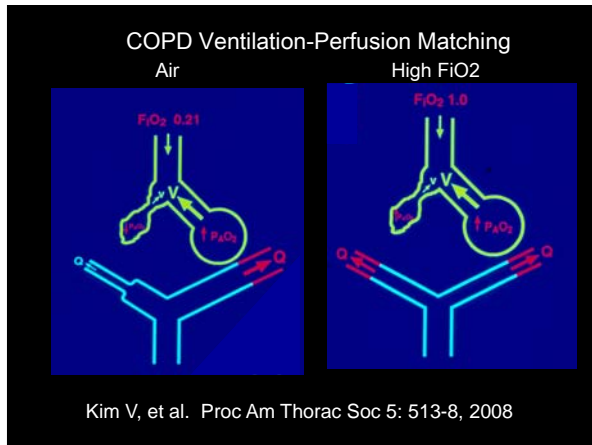


COPD patients in Ac. Resp. Failure

ABG's air vs. 100% Oxygen

	Air	100% O2 (15 min)
PaCO2 (mm Hg)	65 +/- 3	88 +/- 5
PaO2 (mm Hg)	38 +/- 2	225 +/- 23
Min Vent (l/min)	10.2 +/- 0.5	9.5 +/- 0.7

Milic-Emille J, Aubier M. Anes Analg 1980



Arterial Blood Gases

16 yr. male, grain aspiration

pH	pCO2	pO2	HCO3
6.5	500	84	30
6.9	300	400	29

Slinger P, et al. Anesthesiology 1997, 68: 291-5



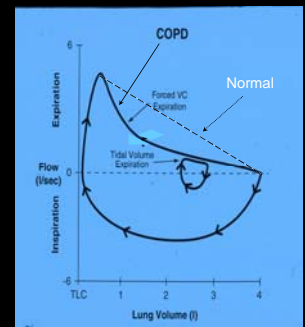
- ### Effects of Hypercapnia
- ◆ Central Nervous System: cerebral blood flow, level of consciousness
 - ◆ Autonomic Nervous System
 - ◆ Cardiovascular System
 - ◆ Respiratory System, Pulmonary Vasoconstriction
- CO2 is Good For You**

COPD, Laparotomy Bowel Obstruction



- ◆ Rapid Sequence Induction
- ◆ Propofol 80 mg., Fent. 100 ug, Roc. 50 mg.
- ◆ Easy Intubation, SpO2 100%, PetCO2 30mmHg
- ◆ Pulse 80 → 96
- ◆ BP 120/60 → 50/30
- ◆ Air Entry Equal Bilat.
- ◆ **Diagnosis ?**

Expiratory Flow Limitation In COPD



Dynamic Hyperinflation

The Lazarus Syndrome: Spontaneous Return of Circulation after Cessation of Cardiopulmonary Resuscitation

Rembrandt van Rijn
1606-1669



Ben-David B, et al
Anesth Analg 2001
92: 690-2

Decreasing Dynamic Hyperinflation



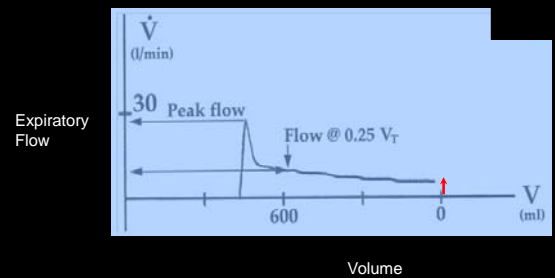
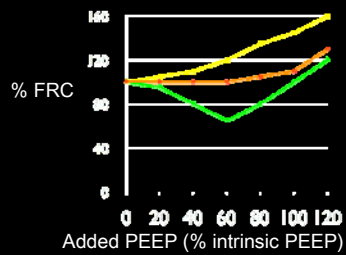
📖 Bronchodilators

📖 Prolong Expiratory Time

📖 Add PEEP


Paradoxical Responses to PEEP in Patients with COPD during Controlled Ventilation

Caramenz MP, et al. Crit Care Med 33: 2005, 1519-28,



COPD Preoperative Assessment

- ◆ 60 y.o. Female
- ◆ Laparotomy for Bowel Obstruction
- ◆ Emphysema, FEV1 27%
- ◆ Prev. colectomy for diverticulitis
- ◆ Rx Puffers, occas. steroids
- ◆ Should you do a Thoracic Epidural?



