VENTILATOR MANAGEMENT FOR THE ANESTHESIA PROVIDER

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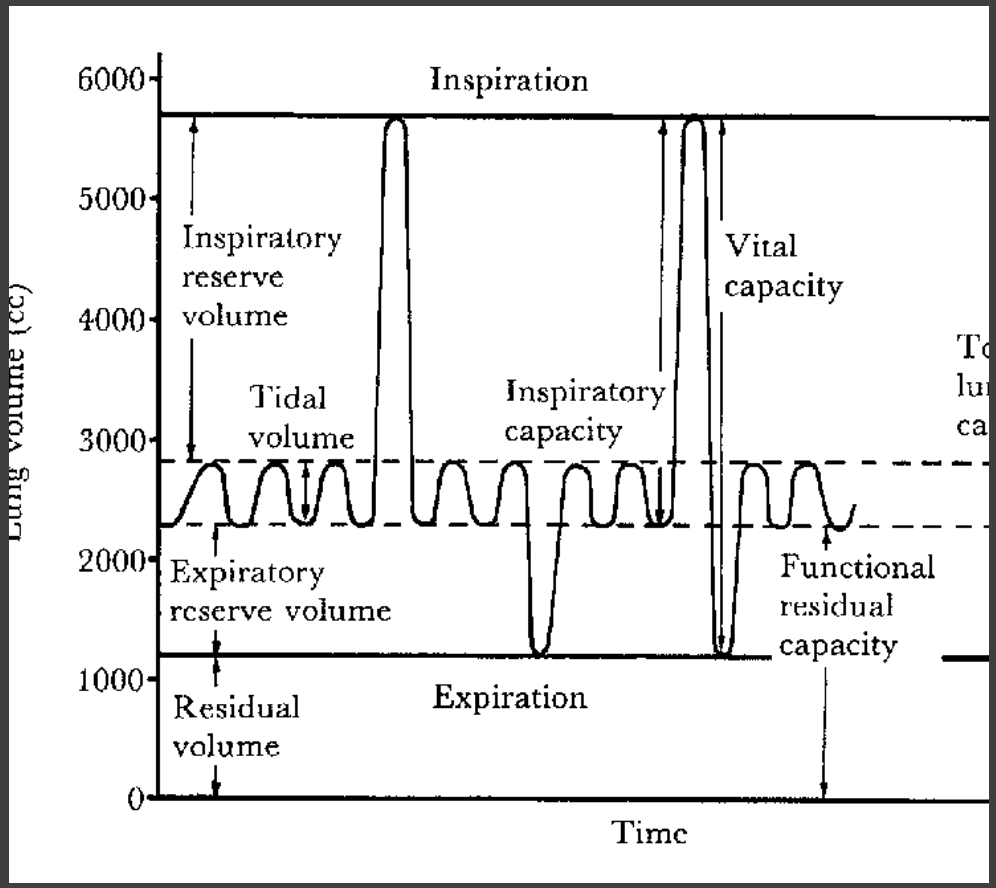
DISCLOSURES

I HAVE NONE

WHY DO I DO THIS LECTURE?

- Refresher for providers
- Better understanding of where we come from and where we are going
- Break old habits
- Encourage you to embrace the future
- Improve patient outcomes

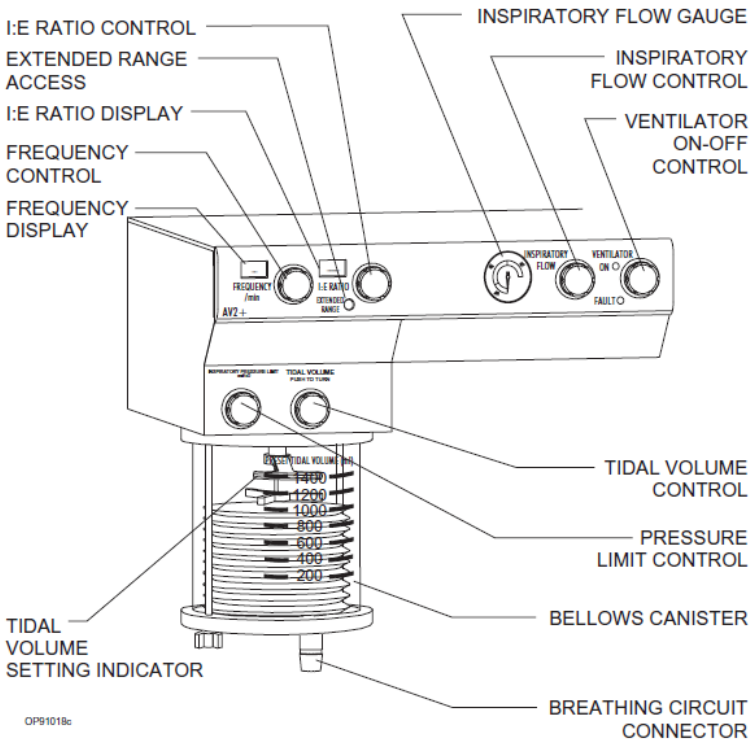
OBJECTIVES



- Review the evolution of the Anesthesia Machine
- Review ventilation settings that we trained with.
- Review what is available now
- Discuss what we can do to "protect" the patient
- Discuss Tidal Volume Selections
- Discuss FiO2 selections
- Scenarios

THE OLD

Drager Narkomed 2A



North American Dräger

Dräger

Operator's Instruction Manual

Part Number: 4113918-002
Rev: B
Date: 20 November 1998

GE AVANCE

Datex Aestiva

Bellows driven

Drager Fabius Drager Apollo

Piston driven

SIEMENS SERVO 900C

MINDRAY A9

MAQUET FLOW-I

SERVO CONTROLLED

Turbine driven

Dräger Perseus® A500

Ventilator

TurboVent2 Ventilator (electrically driven and electronically controlled turbo ventilator), fresh-gas decoupled, ventilation also possible without any gas supply (driving gas consumption 0 L/min), autoclavable

Standard ventilation modes	– Manual/Spontaneous (MAN/SPON) – Pressure-controlled: time-cycled (PC-CMV), synchronised (PC-BIPAP), – Volume-controlled: time-cycled (VC-CMV), synchronised (VC-SIMV), time-cycled AutoFlow (VC-CMV/AF), synchronised AutoFlow (VC-SIMV/AF)
Optional ventilation modes	– Pressure support: Pressure-supported ventilation (CPAP/Pressure Support), selectable pressure support for volume-controlled ventilation (VC-SIMV/PS), pressure-controlled ventilation (PC-BIPAP/PS) and AutoFlow (VC-SIMV/AF/PS), selectable CPAP for Manual/Spontaneous – Airway Pressure Release Ventilation (PC-APRV) – External fresh-gas outlet

TECHNOLOGY

- WHAT IS THE "SO-WHAT FACTOR"

VOLUME CONTROL VENTILATION

Advantage:

- Predictable
- Easy. Set it and forget it
- Works well for 90% of the pt's we deal with

