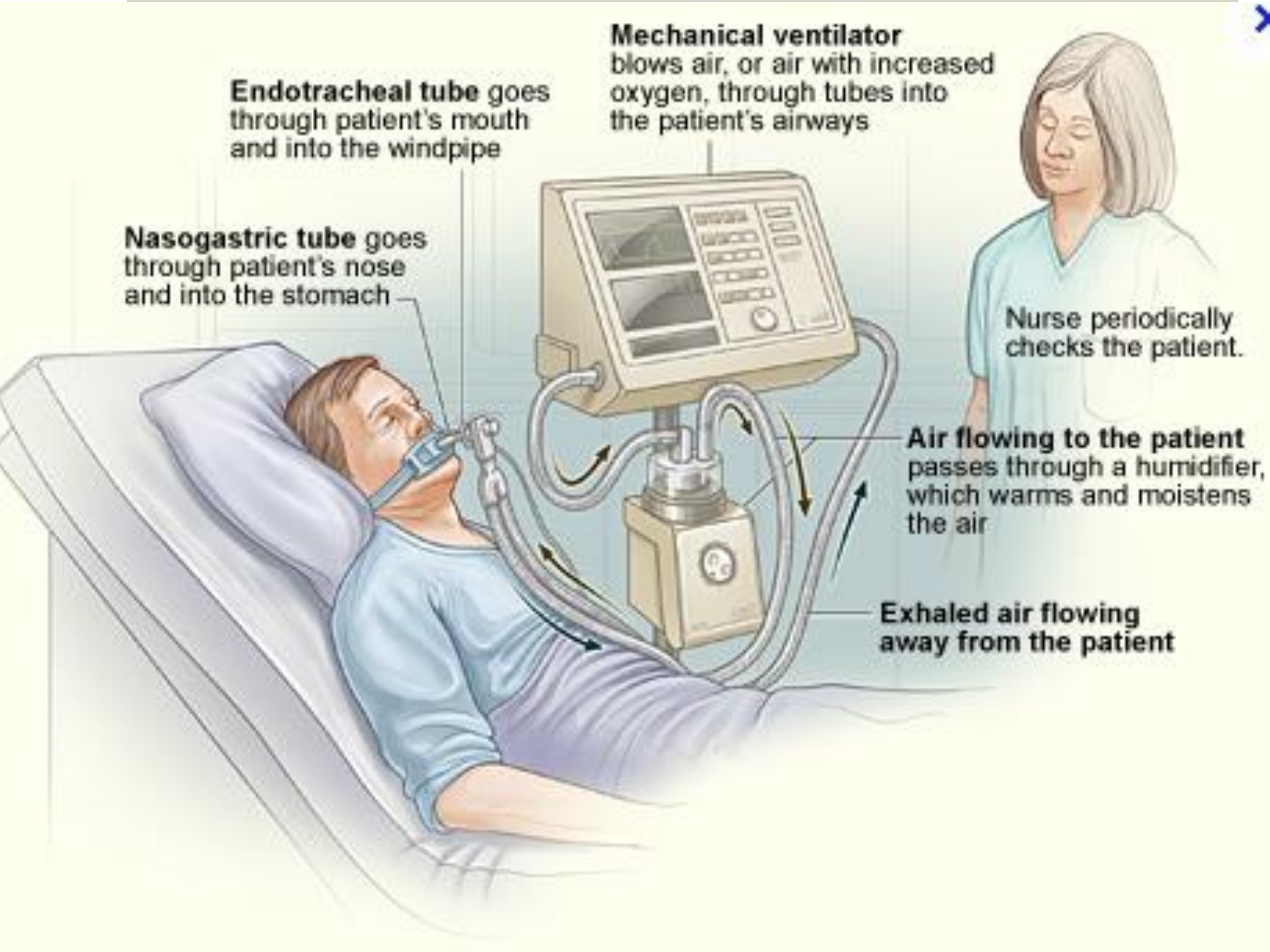
Mechanical ventilator blows air, or air with increased oxygen, through tubes into the patient's airways

Nasogastric tube goes through patient's nose and into the stomach

Nurse periodically checks the patient.