Greatest Hospital Costs from Complications after Surgery?

- Cardiac/Vascular
- Thromboembolic
- Respiratory**
- Wound Infection

Dimick JB, et al. JACS 2004; 199: 531-7

Hospital Costs Associated with Surgical Complications

Complication	Incidence %	Increase LOS d	Median Cost \$K
Cardiac/Vascular	1	0	7.7
Thromboembolic	1	15	18.3
Respiratory	3.4	14	52.5
Wound Infection	6.9	4	1.4

Dimick JB, et al. JACS 2004; 199: 531-7


Incidence and Mortality of Postoperative Pulmonary Complications (PPC)

Type of Surgery	Incidence %	In-Hosp. Death with PPC%
Cardiac	40	0
Thoracic	31	18
Abdominal	7	35
Orthopedic	2	5
Other	2	15


Canet J, et al. Anesthesiology 2010, 113: 1338-50
n = > 2400, Major Surgery

Perioperative Management of the Patient with Severe Lung Disease


Chronic Obstructive Pulmonary Disease



Pulmonary Hypertension



Pulmonary Hypertension



- ◆ 54 y.o. Female
- ◆ Open Wedge Resection of Recurrent Left Upper Lobe Metastasis
- ◆ VATS resection LUL lesion 1yr. prev., no problem GA
- ◆ Post-op. DVTs
- ◆ Colectomy for Ca. 3yr. prev.

Pulmonary Hypertension

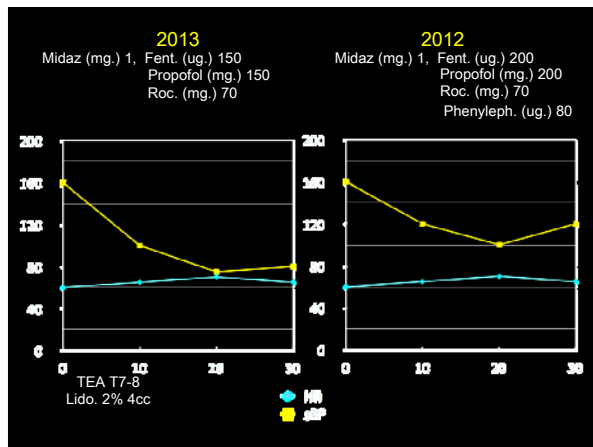


- 54 y.o. Female
- COPD, Hypertension
- Diabetes, oral meds
- Obstructive Sleep Apnea
- Morbid Obese, BMI 53

54 Female , Obese, Wedge Resection LU Lobe



- FEV1 65%, DLCO 78%
- ECG Normal
- Exercise tolerance SOB 1 flight
- Labs Normal
- Trans-thoracic echo: Normal LV & Right Ventricle, RVSP 32mmHg
- ? Anesthetic Management

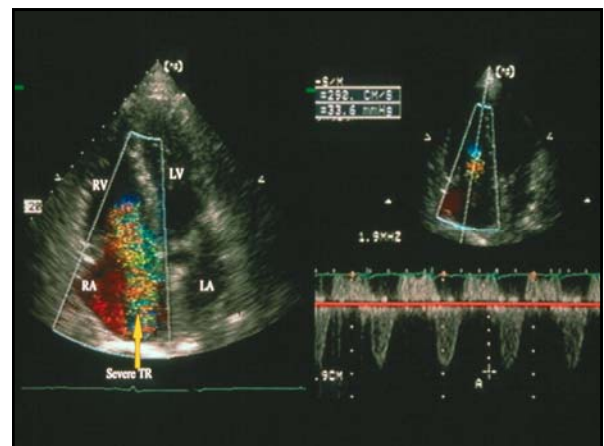


Preoperative Assessment

- | 2013 | 2012 |
|--|-------------------------------|
| 54 y.o. Female | 53 y.o. Female |
| Open Resection of Left Upper Lobe Metastasis | VATS resection LUL lesion |
| VATS LUL 1yr. prev., post-op. | Colectomy for Ca. 3yr. prev. |
| Colectomy for Ca. 3yr. prev. | COPD, hypertension |
| COPD, hypertension | Diabetes, oral meds |
| Diabetes, oral meds | Obstructive Sleep Apnea |
| Obstructive Sleep Apnea | Morbid Obese, BMI 51 |
| Morbid Obese, BMI 53 | Pulmonary Hypertension |
| | RVSP 55mmHg |