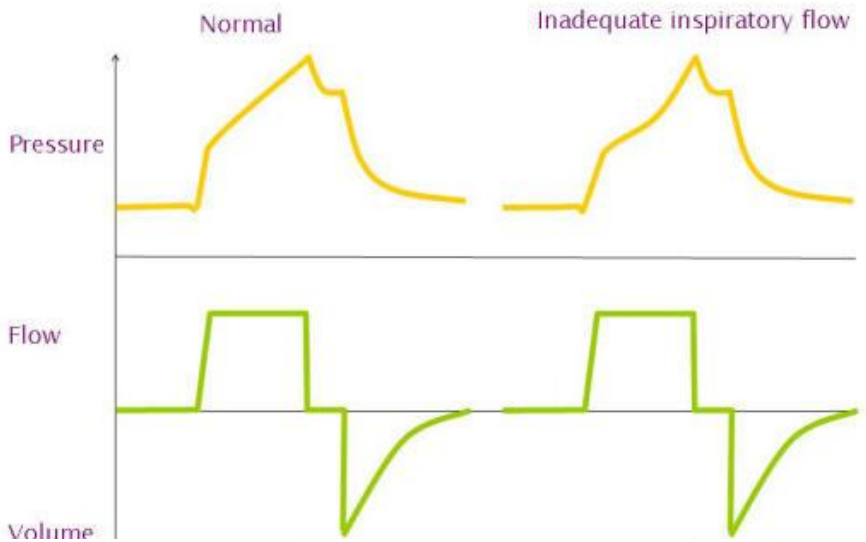
Disadvantages:

- PIP varies according to compliance
- Higher risk of barotrauma
- Increased risk of Atelectrauma
- Reduced ability to recruit

VOLUME CONTROL VENTILATION

CONTROLS- TV, RR, PIP, I:E. *CONSTANT FLOW RATE

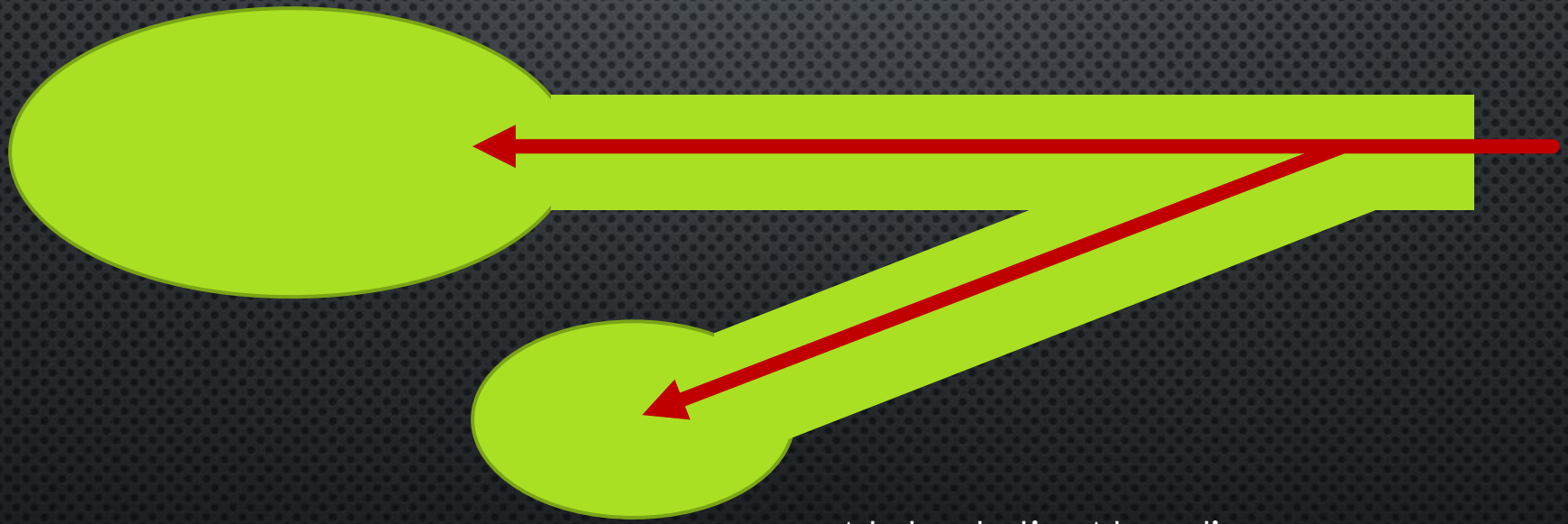
*BAROTRAUMA
*ATELECTRAUMA



VOLUME CONTROL AND ATELECTASIS

Normal Alveoli

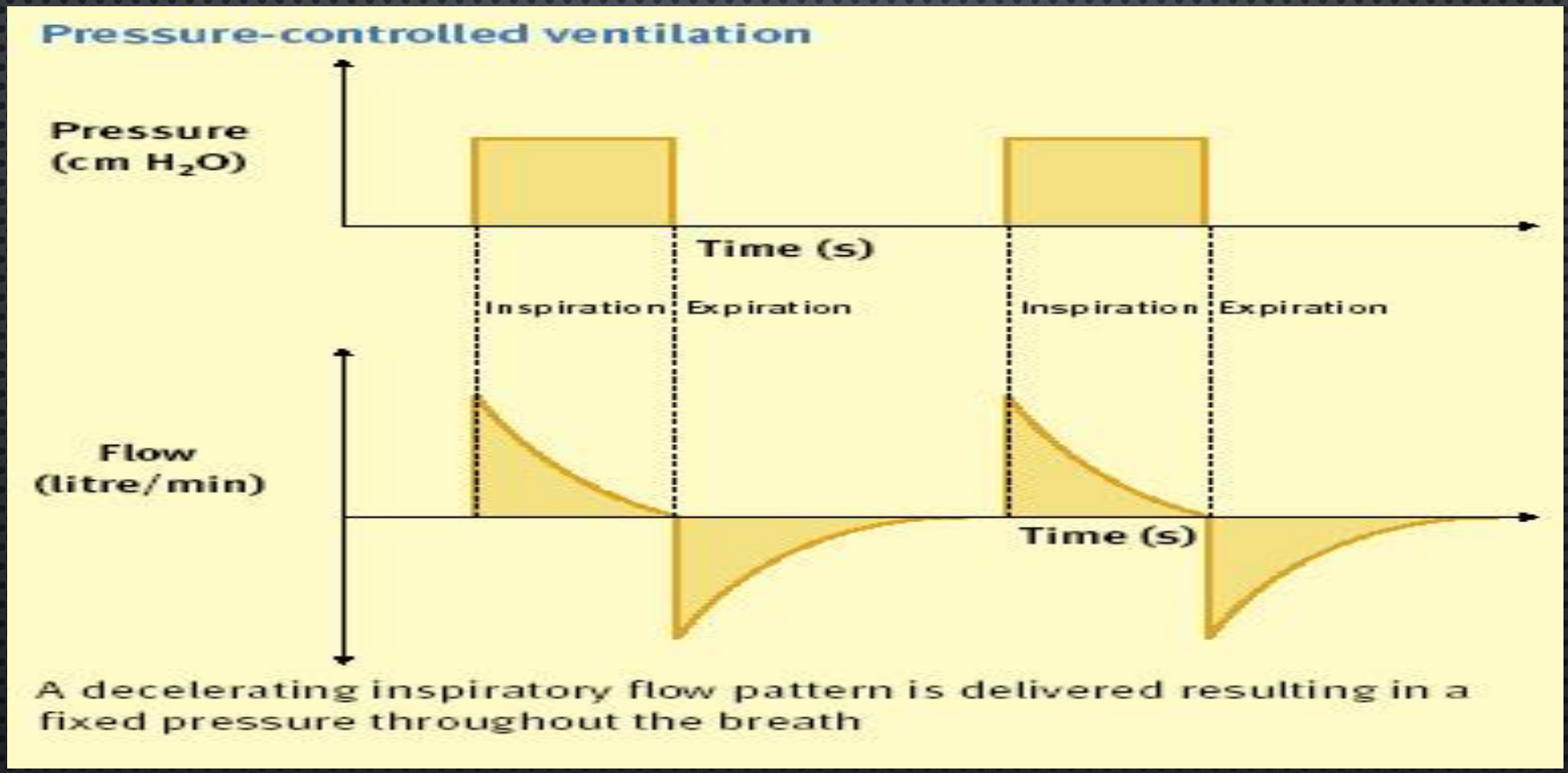
Receives lion's share of the Volume and has increased risk of volutrauma