Air flowing to the patient passes through a humidifier, which warms and moistens the air

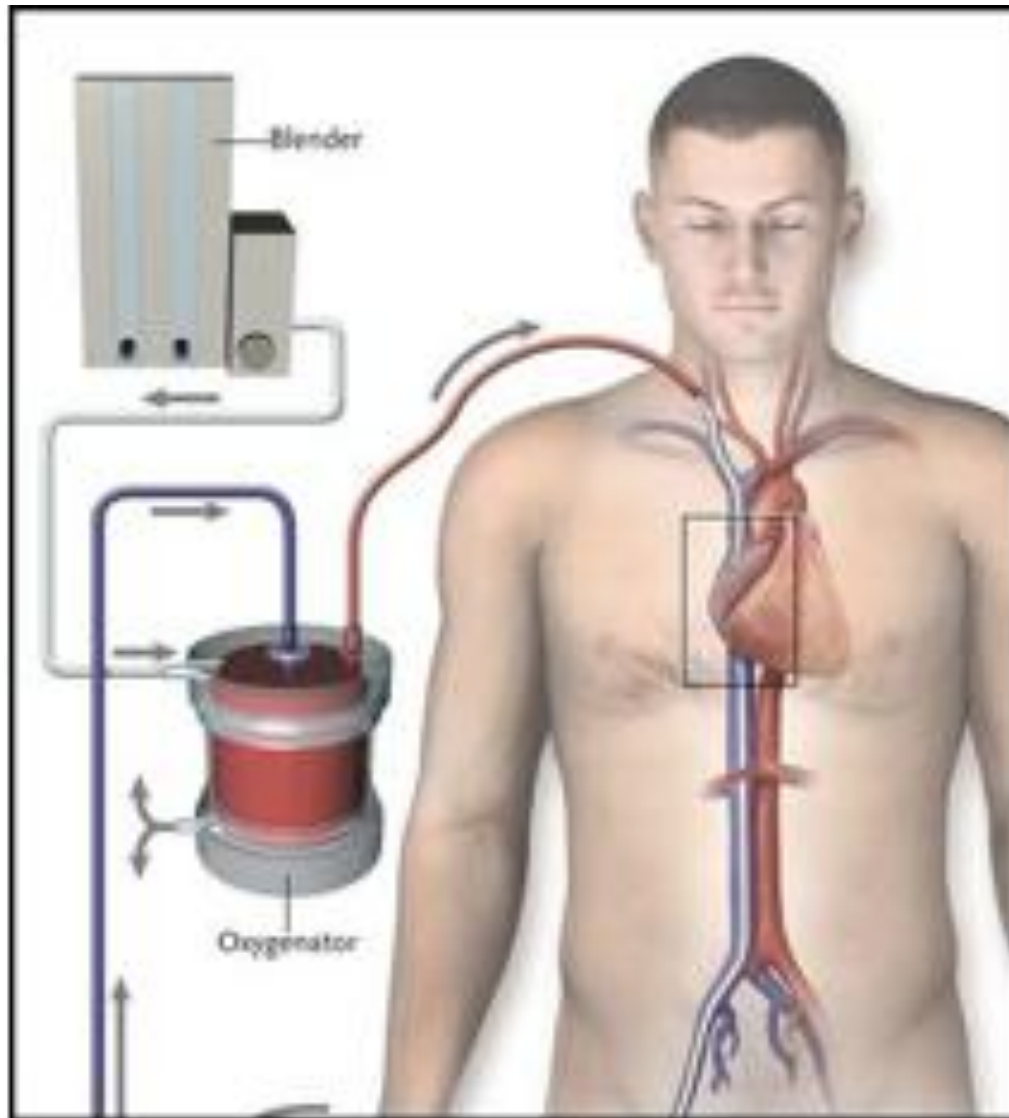
Exhaled air flowing away from the patient



Extracorporeal Membrane Oxygenation (ECMO)