Trans-Thoracic Echocardiography

- 2012 : Difficult study, Mild hypertrophy RV, RVSP calculated **55mmHg**
- 2013 (1 week preop.) Difficult study, Normal LV/RV, RVSP calculated **32mmHg**
- 2013 (1 week postop.) Difficult study, Mild hypertrophy RV, RVSP calculated **58mmHg**



54 Female , Obese, Wedge Resection LU Lobe



- ☐ FEV1 65%, DLCO 78%
- ☐ ECG Normal
- ☐ Exercise tolerance SOB 1 flight
- ☐ Labs Normal
- ☐ Trans-thoracic echo: Normal LV
- ☐ RVSP 55mmHg
- ☐ Change Management?

Pulmonary Hypertension Classifications

(Eur Heart J 2009; 30: 2493-537)

- ◆ Pulmonary Arterial: Idiopathic , Drug/Toxin induced, Portal Hypertension, Connective Tissue Diseases, Veno-occlusive Disease
- ◆ Lung Disease : COPD, Interstitial Lung Dis., Sleep Apnea, Central hypoventilation, Altitude
- ◆ Chronic Thromboembolic Pulmonary Hypertension
- ◆ Left Heart Disease, Systolic Dysfunction, Diastolic Dysfunction, Valvular Disease
- ◆ Uncertain Etiologies: Sarcoidosis, Glycogen Storage Disease, Fibrosing mediastinitis

Hosseinian L, JCVa 2014, 28: 1076-86

Fischer LG, et al. Anesth Analg 2003; 96: 1603-16

Pulmonary Hypertension Re-Classification for Anesthesia

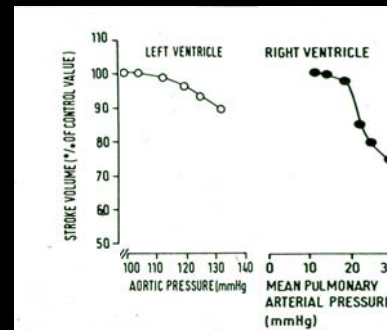
Heart Disease

☐ Systolic Dysfunction, Diastolic Dysfunction, Valvular Disease

Lung Disease

- ☐ Pulmonary Arterial Hypertension, Primary, etc.
- ☐ Secondary to Chronic Lung Disease
- ☐ Chronic Thromboembolic Pulmonary Hypertension
- ☐ Uncertain Etiologies

The Right Heart is Not Smart



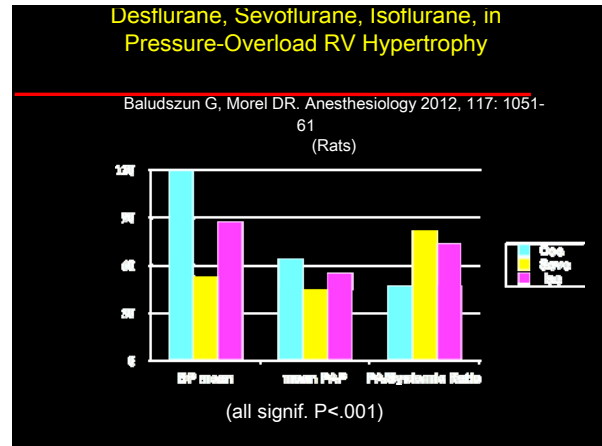
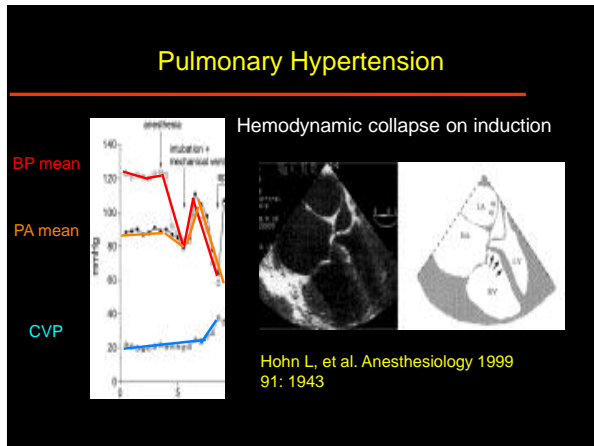
Severe Pulmonary Hypertension Complicates Postoperative Outcome of Non-Cardiac Surgery