Atelectatic Alveoli

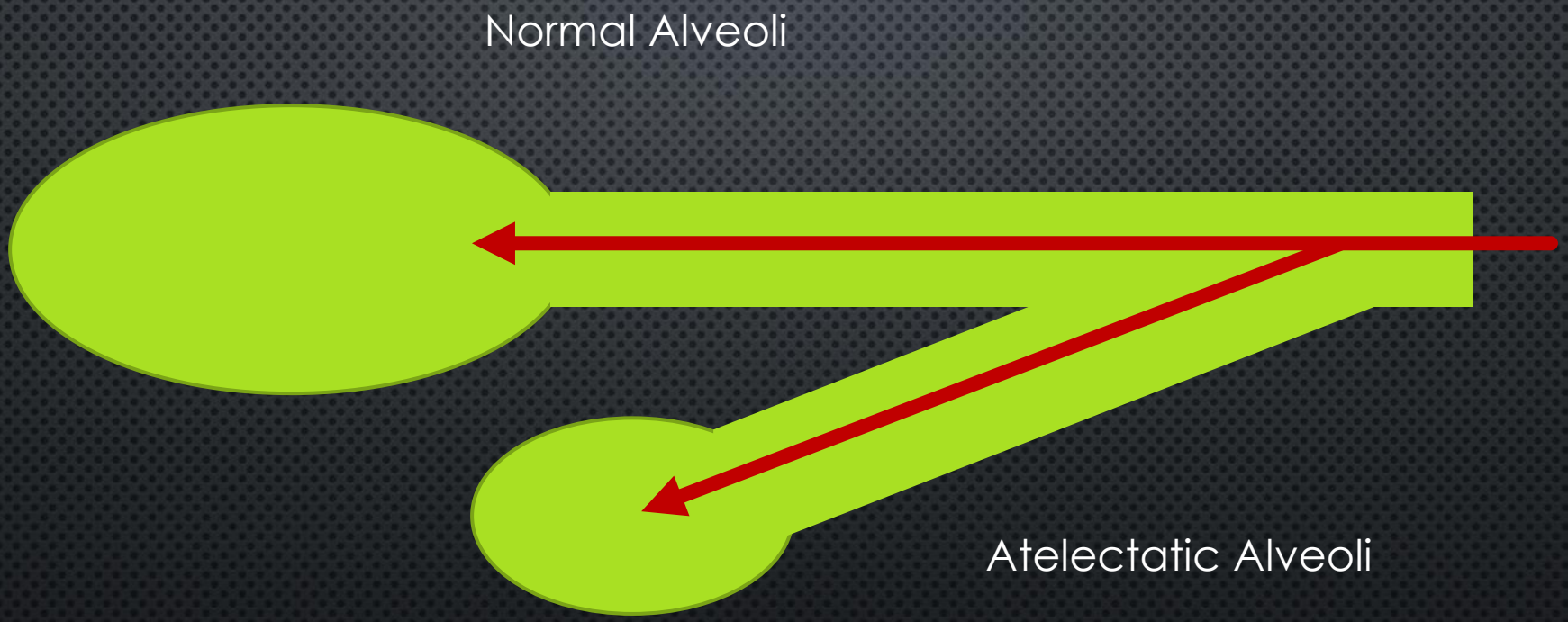
If pressure and flow are not great enough to overcome resistance, alveoli will remain collapsed

PRESSURE CONTROL VENTILATION



Set pressure at a variable flow rate. *Control: PIP, RR, PEEP, I:E
*Excellent for recruitment *Same TV at low Plateau pressure
*Reduced Barotrauma *Increased Volutrauma

PRESSURE CONTROL AND ATELECTASIS

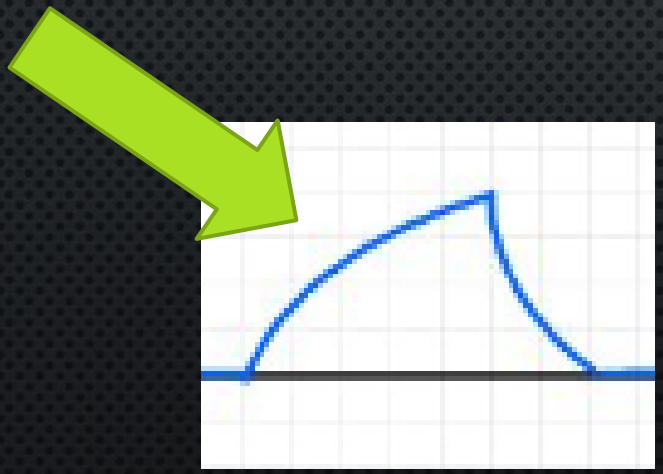


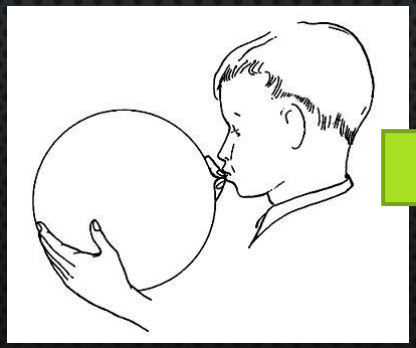
Recruitment

CAN'T GET PCV TO WORK? .....HERE'S A NUGGET

PCV with Inadequate Flow Rate

- Play with your Insp Flow Rate
  - Should be roughly 4x the minute volume
  - Ex. MV 15L -- Peak Flow>60






Best of both worlds….