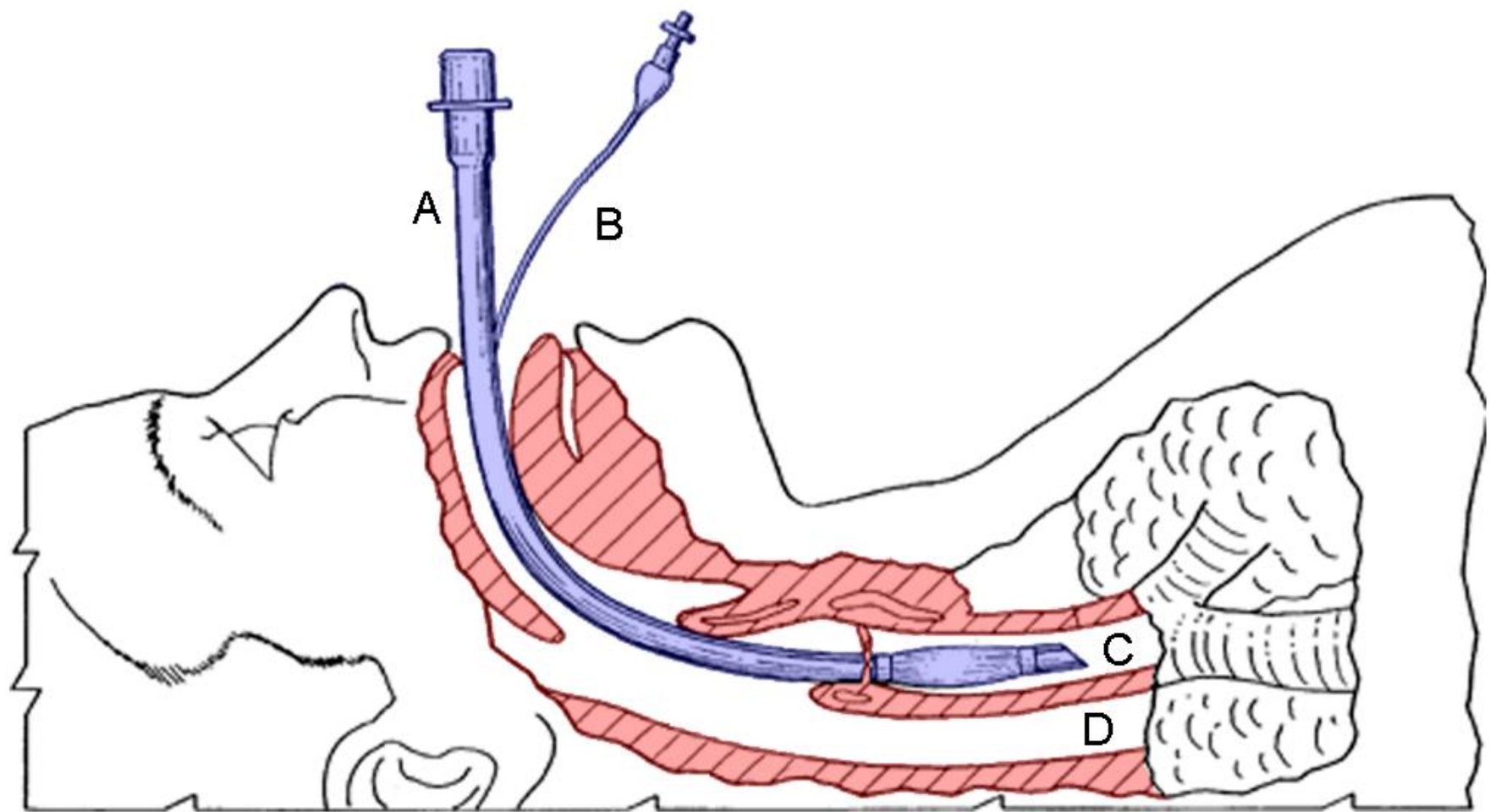
- Takes out carbon dioxide just like our lungs do.
- For severely damaged heart and lungs (non-functional)
- Cannulation is performed by Surgeon
- Maintenance: 24/7 monitoring care during treatment by EMCO specialist
- ECMO treatment provides oxygenation until their lung function has sufficiently recovered to maintain appropriate O2 saturation.
- Extracorporeal means that the blood circulates outside of the body with the help of a machine.
- ECMO is costly and labor intensive
 - 73,979 (\$116,502) over six months.
- LAST RESORT!