- ☐ 9600 Preop. Echoc, n= 62 RVSP >70 mmHg
- ☐ 37/62 (60%) Non-Cardiac Pulm. Hypertension
- ☐ Abd. Surg 15, Ortho 14, Thoracic 4, Minor 15
- ☐ Delayed Extubation (> 24h) 20% (vs. 3%)
- ☐ Mortality 10% (vs. 0%)

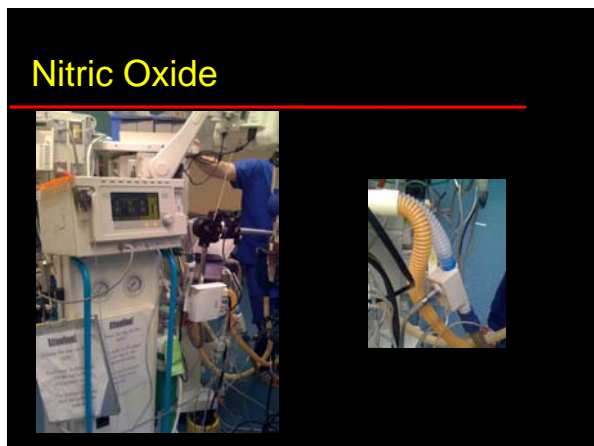
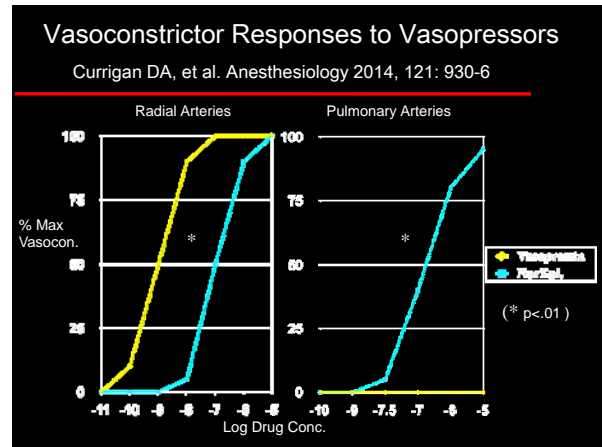
Lai H-C, et al. Br J Anesth 2007, 99: 184-90