PRESSURE CONTROL VENTILATION - VOLUME GUARANTEE

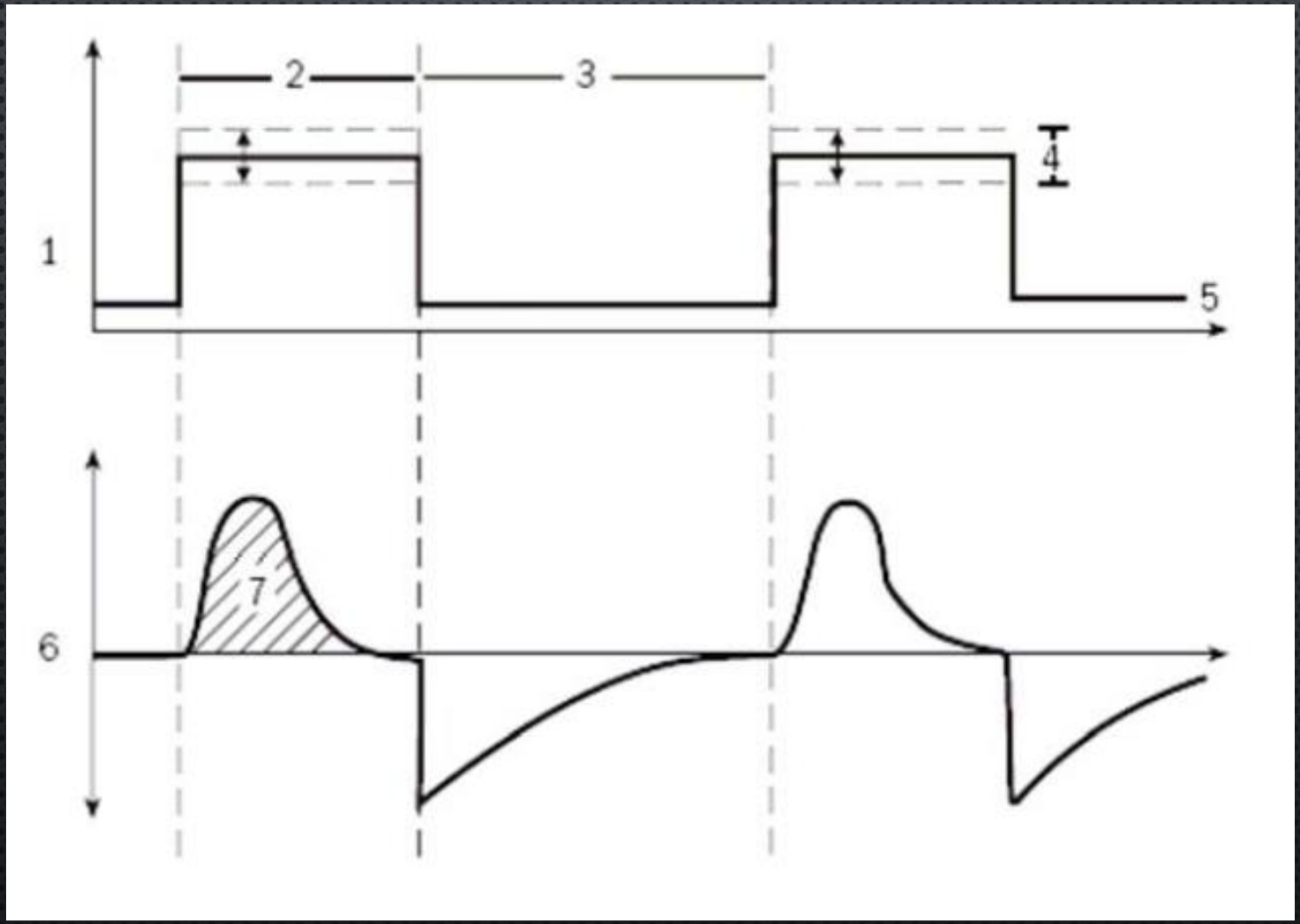
PCV ventilation with a set TV

The vent will change the flow dynamically to achieve a desired VT breath to breath

Benefits of both PC and VC.

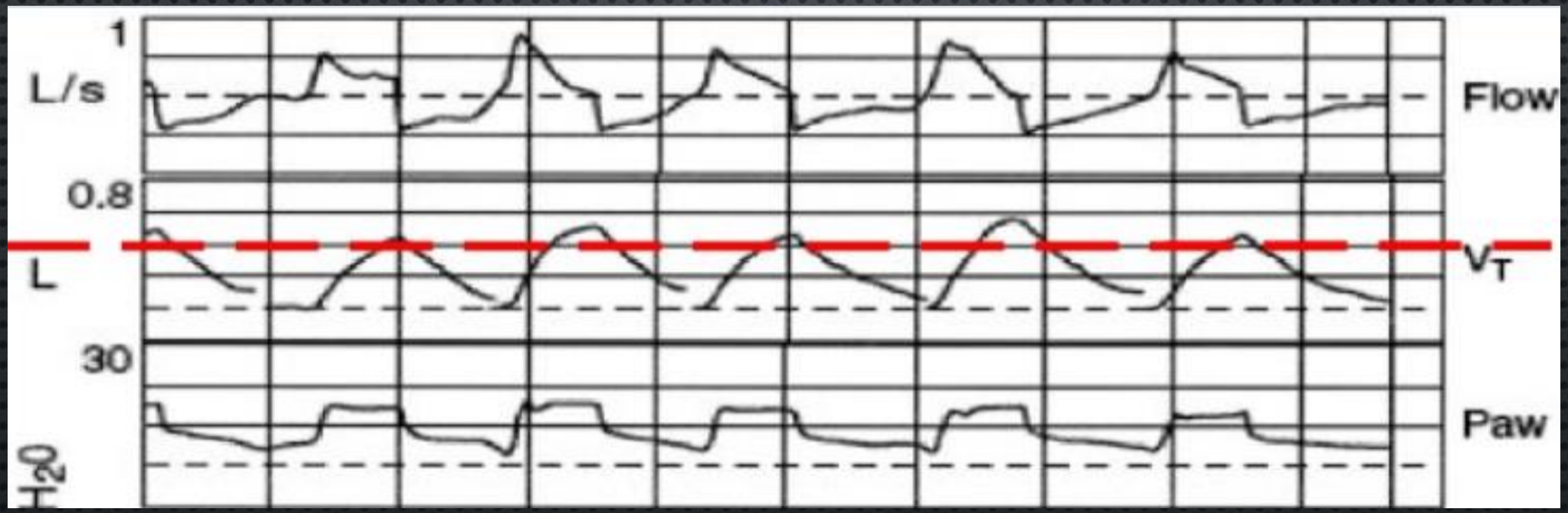
- Achieve adequate TVs at lower pressure
- Volume delivered is static
- Guaranteed Minute Volume