ECMO



Endotracheal Tube

- Plastic tube used during artificial respiration
- One end of the breathing (endotracheal) tube is placed into the windpipe (trachea) through the mouth or nose.
- The other end of the tube is connected to a breathing machine (mechanical ventilator) or breathing bag (manual resuscitator).
- The breathing tube provides an airway so that air and oxygen from the breathing machine or breathing bag can be provided to the lungs.



Treatment for ARDS

- **GOAL:** provide breathing support and treat the underlying cause of ARDS.
 - This may involve medications to treat infections, reduce inflammation, and remove fluid from the lungs.
- Intensive care unit (ICU).
- A breathing machine:
 - Delivers high doses of oxygen and a continuous level of pressure called PEEP (positive end-expiratory pressure) to the damaged lungs
 - Patients often need to be deeply sedated
- Treatment continues until you are well enough to breathe on your own.
- Many family members of people with ARDS are under extreme stress.
 - Support groups

PEEP (Positive End-Expiratory Pressure)

- airway pressure is maintained above atmospheric pressure at the end of exhalation
- usually a valve, within the circuit
- PURPOSE: to increase the volume of gas remaining in the lungs at the end of expiration

Medications/Therapies

- Steroids
- Surfactant
- Neuromuscular blocking agents

Steroids: Glucocorticoid receptor

- Down-regulation of systemic inflammation:
 - restore homeostasis
 - decrease morbidity
 - improve survival
 - significantly enhanced with prolonged low-to-moderate dose glucocorticoid treatment.
 - Improvement in pulmonary and extrapulmonary physiology
- Improved patient-centered outcomes.
 - mechanical ventilation-free days (average 6.58 days)
 - ICU-free days (average 7.02 days)
 - significant risk reduction in mortality

Surfactant

- Surfactant reduces the surface tension of fluid in the lungs and helps make the small air sacs in the lungs (alveoli) more stable. This keeps them from collapsing when an individual exhales.
- Surfactant Therapy:
 - Improve gas exchange
 - Increase lung function
 - Improvement in ventilation efficiency index

Neuromuscular blocking agents

- Decreases inflammatory response by causing paralysis
- Lower 90-day mortality
- Decreased morbidity
 - Increased ventilator-free days
 - Increased ICU-free days
 - Increased organ failure-free days
- Possible side effects:
 - Muscle weakness

MNT & Nutrition Support

ARDS Basics

- Acute respiratory distress syndrome is a common complication of critical illness
- Nutrition needs vary
 - Underlying disease process
 - Prior nutrition status
 - Age
- Body composition fluctuation is the hallmark nutrition assessment indicator for ARF.

ARDS Basics

- Many become underweight- Anthropometric measurements are critical.
- Other factors to assess:
 - Immunocompetence
 - Chronic mouth breathing
 - Aerophagia
 - Dyspnea
 - Exercise tolerance
 - Depression

Prevention

- Treatable infections (sepsis, pneumonia)
- Abdominal infections (antimicrobial agents or surgery)
- Prevent nosocomial infections
- Enteral feeding is preferred
- Prevention of GI bleeding and thromboembolism is important

Goals of MNT

- ▣ Provide adequate energy and protein via EN
- ▣ Prevent weight loss, even in overweight PTs
- ▣ Maintain LBM
- ▣ Restore respiratory muscle mass and strength
- ▣ Maintain fluid balance
- ▣ Improve resistance to infection
- ▣ Facilitate weaning of O₂ support & mechanical ventilation:
provide energy substrates w/o exceeding capacity of the
respiratory system to clear CO₂