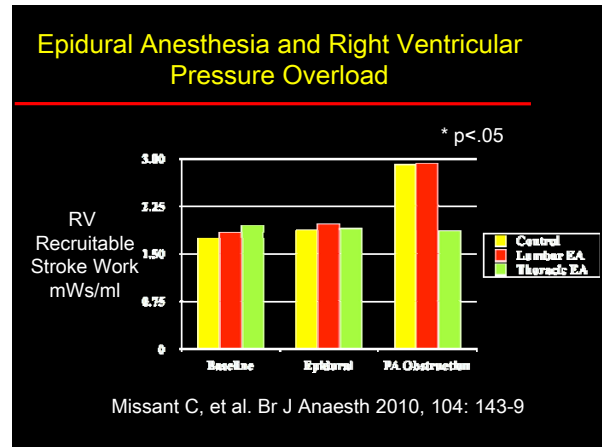
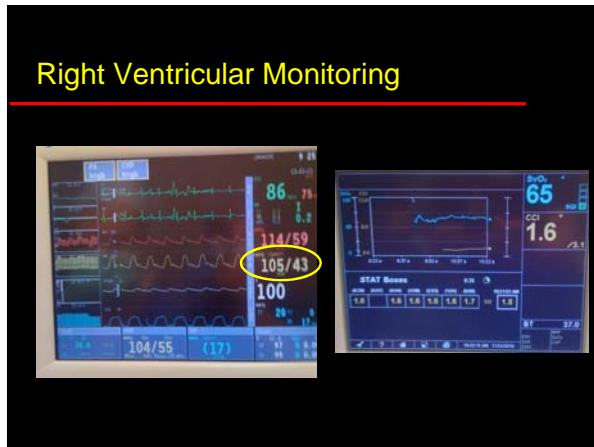
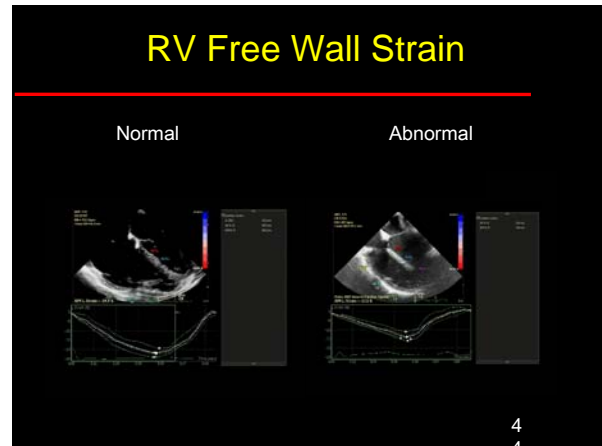
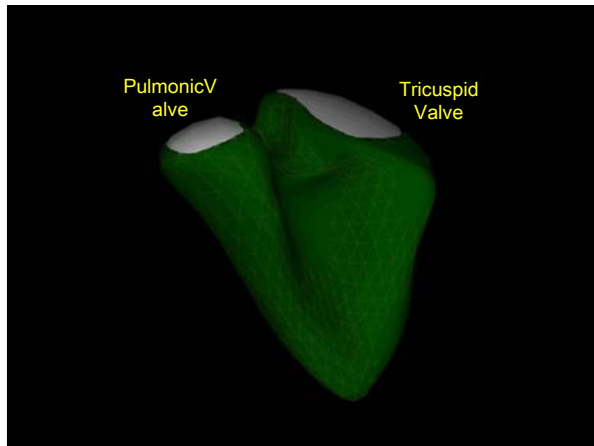
Pulmonary Hypertension Anesthetic Management (as per Review Articles)

- ☐ Propofol is good
- ☐ Ketamine is bad
- ☐ Dobutamine is good
- ☐ Nitric Oxide is good
- ☐ TEE is good
- ☐ Epidurals are good



- ### Pulmonary Hypertension Anesthetic Management
- Propofol is good
 - Ketamine is bad
 - Dobutamine is good
 - Nitric Oxide is good
 - TEE is good
 - Epidurals are good





Pulmonary Hypertension Anesthetic Management

Revised:

Propofol is good	Hypotension is bad
Ketamine is bad	Ketamine/Etomidate OK
Dobutamine is good	Norepi/Vasopressn. good
Nitric Oxide is good	NO/ Epoprostenol good
TEE is good	TEE is OK, CO good
Epidurals are good	Epidurals may be OK
Avoid Hypox./Hypercarb.	Avoid Hypox./ Hypercarb.

Manecke GR. Semin Thorac Cardiovasc Surg 2006; 18: 236-42

Pulmonary Arterial Hypertension, Blaise G, et al. Anesthesiology 2003; 99: 1415-32

Management of Pulmonary Hypertension: Physiological and Pharmacological Considerations for Anesthesiologists
Fischer LG, et al. Anesth Analg 2003; 96: 1603-16

Pulmonary Hypertension and Right Ventricular Dysfunction: Physiology and Perioperative Management. Strumpher J, Jacobsohn E. J Cardiothorac Vasc Anesthesia 2011, 25: 687-704

Efficacy of Sildenafil in Primary Pulmonary Hypertension



Sastry B, et al. JACC 2004; 43: 1149-53

Perioperative Management of the Patient with Severe Lung Disease

Chronic Obstructive Pulmonary Disease



- Bullae
- CO₂ Retention
- DHI

Pulmonary Hypertension



- Right Heart vs. Left Heart