PCV- VG



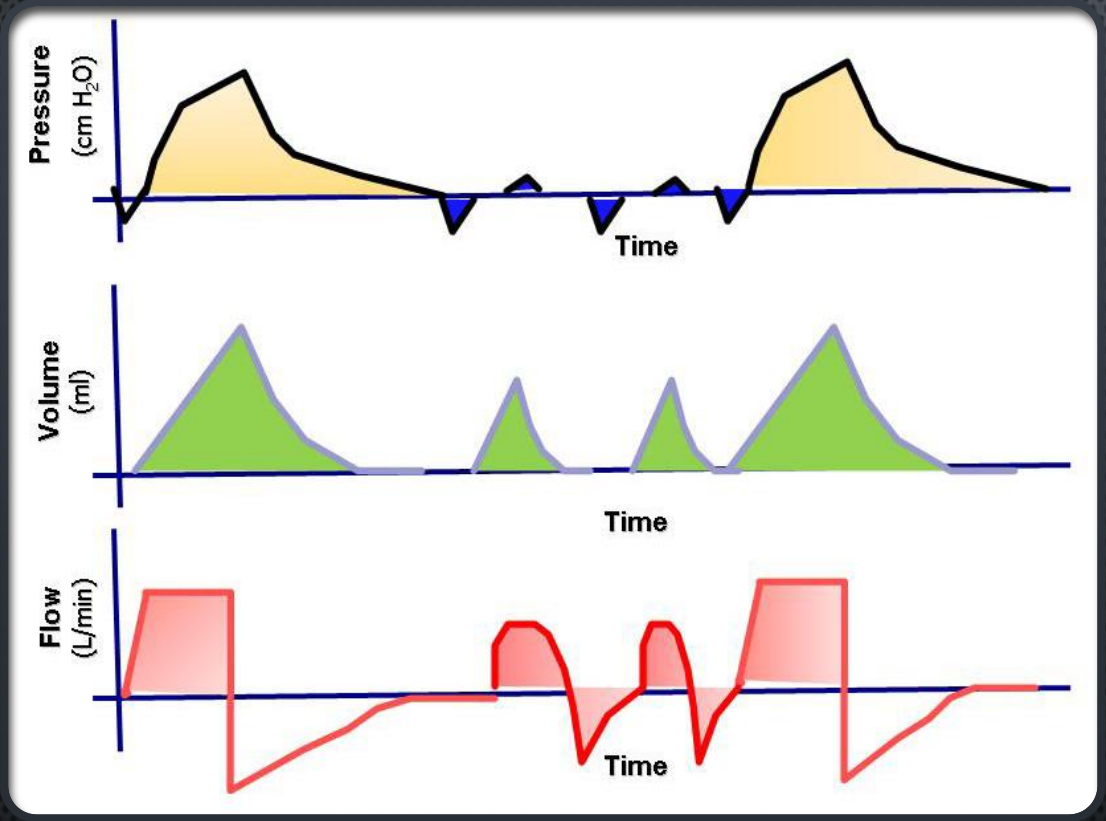
VOLUME AUTO-FLOW

- SIMILAR TO PCV- VG
- DECREASED COMPLIANCE LEADS TO SLOW INCREASES IN INSP PRESSURE AND FLOW



SIMV (VOLUME)

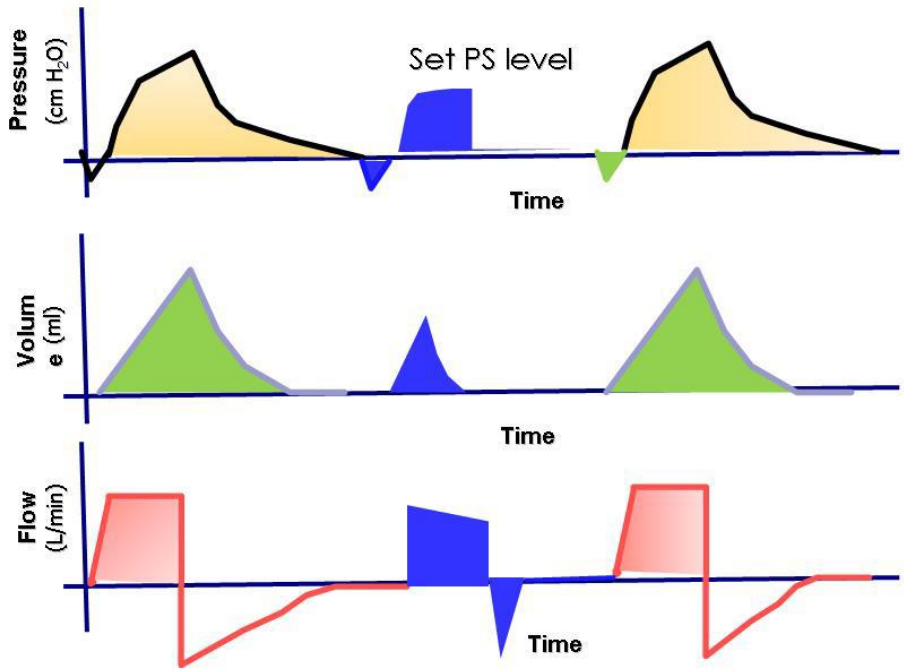
- VC with allowance for SPV.
- Delivers ventilator generated breaths in sync with pt effort.
- Maintains adequate MV while avoiding bucking or stacking
- Control of Trigger window- what % of expiratory pause the vent monitors for patient effort
- Control of Sensitivity: What neg insp effort required to trigger breath from vent
- Pt may breath at will between vent generated breaths



SIMV (VOLUME)

PRESSURE SUPPORT

- Delivers a set pressure for each pt initiated breath
- We control PS and PEEP
- Some anesthesia machines have a backup PC rate thus making it a "SIMV-PC"


Pressure
(cm H_2O)
Set PS level
Time
Volum
e (ml)
Time
Flow
(L/min)
Time

SIMV-PS

ALL THESE FANCY THINGS….

BUT WHAT IS OUR GOAL?

HOW CAN WE "HURT" THE PATIENT?

- Atelectasis - Atelectrauma
- Overdistension- Volutrauma
- Sustained High Pressures – Barotrauma
- Release of Inflammatory Mediators - Biotrauma

DON'T OVERFILL and DON'T UNDERFILL!!

Protective Lung Ventilation

LET'S LOOK AT 4 CONCEPTS OF PROTECTIVE LUNG VENTILATION

- Low Tidal Volumes
- PEEP
- Control of Ventilation Prior to, During and After extubation
- Appropriate Choice of FiO_2

1. TIDAL VOLUMES

- DON'T OVERFILL AND DON'T UNDERFILL!!

THE TIDAL VOLUME DEBATE!