Oxepa

- Abbott product features:
 - 1.5 Cal/mL
 - Unique oil blend (EPA and GLA)
 - Elevated Vit C, Vit E, and beta-carotene
 - Gluten-free, okay for lactose intolerance, and Halal
- Benefits:
 - Include easier weaning off of ventilator, and decreased length of stay in hospital

Tab. 1: Anti-inflammatory immune-modulating (IM) enteral nutrition (Oxepa[®], Abbott Nutrition, Columbus, OH) vs. standard enteral nutrition (Stand EN) in patients with acute respiratory distress syndrome (ARDS), acute lung injury (ALI), and sepsis [16])

Study	Population	Study groups	Mortality	LOS days, mean \pm SD	Vent days, mean \pm SD	New organ dysfunction
Gadek et al. [45]	ARDS ICU (<i>n</i> = 146)	Oxepa	11/70 (16%) ICU	11.0 \pm 0.9 ICU ^a	9.6 \pm 0.9 ^a	7/70 (10%) ^a
		Stand EN	19/76 (25%) ICU	14.8 \pm 1.3 ICU	13.2 \pm 1.4	19/76 (25%)
		Oxepa		27.9 \pm 2.1 Hosp		
		Stand EN		31.1 \pm 2.4 Hosp		
Singer et al. [47]	ARDS and ALI (<i>n</i> = 100)	Oxepa	14/46 (30%) at 28 d ^a	13.5 \pm 11.8 ICU	12.1 \pm 11.3	NR
		Stand EN	26/49 (53%) at 28 d	15.6 \pm 11.8 ICU	14.7 \pm 12.0	
Pontes-Aruda et al. [48]	Severe sepsis ICU (<i>n</i> = 165)	Oxepa	26/83 (31%) at 28 d ^a	17.2 \pm 4.9 ICU ^a	14.6 \pm 4.3 ^a	32/83 (39%) ^a
		Stand EN	38/82 (46%) at 28 d	23.4 \pm 3.5 ICU	22.2 \pm 5.1	66/82 (80%)

SD = standard deviation; NR = not reported; ICU = intensive care unit; LOS = length of stay; d = day(s); *P* \leq 0.05.

Nutrition Assessment

- Interpretations may be confounded by fluid imbalances, meds, and ventilator support.
- PTs should receive 1.5 to 2 g protein/kg
- Fluid requirements: Normal, unless underlying disease requires a restriction (2 L/day)
 - PT is deficient in fluid if:
 - Hyponatremia, elevated BUN, dry mucous membranes
 - PT may have fluid overload if:
 - Hyponatremia, edema



Energy

- Elevated needs- due to hypercatabolism and hypermetabolism
 - Give enough to prevent the use of body's own protein and fat reserves.
 - Avoid overfeeding
 - Start with 1.2 – 1.4 x REE
 - 30 kcal/kg per day and increase based on substrate tolerance
 - Indirect calorimetry is best

Macronutrients

- Negative N balance
 - Protein
 - (Notice that EN or TPN supplied protein or AA do affect the RQ)
- HIGH fat, LOW carb
 - Protein 1.5-2 g/kg of dry body weight
 - Non-protein: Fat and Carbohydrate
 - For the obese PT (60-70% of target; 2-2.5 g/kg protein)
 - Fat: Borage Oil?

Vitamins & Minerals

- Supply at least DRI level plus repletion
 - Enough for anabolism, wound healing, and immunity
- Antioxidants
- Monitor mineral balance- VERY closely
 - Why?

Refeeding Syndrome

- Low serum levels of K, P, Mg
- Review: There is an increased demand on amounts of glucose, K, P, and Mg due to new tissue proliferation. If intracellular electrolytes are insufficient to keep up with tissue growth- low serum levels manifest. Carbohydrate metabolism by cells also causes electrolyte shift to intracellular space as glucose moves into cells for oxidation.

Refeeding cont.