…….Its not a debate any more

- LOW TIDAL VOLUMES are where it's at
- Anesthesia providers are horrible at complying

- **Ventilation with Lower Tidal Volumes as Compared with Traditional Tidal Volumes for Acute Lung Injury and the Acute Respiratory Distress Syndrome**

  The Acute Respiratory Distress Syndrome Network

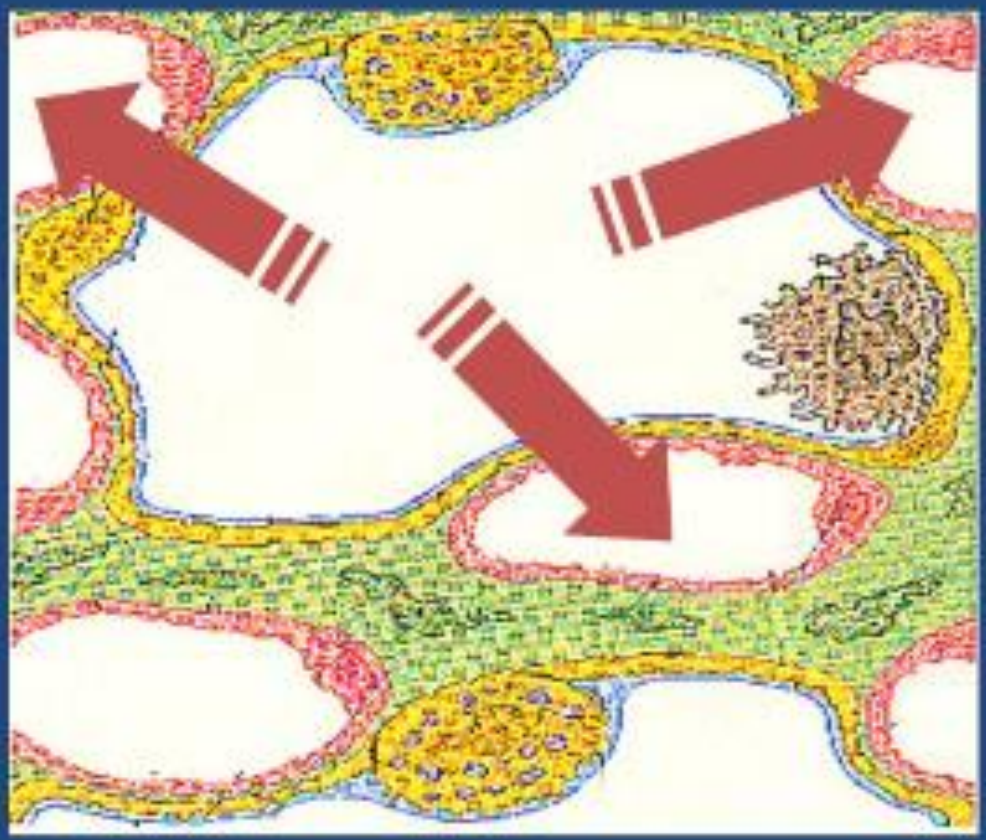
  In patients with acute lung injury and the acute respiratory distress syndrome, mechanical ventilation with a lower tidal volume than is traditionally used results in decreased mortality and increases the number of days without ventilator use.

Anesthesiology

- **Mechanical Ventilation with Lower Tidal Volumes and Positive End-expiratory Pressure Prevents Alveolar Coagulation in Patients without Lung Injury**

Choi, Goda M.D.; Wolthuis, Esther K. M.D.; Bresser, Paul M.D., Ph.D.; Levi, Marcel M.D., Ph.D.; van der Poll, Tom M.D., Ph.D.; Dzoljic, Misa M.D., Ph.D.; Vroom, Margreeth B. M.D., Ph.D.; Schultz, Marcus J. M.D., Ph.D.

Mechanical ventilation with higher tidal volumes and no PEEP promotes procoagulant changes, which are largely prevented by the use of lower tidal volumes and PEEP.



OVERDISTENTION MAY CAUSE BIOTRAUMA- WHAT IS IT?

5-7ML/KG

HERE'S ANOTHER NUGGET- LUNGS ARE TALL--NOT WIDE

Ideal Body Weight (Devine formula)

Men = 50 kg + 2.3 kg x (height, in - 60)

Women = 45.5 kg + 2.3 kg x (height, in - 60)

Adjusted Body Weight (ABW)

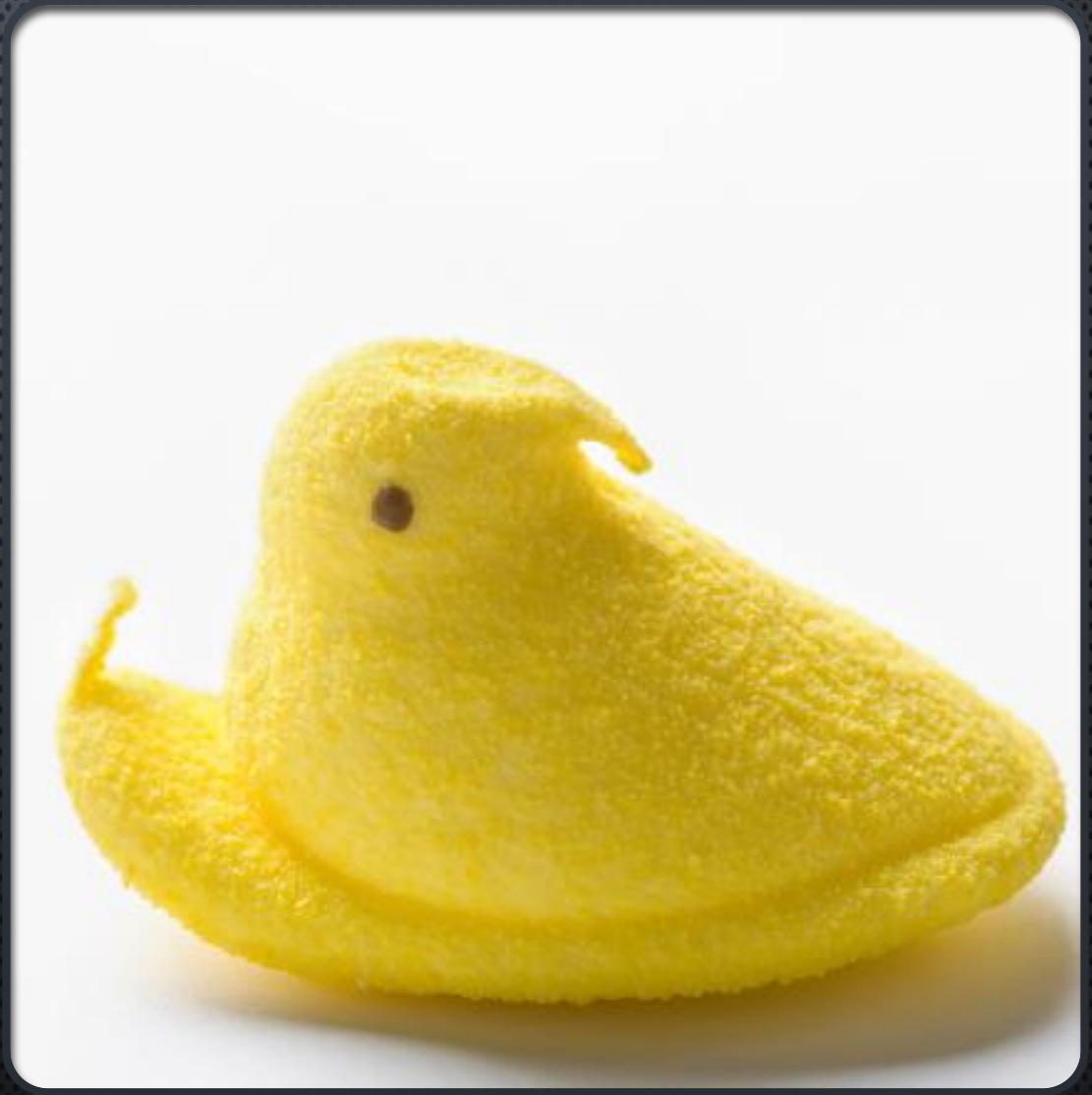
- for use in obese patients (where actual body weight > IBW):

ABW = IBW + 0.4 x (actual body weight - IBW)


17ST WOMAN
8ST WOMAN

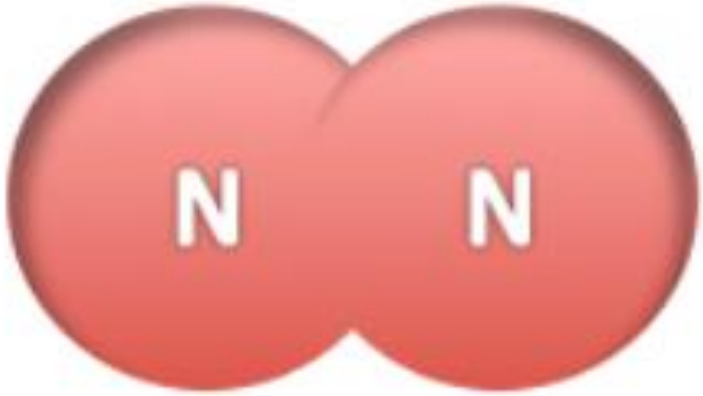
2. POSITIVE END-EXPIRATORY PRESSURE

- DON'T OVERFILL AND DON'T UNDERFILL!!



POSITIVE END-EXPIRATORY PRESSURE

Oxygen
O_2



Nitrogen
N_2

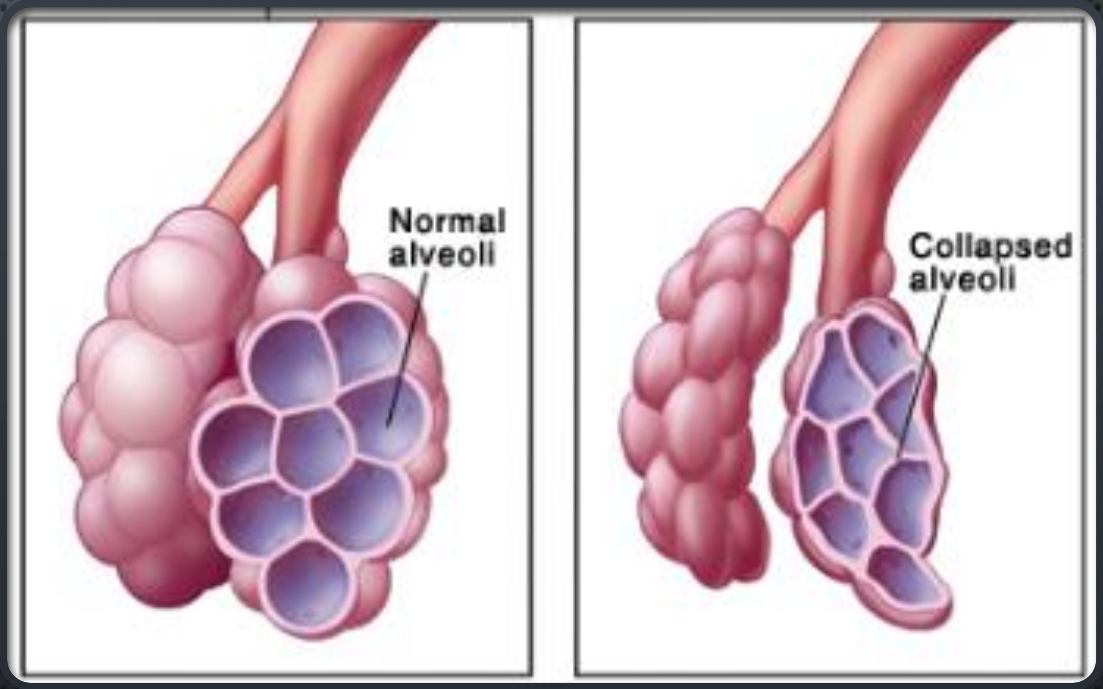
3. WHAT ABOUT FIO2?

FRACTION OF INSPIRED OXYGEN

- How do we pick FiO2?
- Why don't we use 100% FiO2 on everybody?
- Does the FiO2 effect only intraoperative oxygenation?
- How many people use 1:1 Air/O2?
  - why?

WHY NOT 100%

- PRIMARILY 3 SUBSTANCES SHARE ALVEOLAR SPACE
  - OXYGEN 21%
  - NITROGEN 78%
  - OTHER (CO_2, ARGON, H_2O) <2%
- WASHOUT OF NITROGEN AND SUBSEQUENT READILY ABSORBED O_2 LEADS TO ABSORPTION ATELECTASIS



What's the "Right" answer?

Comparable postoperative pulmonary atelectasis in patients given 30% or 80% oxygen during and 2 hours after colonic resection

O Akca, A Pololsky, E Eisenhuber, O Panzer, H Hetz, K Lampl, FX Lackner, K Wittmann, F Grabenwoeger, A Kurz, A Schultz, C Negishi and D Sessler

Anesthesiology

- 30 pts undergoing Colon Resection
- .30 FiO2 vs .80 FiO2
- Preop CXR, POD 0 and 1 CXRs
- POD 1 CT
- Near similar results 36% vs 40% with atelectasis
- Result: Minimal to no difference between the 2 groups.

Neat Theory……

Supplemental Perioperative Oxygen to Reduce the Incidence of Surgical-Wound Infection

Robert Greif, M.D., Ozan Akça, M.D., Ernst-Peter Horn, M.D., Andrea Kurz, M.D., Daniel I. Sessler, M.D., for The Outcomes Research Group

JAMA®
The Journal of the American Medical Association

Supplemental Perioperative Oxygen and the Risk of Surgical Wound Infection

F. Javier Belda, MD, PhD; Luciano Aguilera, MD, PhD; José García de la Asunción, MD, PhD; Javier Alberti, MD; Rosario Vicente, MD; Lucía Ferrándiz, MD; Rafael Rodríguez, MD; Roque Company, MD, PhD; Daniel I. Sessler, MD; Gerardo Aguilar, MD, PhD; Stephanie García Botello, MD; Rafael Ortí, MD, PhD; for the Spanish Reduccion de la Tasa de Infeccion Quirurgica Group

JAMA. **2005**;294:2035-2042

Supplemental Perioperative Oxygen and the Risk of Surgical Wound Infection

- Two studies with near identical methodology exposed nearly 700 pts undergoing colorectal surgery to either .30 or .80 FiO2
- The pts receiving the .80 FiO2 consistently had less wound infection rates that the .30 FiO2
- Concept of increasing the partial pressure of oxygen at the wound improves healing and prevents infection


NOPE.