- Rapid infusion of carbohydrates stimulates insulin release → Which reduces salt and water excretion.
 - AND also increases the chance of cardiac and pulmonary complications from fluid overload
 - In early phase of refeeding (Starting TPN... and having no form of nutrition for a significant period should be monitored for electrolyte fluctuation and fluid overload)

Nutrient prescriptions

- Moderate in carbohydrates
- Supplement with K, P, and Mg
 - Minerals function as electrolytes
 - May cause fluid imbalances and the occurrence of respiratory acidosis or alkalosis
 - Side effect of meds may be: K, Ca, and Mg lost in the urine.

Monitoring the PT on EN

- P. 516 Box 20-3
 - Weight (at least 3 x/wk)
 - S/S of edema (daily)
 - S/S of dehydration (daily)
 - Ins and outs (daily)
 - Adequacy of enteral intake (at least 2 x/wk)
 - Abdominal distention and discomfort
 - Serum electrolytes, BUN, creatinine (2-3 x/wk)
 - Serum glucose, Ca, Mg, P (weekly or as ordered)
 - Stool output and consistency (daily)

Feeding Strategies

- NON intubated PTs: Most will be able to meet most or all of nutrition needs by mouth.
- Tips:
 - Small portions
 - Favorite foods
- Give adequate O₂ supply
- Inadequate O₂ → PT may complain of anorexia, early satiety, malaise, bloating, constipation or diarrhea

Feeding Strategies

- Intubated PTs: EN or TPN
 - Appropriate enteral feeding → better clinical outcomes such as decreased duration of mechanical ventilation
 - Specially formulated pulmonary proprietary products
 - GI route is preferred
 - Concerns: Aspiration and bacterial overgrowth.

Procedures that minimize aspiration

- Continuous vs. bolus feedings
- Tube placement
- Use of small-bore nasogastric feeding tubes
- Chest elevation to at least 45 degrees
- Frequent evaluation for gastric residuals
- Endotracheal tube cuff inflation



Case Study

- DH
- Age 65
- Male, smoker
- Chief Complaint: difficulty breathing during yard work
- Hx: COPD, emphysema, chronic tobacco use, total dental extraction
- Dx: Acute Respiratory Distress, COPD, peripheral vascular disease with intermittent claudication
- Hospital course: chest tube inserted into left thorax for drainage. Resuscitation bag was used to ventilate DH with fresh O₂. Pt was intubated and then ventilated with 15 breaths/min. Enteral feedings initiated. Pt started on Procalamine due to high residuals. Respiratory status was worse on day 5, but increased after that.

Nutritional Assessment

- Anthropometric
 - Ht 5'4"
 - Wt 122lbs (UBW 135lbs)
 - BMI 21
 - 90% UBW
 - 93% IBW

- Biochemical
 - Everything mainly WNL
 - Low labs for Transferrin, Uric Acid, HDL
 - High for LDH, LDL

- Clinical
 - Dyspnea
 - Pitting edema in extremities
 - Harsh breath sounds over right chest during inhalation
 - Absent sounds on left chest

Nutritional Assessment

- Dietary Assessment
 - Usual Intake:
 - Breakfast: Egg, hot cereal, bread or muffin, hot tea (with milk and sugar)
 - Lunch: soup, sandwich, hot tea (with milk and sugar)
 - Dinner: small amount of meat, rice, 2-3 kinds of vegetables, hot tea (with milk and sugar)
- 24 hour recall

Nutritional Assessment

- Estimated calorie needs
 - Harris Benedict: 1190
 - Add stress factor of 1.2
 - 1450
- Protein Needs:
 - 1.5 – 2.0 g/kg
 - = 82.5 – 110 grams

PES Statement

- Inadequate Oral Intake related to decreased appetite as evidenced by dyspnea and significant weight loss
- Intervention:
 - Put on enteral feeding due to a ventilator tube going into his lungs.
 - Oxepa Enteral Feeding

Nutrition Diagnosis

- Monitoring and Evaluation
 - I/Os
 - Biochemical labs
 - Stop weight loss
 - Do not overfeed

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