- **METHODS:**
- FiO2 was alternated between 30% and 80% at 2-week intervals for 39 months.
- Major intestinal surgery lasting at least 2 h.
- N=5479

- **CONCLUSIONS:**

Elevated FiO2 does not prevent major infection and healing-related complications after major intestinal surgery.

BJA British Journal of Anaesthesia

Supplemental oxygen and surgical-site infections: an alternating intervention controlled trial

A. Kurz[1,2], T. Kopyeva[1], I. Suliman[2], A. Podolyak[2,3], J. You[2,4], B. Lewis[1], C. Vlah[1], R. Khatib[1], A. Keebler[1], R. Reigert[3], M. Seuffert[3], L. Muzie[3], S. Drahuschak[3], E. Gorgun[5], L. Stocchi[5], A. Turan[1,2], D.I. Sessler[2,*]

Editorial decision: August 31, 2017

CONCLUSION ON FIO2

- Patient tailored
- Understand the risks of 100%
- 80% seems to be safe for longer periods of time

4. CONTROL OF VENTILATION PRIOR TO, DURING AND AFTER EXTUBATION

- DON'T LET ALL THAT HARD WORK GO TO WASTE!!!
- SIMV
- PS
- CPAP IN PACU

SCENARIOS

- 17 yo Male
- 75kg
- Open inguinal hernia repair
- No PMH

- Induction
- Vent settings
- Emergence/extubation

SCENARIOS

- 55yo Male
- 186kg 70”
- Lap Gastric Banding
- PMH DM II, HTN, OSA (CPAP 5/15)
- Exam: Thick Neck, redundant tissue, MP 3, Adequate Oral Opening and neck extension

- Induction
- Vent Settings
- Emergence

ANESTHESIA & ANALGESIA
The Gold Standard in Anesthesiology

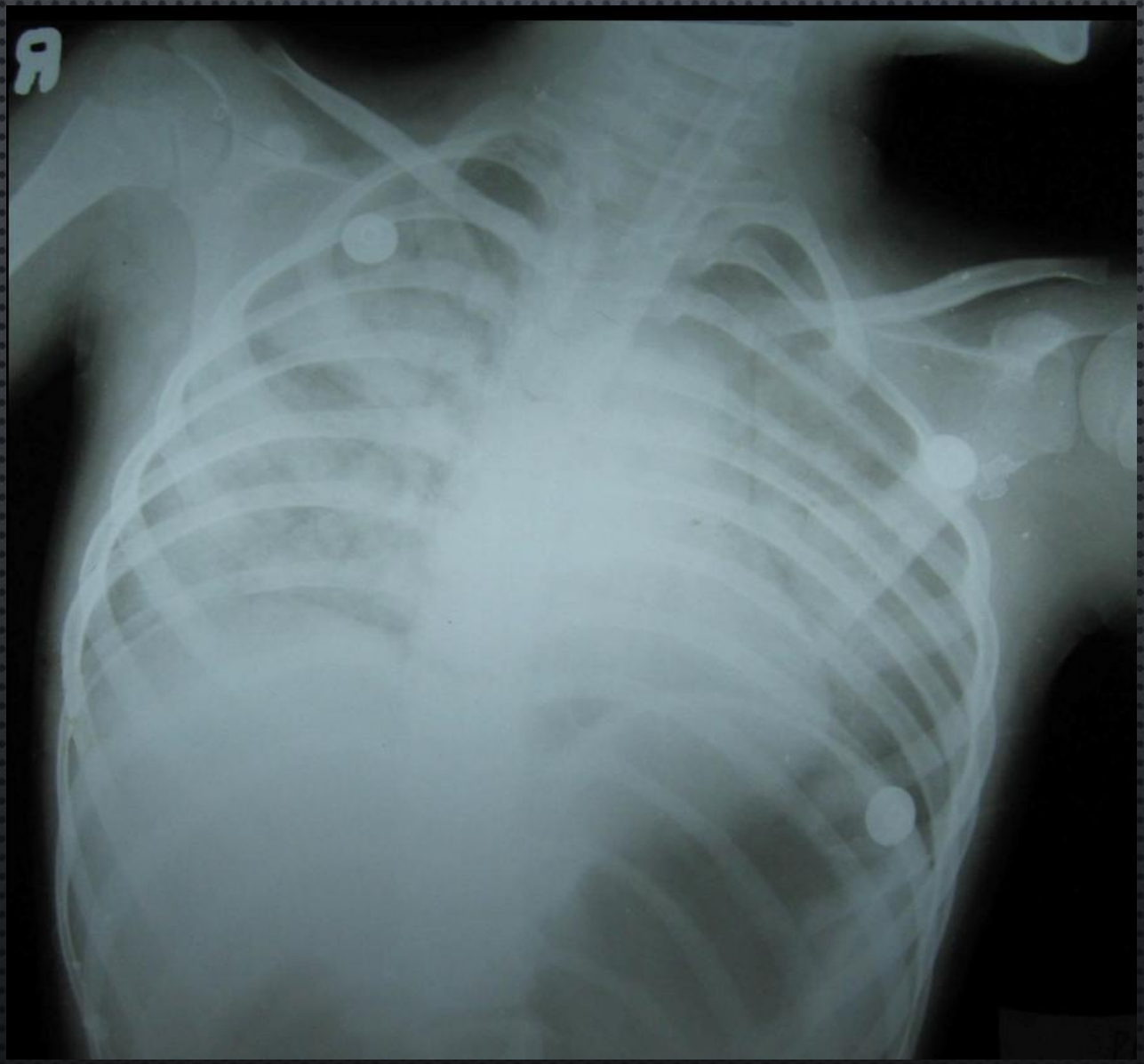
- **Positive End-Expiratory Pressure During Induction of General Anesthesia Increases Duration of Nonhypoxic Apnea in Morbidly Obese Patients**

Sylvain Gander, MD*, Philippe Frascarolo, PhD*, Michel Suter, MD†, Donat R. Spahn, MD* and Lennart Magnusson, MD, PhD*

- CPAP (10 cm H_2O) for 5 minutes in conscious morbidly obese patients followed by 5 minutes of mechanical ventilation with PEEP (10 cm H_2O) during anesthesia induction is safe, simple.
- This technique completely prevents atelectasis formation during anesthesia induction in morbidly obese patients and increases nonhypoxic apnea duration by 50% (1 minute).

SCENARIO

- 84 yo Female
- Decompressive Lumbar Laminectomy. s/p Fall
- 54kg and 60”
- PMH: Subdural Hematoma (recent and resolving), COPD, HTN, Smoker, DM I, Osteopenia, frequent Pneumonias, prolonged intubation
- Vasopressin gtt, Levophed gtt
- CXR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ANY OTHER SCENARIOS?